Manual for Adaption and Increasing Resilience of Industrial Parks to the Impacts of Climate Change

in Andhra Pradesh and Telangana State, India

Manual 1: Tools for planning and Resilience measures for Climate Change Adaption in Industrial Parks

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APIIC	Andhra Pradesh Industrial Infrastructure Corporation

APITCO	Andhra Pradesh Industrial and Technical Consultancy Organisation Ltd.
CCA	Climate Change Adaptation
CEAC	Central Environmental Appraisal Committee
CETP	Common Effluent Treatment Plant
CPCB	Central Pollution Control Board
CRA	Climate Risk Analysis
CZMA	Coastal Zone Management Authority
CFO	Consent for Operation
CFE	Consent for Establishment
DPR	Detailed Project Report
EIA	Environmental Impact Assessment
EIP	Eco-industrial Park
GoI	Government of India
IALA	Industrial Area Local Authority
IC	Industrial Corridor
IP	Industrial Park
IMD	Indian Meteorological Demand
MoEF&CC	Ministry of Environment, Forests and Climate Change
MSME	Micro, Small and Medium Enterprises
NIMZ	National Investment and Manufacturing Zones
NLP	National Land Use Planning
PF&IC	Price Fixation & Infrastructure Committee
SAR	Site Analysis Report
SC/ ST	Scheduled Castes/ Schedule Tribes
SEA	Strategic Environmental Assessment
SEAC	State Level Environmental Appraisal Committee

SEZ	Special Economic Zone
SFC	State Financial Corporation
SPCB	State Pollution Control Board
ST/SC	Scheduled Tribes / Scheduled Casts
SLAC	State Level Allotment Committee
SMP	Site Master Planning
TSIIC	Telangana State Industrial Infrastructure Corporation
ZM	Zonal Manager

Glossary

Adaptation	Any activity that reduces the negative impact of climate change, while taking advantage of new opportunities that may be presented as a result of climate change.

Cloud Burst	A cloudburst is an extreme amount of precipitation, sometimes accompanied by hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions. A cloudburst can suddenly dump large amounts of water e.g. 25 mm of precipitation corresponds to 25000 metric tons/km2 (1 inch corresponds to 72,300 short tons over one square mile). However, cloudbursts are infrequent as they occur only via orographic lift or occasionally when a warm air parcel mixes with cooler air, resulting in sudden condensation.
Coastal inundation	The flooding of normally dry, low-lying coastal land, primarily caused by severe weather events along the coasts, estuaries, and adjoining rivers or caused by rise in mean sea level. The winds drive large waves and storm surge on shore, and heavy rains raise rivers and overall water level.
Conducted Strike	This occurs when lightning strikes a conductor and that in turn induces the current into an area some distance away from the ground strike point. Unprotected connected equipment can be damaged if they become an indirect path in the completion of the ground circuit.
Cyclone	A cyclone is an intense low pressure area or a whirl in the atmosphere over tropical or sub-tropical waters, with organised convection (i.e. thunderstorm activity) and winds at low levels, circulating either anti-clockwise (in the northern hemisphere) or clockwise (in the southern hemisphere). From the centre of a cyclonic storm, pressure increases outwards. The amount of the pressure drop in the centre and the rate at which it increases outwards gives the intensity of the cyclones and the strength of winds.
Direct Strike	This is the most dangerous form, wherein the structure is a direct path for lightning currents to seek ground. The extent of the current determines its effects.
Down-slope wind	These are the winds blowing at / with very high speed down the slope of mountains
Drought	Droughts are periods of abnormally dry weather that results in serious hydrological imbalance. Droughts can be divided within the different hydrological cycle that they affect the most. Agricultural drought refers to abnormally low soil moisture, and hydrological drought implies a reduced runoff and groundwater recharge. The Indian Central Water Commission defined drought as “a situation occurring in an area when the annual rainfall is less than 75% of the normal (defined as 30 years average) in 20% of the years examined and where less than 30% of the cultivated area is irrigated”.
Flood	A flood is an overflow of water that submerges land which is usually dry. Flooding may occur as an overflow of water from water bodies, such as a river, lake, or ocean, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground.
Flood Plain	A lowland area, whether diked, flood proofed, or not, which, by reasons of land elevation, is susceptible to flooding from an adjoining watercourse, ocean, lake or other body of water and for administration purposes is taken to be that area submerged at the Designated Flood Level.

Heat Stress	Heat stress refers to the severe consequences of extreme heat for human health, affecting most strongly the vulnerable groups such as elderly, infants and children, as well as people with chronic heart or lung disease. Severe cases of heat stroke can cause death. It affects the labour productivity significantly in industrial parks.
Heat wave	Heat waves, also referred to as extreme heat events, are periods of abnormally hot weather, relative to the expected conditions of the area at that time of the year. IMD (India Meteorological Department) specifies heat waves by the maximum temperature of a station of at least 40°C for plains and at least 30°C for hilly regions.
Heavy Rainfall	Precipitation falling with an intensity in excess of > 7.6 mm (0.30 in) per hour, or between 10 mm (0.39 in) and 50 mm (2.0 in) per hour. Short periods of intense rainfall can cause flash flooding, longer periods of widespread heavy rain can cause rivers to overflow.
Lightening	Lightning is a sudden electrostatic discharge during an electrical storm between electrically charged regions of a cloud (called intra-cloud lightning or IC), between that cloud and another cloud (CC lightning), or between a cloud and the ground (CG lightning). The charged regions in the atmosphere temporarily equalize themselves through this discharge referred to as a strike if it hits an object on the ground, and a flash, if it occurs within a cloud. Lightning causes light in the form of plasma, and sound in the form of thunder. Lightning may be seen and not heard when it occurs at a distance too great for the sound to carry as far as the light from the strike or flash.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. Comment: Resilience means the ability to “resile from” or “spring back from” a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need. (UNISDR, 2015). According to the IPCC: “The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.” ((IPCC, Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Working Group II, 2014), p. 5)
Risk	The latest IPCC report now focuses more on risks whereas earlier reports applied the concept of vulnerability. The IPCC defines risk as ((IPCC, Climate Change 2014. Impacts, Adaptation and Vulnerability. Summary for Policy Makers. Working Group II, 2014), p.5): “The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. (…) the term risk is used primarily to

	refer to the risks of climate-change impacts."
Sea Dike	A dike, floodwall or any other thing that prevents flooding of land by the sea. As defined in the Dike Maintenance Act, "dike" means "an embankment, wall, fill, piling, pump, gate, flood box, pipe, sluice, culvert, canal, ditch, drain"
Sea level rise	An increase in the mean level of the ocean. Seal levels can rise at a global level through an increase in the volume of the world's oceans or at a local level due to ocean rise or land level subsidence. Sea level rises can considerably influence human populations in coastal and island regions and natural environments like marine ecosystems. Sea level rise is expected to continue for centuries. Because of the slow inertia, long response time for parts of the climate system, it has been estimated that we are already committed to a sea-level rise of approximately 2.3 metres (7.5 ft) for each degree Celsius of temperature rise within the next 2,000 years.
Sediment Control	Any temporary or permanent measures taken to reduce erosion, control siltation and sedimentation, and ensure that sediment-laden water does not leave a site.
Setback	Means withdrawal or siting of a building or landfill away from the natural boundary or other reference line to maintain a floodway and to allow for potential land erosion.
Sewer Backflow Flood Event	This type of flood event is noticeable in places where the sewer system is combined. When both storm-water and sewage flows through a single pipe, there would be situations of sewer system backflow, resulting in underground flooding.
Sheet erosion	This is the uniform removal of soil in thin layers from the land surface by winds. It occurs in areas where loose, shallow topsoil overlies compact soil.
Shortages in Energy Supply	Shortages in energy supply refers to the problems occurring in the electricity sector due to heat waves and droughts, which cause blackouts and brownouts.
Side Strike	This results from the disintegration of the direct strike when alternate parallel paths of current flow into the ground via structure. When the determined current path has some hindrance to current flow, a potential above ground develops and the structure's resistance to ground becomes the alternate path of conduction.
Splash erosion	This erosion occurs due to the impact of falling raindrop on the surface of soil.
SRI (Solar Reflectance Index)	SRI refers to the ability of the surface to keep cool under the sun by reflecting solar radiation and emitting thermal radiation. It is calculated according to ASTM E 1980 by utilizing solar reflectance and thermal emittance of a given material.
Storm Surge	A change in water level caused by the action of wind and atmospheric pressure variation on the sea surface. The typical effect is to raise the

	level of the sea above the predicted astronomical tide level, although in some situations, such as when winds blow offshore, the actual water level may be lower than that predicted. The rise in water level can cause extreme flooding in coastal areas particularly when storm surge coincides with normal high tide, resulting in storm tides, reaching up to 20 feet or more in some cases.
Storm tide	Storm tide is the resulting water level produced by the combined effect of storm surge and astronomical tides. It is therefore an absolute water level as recorded. The storm tide level may be lower than a high astronomical tidal level if there is a storm surge that occurs at low tide. The storm tide therefore depends on the storm surge level, the astronomical tide level and the timing of the storm surge relative to the timing of the astronomical tides.
Straight-line wind	High winds associated with intense low pressure can last for approximately a day at a given location. The blow in a straight line
Surface flood	Here the flood event is noticeable above ground and it occurs mainly due to overflow of water from any nearby river, lake or as a result of storm surge, heavy rainfall, or coastal inundation
Surge Protection Device	SPD also known as a transient voltage surge suppressor (TVSS), is designed to divert high-current surges to ground and bypass your equipment, thereby limiting the voltage that is impressed on the equipment.
Thunderstorm	They can form rapidly and produce high wind speeds. Thunderstorms often create heavy rain and they move very rapidly, causing high winds for few minutes at a location.
U-value	U-value refers to the rate of heat transfer through a structure, with a unit of measurement of W/m2K. The u-value decreases as the insulation gets better. One can imply a simple calculation of the u-value by using the thickness and the conductivity (k-value) of the particular material.
Water scarcity	Water scarcity is the lack of water due to low water availability and water demand exceeding the supply capacity – affected by the severity and frequency of droughts. Water scarcity has significant impacts on industrial parks in terms of production and processes.

Introduction to the Manual: 1

The Ministry of Commerce and Industry (GoI), the Departments of Industries and Commerce of the then Govt. of Andhra Pradesh and APIIC along with GIZ took a decision in the year 2013 to take up the project of "Adaptation to Climate Change in Industrial Areas in India" to address the challenges of climate change with a focus on Andhra Pradesh and Telangana.

Andhra Pradesh Industrial Infrastructure Corporation Limited (APIIC), an undertaking of Government of Andhra Pradesh, is a premier organization, vested with the objective and responsibility of building and holding land banks, developing Industrial Parks/Estates and Special Economic Zones by providing necessary Industrial infrastructure. Over 201 Industrial Parks have been established throughout the State in eight (8) industrial zones covering an extent of 57, 836 Acres. These industrial parks are prone to various types of extreme climate events such as Cyclones, Drought, Floods, Heat Waves, etc.

Telangana State Industrial Infrastructure Corporation Limited (TSIIC), an undertaking of Government of Telangana State, is a premier organization in the state, vested with the objective of providing Industrial infrastructure through development of Industrial Parks and Special Economic Zones. Over 131 Industrial Parks have been established throughout the State of Telangana covered under 6 zones of the TSIIC. Telangana state is threatened by disasters like floods, drought, heat waves,

This manual is a part of set of documents it **includes the tools required to execute a climate risk assessment, adaption planning, adaptation measures, best practices, legislative, regulatory and operational framework for Andhra Pradesh and Telangana. This document focuses on adaptation tools for the industrial parks and industries considering various disasters like cyclones, floods, lightening, drought and heat waves.** The following section gives the details of tools prepared under this manual. Document 3 corresponds on Tools for planning adaptation and resilience measures, which is explained in this manual-1 in detail.

TSIIC/APIIC, in cooperation and with support from GIZ-INTEGRATIN has developed a set of documents targeting adaptation to climate change of existing and upcoming industrial areas in Telangana / Andhra Pradesh States, India. The following table gives an overview on the various documents and their scope.

Table1: Documents for adaptation to climate change in industrial areas in [Telangana State / Andhra Pradesh]

	Document	Scope
1	Policy for Climate Change Adaptation in Industrial Areas	The policy is setting the frame for AP/ TS IIC's strategy to promote and implement adaptation of existing and upcoming industrial areas in AP to make the State industry and economy more climate resilient.
2	Guideline for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change	The guideline provides orientation and develops a standard approach and methodology on how to plan for adaptation and increasing resilience of existing and upcoming industrial areas in APIIC/TSIIC.
3	**Manual for Adaptation and increasing Resilience of Industrial Parks to the**	**Part 1 of the manual includes the tools required to execute a climate risk analysis for existing and upcoming industrial areas. The results of the risk**

	Impacts of Climate Change, Part 1: Tools for Planning and resilient measures	**analysis provide a sound baseline to further plan and implement concrete adaptation measures, both in terms of infrastructure and operation, management and maintenance of the industrial parks in APIIC/TSIIC.**
4	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – **Part 2: Engineering measures for planning adaptation and resilience measures**	Part 2 of the manual includes the engineering required to translate the results of the risk analysis into co concrete adaptation measures. According to the prevailing climate hazards in the state the tools focus on adaptation to heavy rainfalls and related impacts, and to heat waves and droughts and related impacts in APIIC/TSIIC.
5	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – **Part 3: Best practice examples**	Part 3 of the manual presents a collection of national and international best practice examples and lessons learnt on adaptation of industrial areas, urban areas and infrastructures to the impacts of climate change. This also includes best practices on law and policies on climate change adaptation in APIIC/TSIIC..
6	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – **Part 4: Financing of plans and measures**	Part 4 of the manual includes a collection of financing instruments and best practices for financing of adaptation measures in existing and upcoming industrial parks in APIIC/TSIIC..
7	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – **Part 5: Existing Planning and Implementation Procedure for Industrial Parks**	Part 5 of the manual providers gives an overview on relevant actors and stakeholders and provides orientation on how the planning steps described in the guideline document are embedded in existing planning and working processes of in APIIC/TSIIC..
8	Manual for Adaptation and increasing Resilience of Industrial Parks to the Impacts of Climate Change – **Part 6: Baseline studies in TS and AP**	Part 6 of the manual presents the results of a pilot risk analysis and baseline study executed in selected industrial areas in APIIC/TSIIC.
9	Training modules on execution of a climate risk analysis for existing and upcoming industrial parks and their adaptation to the impacts of climate change	To successfully implement the guidelines and even more important the respective adaptation measures in planning and refurbishment of industrial parks, APIIC has to develop the respective capacities in planning and operational departments. Furthermore, external capacities have to be supported and developed to be able to provide the required services to the infrastructure corporations and to individual industries and companies, particularly to (M)SMEs.

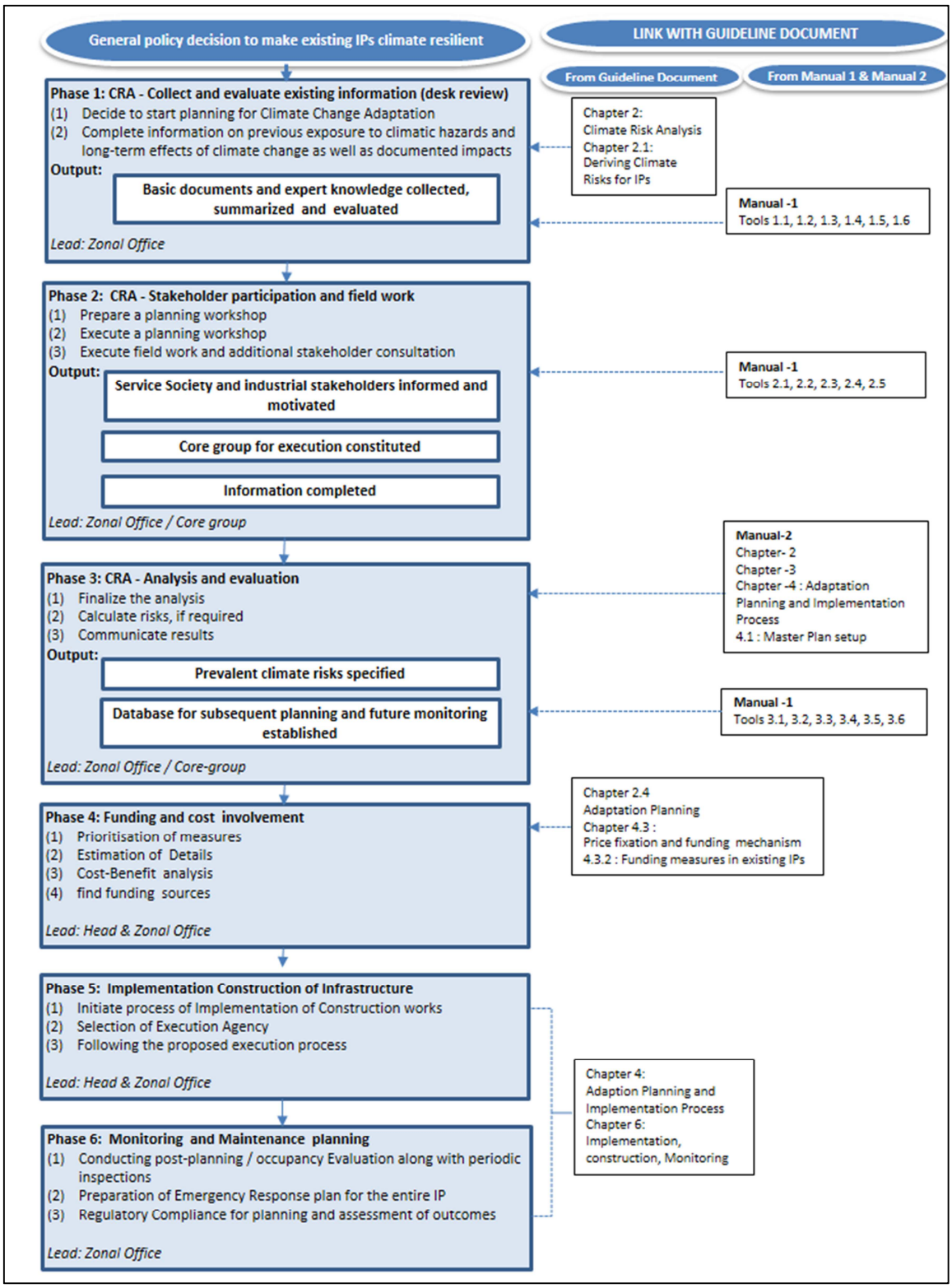

Figure 1: Flowchart for general policy decision to make existing IP climate resilient

Annex A: Tools for CRA in EXISTING IPs

Tool 1.1: Define the system of interest

Table 1: Define the system of interest

General information:	
Name of the IP:	
Zone of the IP:	
Revenue Mandal:	
Start year of operation:	
IALA yes/no	Contact details:
Service Society yes/no	Contact details:
Size in hectares:	
Occupancy level (%):	
Types of industries:	
Surrounding population:	Dense / medium / low
Maps / plans available, with date and name of the document	Map or plan of the IP: yes / no,
	Maps or plans of sub-entities: yes/no
	Process maps: yes/no
Important links to other entities, with name of organisation, contact person and details	Government::
	Water suppliers:
	Energy suppliers:
	Solid waste management
	Ground water Management
	Waste water management:
	Transportation:
	Emergency response:
Scope of the CRA analysis	
Temporal scope	(how many years looking back / forward – might also depend on data availability)
Spatial scope	(Only premises of the respective IP analysed; any areas to be excluded?)
Level of detail	(only IP level (anything in control of IP), not individual industries)
Results	(check if only vulnerability sufficient (i.e. until step 7) or if risks are needed (until step 8))

Tool 1.2 Identify climatic hazards

To document that which climate hazards will be analysed during the CRA and why. The analytical step will help to decide which climatic hazards shall be further analysed.

Table 2: Identify climatic hazards to be analysed

Climate hazard	Experienced (Y/N)	Source of information
Cyclone / storm		
Storm surge		
Floods caused by local heavy rains		
Floods caused by inundation of a nearby water course / water body		
Drought		
Heat wave		
Stroke if lightning		
Change in rainfall patterns		
General increase in temperature		
Long-term depletion of water resources		
Sea level rise		

Tool 1.3 Collect information on previous exposure to Climatic hazards

During the desk review various sources of official information and expert knowledge from the IIC (Headquarter, Zonal Office and IALA), as well as from other institutions (DRM Authorities, Meteorological services etc.) are collected, evaluated and documented in the following tables focused on past and projected future exposure; and checks, which hazards exist and which areas can be hit.

Information on temporal exposure (past, present, future) of IPs to climate hazards e.g. information on frequency of smaller flooding etc., and understanding the spatial exposure to climate hazards is collected during preliminary desk work, stakeholder interactions and fieldwork.

Table 3: Exposure to climatic hazards experienced by the IP in last 30 years

Climate hazard	Severity of single events (try to get information per single event) (Very severe, severe, moderate, slight, very slight)	Frequency	Was an increase in frequency or severity of events observed over the years?	Source and year of information (interview, official records, newspaper, other publications)
Cyclone / storm				

Storm surge				
Floods caused by local heavy rains				
Floods caused by inunda-tion of a nearby water course / water body				
Drought				
Heat wave				
Stroke if lightning				

Outputs of step 3:

1. Description of the various parameters explored, clearly indicating the temporal (past, present, and future) and spatial dimension of exposure and resulting in the exposure class.
2. Exposure maps for the hazards.

Tool 1.4 Collect information on industries located in the IP

Susceptibility of the IP to climate hazards is amongst others depending on the industries present. A screening of industrial branches located at site will provide a preliminary orientation to be further elaborated further. Potential susceptibility of industries related to the various hazards has been determined through a preliminary classification of the various industrial sectors. During this phase, a list of the industrial branches located in the IP is compiled.

Table 4: susceptibility to climate hazards

Industrial sector	Susceptibility to climate hazards	Present in the IP
Engineering	power stations close to rivers and on the coast Fuel supply infrastructure. short circuit at Power lines Electricity substations transmission efficiency Soil shrinkage due to drought	
Automotive	Design, Research, Engineering & Manufacturing, Energy efficiency Sales, marketing, Overall corporate strategy Recycling and disposal	
Auto components	Manufacturing, Sales, marketing, recycling and disposal	
Bio-technology	water and energy management Demand on cooling systems.	
Cement & Mining	slope stability near opencast mines, Profits and commodity prices, transportation routes, availability of water and energy, Health & safety of employees and productivity	
Chemicals	Water demand effluent system overloads during heavy rains & Plant operation during extreme temperatures Evaporation rates of volatile material increase with higher temperature, Equipment cooling systems.	
Food processing	Water demand Crop management transportation issues	

	marketing	
Gems and jewellery	High temperatures & moisture Sales, marketing, Business & exports	
Heavy industry	Energy & water demand Technological capacity, Workers management	
Oil and gas	Safety measures for storage considering floods, high temperatures	
Textiles	Water & energy demand Effluent management Health & safety of workers	
Pharmaceuticals	challenges and opportunities resulting from the impacts of climate change, Drug demand Building resilience & Equipment cooling systems	
Steel	power and energy demand market management	
Paper and pulp	Water & energy demand Raw material quality	
Printing	high water and energy demand market management	
Plastics and rubber	Energy demand Raw material efficiency	
Construction and construction materials	Workers demand, Building resilience , Disruptions in delivery of materials, Disruptions due to extreme weather events	
ICT	Energy demand , Management of Cooling system, server management	

Outputs of step 4:

1. List indicating potential susceptibility of the various branches in relation to the hazards, if possible this can be differentiated to specific sub-systems, e.g. storage / production buildings and infrastructure and handling of hazardous materials, or materials sensitive to specific hazards (fire, water etc.,).
2. Description of the various parameters explored, clearly indicating the susceptibility and fragility of the objects explored resulting in the susceptibility class.
3. Susceptibility maps for the hazards.

Tool 1.5 Collect information on impacts observed in the past

In addition to the deduction of possible impacts, already observed ones will be analysed during the desk review from various sources of official information and expert knowledge from the IIC (Headquarter, Zonal Office and IALA), as well as from other institutions (DRM Authorities, Meteorological services etc.).

Use the below table to document information on observed impacts indicating type of hazard and number of observed events in the respective fields.

For types of hazards use the following acronyms: Cyclone / storm (CS), Storm surge (SS), Floods caused by local heavy rains (FR), Floods caused by inundation of a nearby water course / water body (FI). Drought (DR), Heat wave (HW).

Table 5: Observed impacts in the last 30 years

	Humans	Infrastructures and buildings	Water / energy supply and waste management services	Operation	Supply Chain
No Knowledge					
No occurrence					
Slight	persons not or only slightly injured, y/n, number:	infrastructures and buildings not or only slightly damaged, y/n, specify:	no interruption of supply and waste management, y/n, specify:	no interruption of operation	No interruption
Moderate	persons moderately injured, y/n, number:	infrastructures and buildings moderately damaged, no significant reconstruction required, y/n, specify:	interruption of supply and waste management for the duration of the event only, y/n, specify:	interruption of operation for the duration of the event only (y/n):	interruption of operation for the duration of the event only (y/n):
Severe	persons heavily injured, y/n, number:	damages to buildings and infrastructure requiring significant reconstruction, y/n, specify:	interruption of supply and waste management for up to one day after the event, y/n, specify:	interruption of operation for up to one day after the event (y/n):	interruption of operation for up to one day after the event (y/n):
Very severe	losses of lives, y/n number:	damages of buildings and infrastructures leading to demolition, y/n, specify:	interruption of supply and waste management for several days, y/n, specify:	interruption of operation for several days (y/n):	interruption of operation for several days (y/n):
Remarks:		Indicate here which infrastructures / buildings were affected	Indicate which supplies / services were affected	Indicate which operations were affected	Indicate which operations were affected

Tool 1.6 Collect information on existing resilience

Use the below table to document the economic status of the IP and preliminary information on its capability to adapt to climate change.

Table 6: Economic status and capability to adapt

Economic status of IP				
1. How is the financial condition of IPs? (This means the IP's management/ IALAs are able to generate enough revenue for maintenance of IPs or it has surplus money to maintain it)				
Very good	Good	Not good/not bad	Bad	Poor
Capability to adapt				
1. Are the IP's management and industries aware of climate change? (Yes/No)				
2. Whether IP's would be willing to undertake activities to reduce sensitivity to climate change through adaptation? (Yes/No)				
3. What percentage of the IP has green patch?				
4. Does the site have a disaster management plan? Y / N, if yes please assess adequacy and explain your assessment				
5. Describe the IP's infrastructure management plan? Y / N, if yes please assess adequacy and explain your assessment				

Tool 2.1: Analysis of previous exposure to climatic hazards

Based on the information collected during step-1, the IP's exposure to climatic hazards has to be classified in three-(five) classes. For this purpose temporal and spatial dimension of exposure have to be combined were relevant; otherwise only temporal exposure has to be classified.

Criteria leading to the classification have to be derived, clearly defined and documented from findings of the preceding work.

Combination of temporal and spatial dimension has to be done according to the below matrix in the classes **(very low)-low** – **medium** – **high – (very high**).

Exposure		Spatial dimension		
		(very low)-low	**medium**	**high – (very high)**
Temporal dimension	**(very low)-low**	**low**	**low**	**medium**
	medium	**low**	**medium**	**high**
	high – (very high)	**medium**	**high**	**high**

Table 7: Exposure matrix

Hazard	Temporal dimension	Spatial dimension	Overall exposure
Cyclones and storms			
Storm surges			
Heavy rainfall inducing floods, land-slides, rock falls, subsidence etc.			
Droughts			
Heat waves			
Sea level rise			
Water shortages			

Tool 2.2 Identify the main impact areas in the IP

During Phase 2 the information from Phase 1 is to be verified and amended through the workshop, stakeholder consultation and field work. Exposure to climate events is correlated to impacts observed during or after the events. This can be done with the help of an impact matrix listing the observed impacts per event and impact area (if required). Finally the impact areas, i.e. either the whole IP, or specific parts or sub-systems hit by the event shall be prior-itized for further analysis of susceptibility (Step 4). More than one impact area can be defined for a single event in case impacts were quite different in the individual areas and information available allows to do so.

Table 8: Impact matrix

Event (Name, date)	Impact area	Observed Impacts					Priority
		Humans	Infrastructures/ buildings	Services	Operation	Supply Chain	

Tool 2.3 Further specify information on susceptibility of the IP

After having identified and prioritized the impact areas (STEP-3, Tool 5.2) the susceptibility of these impact areas is further analysed together with the stakeholders and subsequent field work. As a first step the impact areas and their priorities are included in the matrix. Please include both strengths and weaknesses influencing the susceptibility of the respective sub-systems below **Fehler! Verweisquelle konnte nicht gefunden werden.** provides details on information relevant to assess the susceptibility of the various sub-systems considered.

Table 9: Susceptibility matrix

Event (Name, date)	Impact area		Priority	Susceptibility of sub-systems						
				All kinds of buildings	Roads	Drainage systems, sewers	Energy and water supply	Greenery	Production, machines, equipment	Workforce

Tool 2.4 Further specify information on existing resilience

Information obtained during Phase 1 has to be amended and detailed using below table during workshop and stakeholder interaction.

Table 10: Parameters to analyse the resilience of IPs against climate hazards

Capacities	Parameters	Current status
Rules and Regulations	1) Floodplain regulation (if situated in a floodplain)	1)
	2) Building code including standards for resilient design (storms, cyclones, heat waves)	2)
	3) Rebuilding restrictions (regarding location, design, dimensioning)	3)
	4) Coastal Zone Management Plans	4)
Supply structures (particularly water and power)	5) Alternative supply paths and / or options	5)
	6) Procedures and / or options to reduce demand and dependency (e.g. energy generation on site)	6)
	7) Climate resilience of the supply network	7)
	8) Existing management and development plans, procedures and standards	8)
	9) Existing DRM plans, procedures and standards	9)
	10) Information generation, distribution, fed-back	10)

Governance and management	11) Existing protection infrastructures (dykes, dams, etc.) and services (fire fighters, para medicals etc.)	11)
	12) Emergency Preparedness Plan/Early Warning System/Evacuation Plans	12)
	13) Signage	13)
	14) OHS measures and standards followed	14)
	15) O&M plan for the site and specific critical parts/infrastructures	15)
	16) Communication plans and lists; communication infrastructures	16)
Resources	17) Human resources to act (O&M, preparedness, first response, recovery including the required backstopping and management)	17)
	18) Level of skills and knowledge	18)
	19) Climate resilient facilities	19)
	20) Financial resources	20)
	21) Insurances	21)
Awareness, knowledge	22) Awareness / sensitization	22)
	23) Willingness of stakeholders to act for adaptation and risk reduction	23)
Spatial	24) Availability of land to establish additional structures (greenery, drainage, construction of RE, water tanks etc.)	24)
Production	25) Options for adaptation of product portfolio to climate change impacts	25)

Tool 2.5 Planning workshop

The goals of the planning workshop are:

- Sensitization and motivation of stakeholders of the need to adapt the IP to the effects of climate change
- Information about the climate change adaptation project
- Explanation of scope of the CCA Action Plan
- Presentation information and findings from phase 1
- Formation of a core group for further planning, e.g. of a sub-committee of the IALA
- Collection of information from stakeholders

This consists **of 4 sections** described below:

1. Summary of findings of Phase 1

Information on the findings from phase 1 is to be included in the presentation for the workshop.

This presentation includes standardized sections about the need for adaptation of IPs and the sections of the CCA Action Plan. A third section for presentation of findings is already prepared and has to be filled during preparation of the workshop.

2. Workshop agenda

The workshop should follow the below agenda which can be adjusted to the specific requirements of the undertaking.

Table 11: Workshop agenda

Topic	Remarks
1) Introductory presentation – the need to adapt IPs to climate change and the scope of a CCA Action Plan	
2) Q/A-Session	
3) Summary of findings from Phase 1	
4) Formation of working groups (depending on number of participants and f Table 2.4 cilitators)	
5) Analysis of spatial and temporal exposure to climate hazards and observed impacts (Tools 3 and 5)	
6) Prioritization of impact areas (Tool 5)	
7) Analysis of susceptibility and fragility (Tool 4)	
8) Analysis of existing resilience (Tool 6)	
9) Summary	
10) Feedback from participants	
11) Schedule for stakeholder consultation and field work	
12) Constitution of a core working group within the IALA for the elaboration of the Climate Change Action Plan	
13) other	

3. Compilation of working materials

Working materials for the workshop are based on the tables and lists provided with the tools for phases 1 and 2. These should be transferred to posters etc. for use in the working groups.

4. Summary of workshop results and identification of topics for stakeholder consultation and field work

The summary report of the workshop shall include:

1) summarized findings for steps 1 to 6 of the CRA
2) information gaps for each steps to be filled during subsequent stakeholder consultation and field work
3) a list of stakeholders to be consulted including the specific question to be asked
4) a list of locations and sub-systems to be visited during field work, including matters to be observed / recorded

Tool 3.1 Parameters for analysis of susceptibility of sub-systems to Climate Change

Table 12: Climate parameters for analysis

Hazards: Systems:	Cyclones and storms; storm surges	Heavy rainfall, floods, landslides, rock falls, subsidence etc.	Drought	Heat wave	Sea level rise
All kinds of buildings	Location,Design, Dimensioning, Status of specifically vulnerable parts of the building (roof, windows, doors) O&M,Refurbishing, Specific use (e.g. storage of sensitive / hazardous materials)	Location,Design, Dimensioning, Site drainage, Foundation, O&M,Refurbishing, Specific use (e.g. storage of sensitive / hazardous materials)	Specific use (e.g. storage of sensitive / hazardous materi-als)Capacity of water supply Source of water supply	Insolation, AC capacity Specific use (e.g. storage of sensitive / hazardous materials)	Location

Roads	Location Foundation Status of O&M	Location Foundation Drainage Status of O&M	n/a	Quality and type of pavement	Location
Drainage systems Sewers	Location Capacity, Design Operability O&M	Location Capacity Design Operability O&M	n/a	n/a	Location
Energy and water supply	Location Resistance against extreme weather events (design, dimensioning, O&M) Operability, operative readiness Age Refurbishing /Rebuilding Susceptibility of infrastructures in direct proximity Sources of supply, bottlenecks, security, reliability, Performance, back-ups		Susceptibility of power generation capacities / water sources Sources of supply, bottlenecks, security, reliability, Performance, back-ups		Location Resistance against intruding salt water
Greenery	Location, Status, Health Maintenance Age	Location, Status, Health Maintenance Age	Location, Status, Health Maintenance Age	Location, Status, Health Maintenance Age	Location
Production / value chain / Machines Equipment	Sensitivity against interruptions in energy, water, material supply Sensitivity of storage facilities (including waste) against flooding and demolition of containment / pipelines etc.		Sensitivity of manufacturing processes against shortage / interruptions in energy and water supply and increasing temperatures. Sensitivity of storage facilities (including waste) against high temperatures and shortages in energy and water supply.		Location
Workforce	Working conditions, OHS and susceptibility to climate hazards (HVAC etc.) Existing shelter centre Early warning system in place				
Industrial community at site	Linkages between companies / industries (e.g. people living on site) Resource mobilisation and coordination during the climate change and extreme weather event				

Tool 3.2 Analysis of susceptibility of the IP

Considering the findings from preceding phases the susceptibility of the various sub-systems shall be classified in three-(five) classes:

(Very low)-Low – **medium** – **high – (very high)** using the matrix below.

Criteria for classification need to be documented for further adjustment – if required.

Table 13: Assessment of susceptibility of sub-systems to Climate Change

Hazards: Systems:	**Cyclones and storms; storm surges**	**Heavy rainfall, floods, landslides, rock falls, subsidence etc.**	**Drought**	**Heat wave**	**Sea level rise**
All kinds of buildings					
Roads					
Drainage systems Sewers					
Energy and water supply					
Greenery					
Production / value chain / Machines Equipment					
Workforce					
Industrial community at site					

Tool 3.3 Analysis of impacts

Analysis of impacts includes for main elements:

1. Classifying the impacts observed during the last decades into five classes according to Tool 5.1 and Tool 5.2
2. Spatial analysis intersecting the maps of exposure and susceptibility and classifying the impact in three-(five) classes according to below matrix

Expected impact		Susceptibility		
		(very low)-low	medium	high – (very high)
Exposure	(very low)-low	low	low	medium
	medium	low	medium	high
	high – (very high)	medium	high	high

3. Identification of additional areas where impacts can be expected in case of more severe events (e.g. more intense rainfalls, more intense heat waves) derived from susceptibility of sub-systems;

The outputs of this step are:

1. A set of maps showing high medium and low impact areas per hazard
2. A table listing high, medium and low impacts to sub-systems or parts of sub-systems per hazard.

Table 14: Impact table

Hazards: Systems:	Cyclones and storms; storm surges	Heavy rainfall, floods, landslides, rock falls, subsidence etc.	Drought (including long-term depletion of water resources)	Heat wave	Sea level rise	Stroke of lightning
All kinds of buildings						
Roads						
Drainage systems Sewers						
Energy and water supply						
Greenery						
Production / value chain / Machines Equipment						
Workforce						
Industrial community at site						

Tool 3.4 Analyse resilience

During this step, the various elements defining the resilience of an IP have to be assessed and summarized. Resilience of the capacities of the IP considering both the IALA and park management, as well as single industries shall summarized highlighting strengths, weaknesses, opportunities and threats related to the various hazards and be classified in three-(five) classes: **(very high)-high** – **medium** – **low – (very low)** using the table below.

Table 15: Analysis of resilience

Capacities	Summary and assessment
Rules and Regulations	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought:

Capacities	Summary and assessment
	• Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Supply structures (particularly water and energy / power)	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Governance and management	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Resources	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Awareness, knowledge	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Spatial	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning:

Capacities	Summary and assessment
	• General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Production	• Cyclone / storm: • Storm surge: • Flooding: • Soil Erosion • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:

Tool 3.5 Combine impact and resilience to derive vulnerability

The Impact and resilience will be combined to deduct the vulnerability. This will be done by using following combination rule:

Vulnerability		Resilience		
		(very high)-high	medium	low – (very low)
Impact	(very low)-low	low	low	medium
	Medium	low	medium	high
	high – (very high)	medium	high	high

The analysis has to consider:

1. Impacts to various sub-systems caused by specific hazards, and
2. Resilience of the IP, and if possible of single sub-systems against the various hazards.

Table 16: Specific vulnerability of sub-systems

CLIMATIC HAZARD:							
Capacities: Systems:	**Rules and regulations**	**Supply structures**	**Governance and management**	**Resources**	**Awareness and knowledge**	**Spatial**	**Production**
All kinds of buildings							
Roads							
Drainage systems Sewers							
Energy and water supply							
Greenery							

CLIMATIC HAZARD:							
Capacities: Systems:	**Rules and regulations**	**Supply structures**	**Governance and manage-ment**	**Resources**	**Awareness and knowledge**	**Spatial**	**Production**
Production / value chain / Machines Equipment							
Workforce							
Industrial community at site							

- Vulnerability map showing the hot spots produced through intersection of impact maps with resilience parameters
- General assessment of the vulnerability of the site summarizing both specific and spatial elements of vulnerability

Outputs of tool 3.5

- Specific assessment of vulnerability of the various systems explored

Tool 3.6: Analyse risk

For a “classical” risk analysis vulnerability has to be combined with the probability of the various events and monetarization of the expected impacts.

Future probability of the various events is already included in the first step, specifically in the future part of the temporal dimension. Hence, there is no need to again consider probability.

For the current project, it seems to be highly ambitious to include the monetary dimension into the analysis. However, if exchange with stakeholders would allow performing a preliminary, rough quantification (or even just ranking of risks), this can be included and combined with the vulnerability analysis.

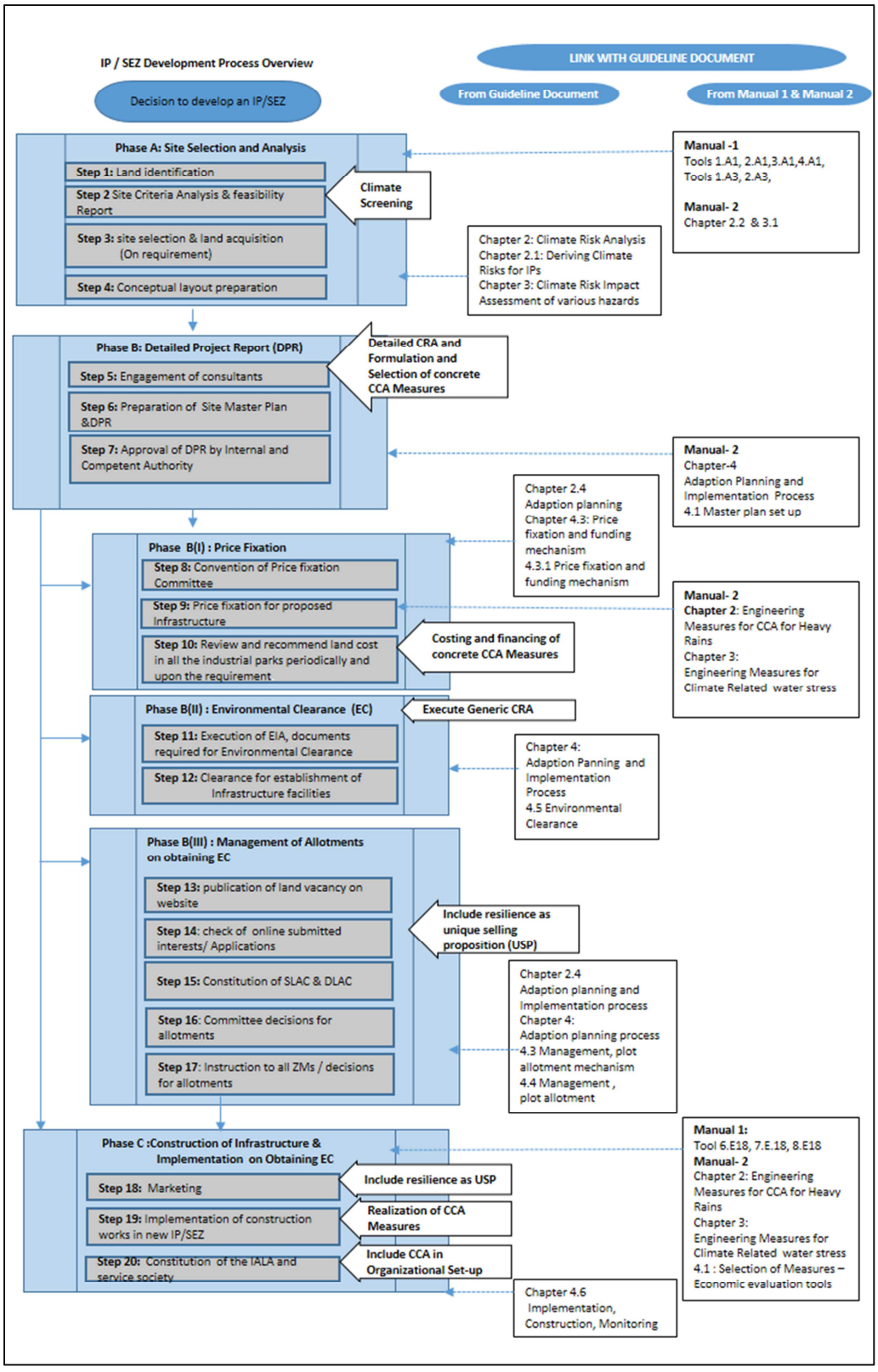

Figure 2: Flowchart for Development process overview for NEW / Planned IPs

Annex B: Tools for CRA in NEW IPs

Tool 1.A1: Description of prospective sites for the IP

Table 17: Descriptive of Prospective sites for the IP

General information:			
Name of the IP:			
Zone of the IP:			
Expected start year of operation:			
Prospective types of industries:			
Description of prospective sites	**Site 1**	**Site 2**	**Site 3**
Name of Site:			
Mandal:			
Size in hectares:			
Types of land uses			
Surrounding population (Dense / medium / low)			
Maps / plans available, with date and name of the document:			
Environmental data:			
Natural resources:			
Population, settlements:			
Supply and disposal infrastructures:			
Transportation infrastructures:			
Important links to other entities, with name of organisation, contact person and details			
	Site 1	**Site 2**	**Site 3**
Government:			
Water suppliers:			
Energy suppliers:			
Solid waste management			
Waste water management:			
Transportation:			
Emergency response:			
Scope of the CRA analysis			
Temporal scope	(how many years looking back / forward – might also depend on data availability)		
Spatial scope	(outreach of the analysis, e.g. 5 km distance around the site):		

Tool 2.A1 Identify prevailing climatic hazards at the prospective sites

Table 18: Prevailing climate hazards of the IP

Climate hazard	Site 1 Experienced (y/n) Source of information	Site 2 Experienced (y/n) Source of information		Site 3 Experienced (y/n) Source of information
Cyclone / storm				
Storm surge				
Floods caused by local heavy rains Is the site located in an area with frequent heavy rain-falls?				
Floods caused by inundation of a nearby water course / water body				
Drought Is the site located in an area frequently hit by droughts?				
Heat wave Is the site located in an area frequently hit by heat waves?				
Stroke if lightning				
Change in rainfall patterns				
General increase in temperature				
Long-term depletion of water resources				
Sea level rise				

Tool 3.A1: Collect information on previous exposure of prospective sites to climatic hazards

Table 19: climate hazards of the prospective sites

Climate hazard	Severity of single events (try to get information per single event) (Very severe, severe, moderate, slight, very slight)	Frequency	Was an increase in frequency or severity of events observed over the years?	Source and year of information (interview, official records, newspaper, other publications)
Cyclone / storm	Site 1:			
	Site 2:			
	Site 3:			
Storm surge	Site 1:			
	Site 2:			
	Site 3:			
Floods caused by local heavy rains	Site 1:			
	Site 2:			
	Site 3:			
Floods caused by inundation of a nearby water course / water body	Site 1:			
	Site 2:			
	Site 3:			
Drought	Site 1:			
	Site 2:			
	Site 3:			
Heat wave	Site 1:			
	Site 2:			
	Site 3:			
Stroke if lightning	Site 1:			
	Site 2:			
	Site 3:			
Summary and remarks (Which is the preferred site?)	Site 1:			
	Site 2:			
	Site 3:			

Tool 4.A1 Identify susceptibility of industrial sectors proposed for the park and of standard subsystems to prevailing climate hazards at the prospective sites

Susceptibility of the IP to climate hazards is amongst others depending on the industries present. A screening of industrial branches prospectively located / proposed / expected for the nw IP will provide a preliminary orientation for site selection. Potential susceptibility of industries related to the various hazards has been determined through a preliminary classification of the various industrial sectors.

Table 20: Industrial sectors' susceptibility to prevailing climate hazards at the prospective sites

Industrial sector	Susceptibility to climate hazards	Expected in new IP according to needs analysis	List prevailing climate hazards and indicate susceptibility: non-susceptible, susceptible, highly susceptible		
			Site 1	Site 2	Site 3
Engineering	High Energy prices raw materials supply chain disruption				
Automotive	High Energy prices raw materials supply chain disruption				
Auto components	High Energy prices raw materials supply chain disruption				
Bio-technology	Changing disease vectors Increased waterborne illness				
Cement	Changes in product standards heat stress working near furnace				
Chemicals	High prices of raw materials more stringent safety norms, changes in regulation,				
Food processing	Water scarcity crop damages increased exposure to pest and insects transportation issues				
Gems and jewellery	More resistant to heat and moisture				
Heavy industry	Energy shortages regulatory risk storage protection				
Oil and gas	Stringent norms for storage safety measures considering floods, heat and cyclones				
Textiles	Less water availability more stringent pollution norms recycle of waste and wastewater high water and energy prices,				
Pharmaceuticals	Changing disease vectors, Increased				

	waterborne illness Higher health insurance costs				
Steel	More power and energy security, high water and energy prices,				
Paper and pulp	Water stressed, high water and energy prices,				
Printing	high water and energy prices, more stringent laws				
Plastics and rubber	Stringent laws for pollution and energy consumption				
Construction and construction materials	Changes in building codes and regulations, Reduced worker productivity due to heat, Disruptions in delivery of materials, Disruptions due to extreme weather events				
ICT	More power consumption, energy crisis, loss of data is high, backup required.				

Following table provides some general information on the generic susceptibility of subsystems of industrial parks to the various climate hazards. Susceptibility is classified in three classes:

low – **medium** – **high**

And further information on parameters causing the susceptibility are given. Hazards and subsystems relevant for the new IP can be marked for further work.

Tool 1.A3: Further specify information on previous exposure to climatic hazards

Information on previous exposure to climate hazards collected during Climate Screening (Tool 3.A1) was quite general.
It is now task of this step to further detail the information for the selected site only.
This will be done through further desk research, interviews with local / regional experts, field work, and GIS analysis if respective geodata (e.g. a digital surface model) are available.

Based on the information collected the prospective IP's exposure to climatic hazards has to be classified in three-(five) classes. For this purpose temporal and spatial dimension of exposure have to be combined were relevant; otherwise only temporal exposure has to be classified. Criteria leading to the classification have to be derived, clearly defined and documented from findings of the preceding work. Combination of temporal and spatial dimension has to be done according to the below matrix in the classes **(very low)-low** – **medium** – **high – (very high**).

Exposure		Spatial dimension		
		(very low)-low	medium	high – (very high)
Temporal dimension	(very low)-low	low	low	Medium
	medium	low	medium	High
	high – (very high)	medium	high	high

The table below provides guidance and shall be filled during the work. Sources are expert knowledge, existing documents and records, knowledge of local inhabitants and field work.

Table 21: Temporal and spatial dimension of exposure of the prospective site

Hazard	Specify temporal dimension	Specify spatial dimension of exposure	Sources of information)	Summarize exposure for consideration during further planning	Overall classification of exposure
Cyclones and storms	• Frequency • Strength / intensity • Duration • Classification:				
Storm surges	• Frequency • Strength / intensity • Duration • Classification	• Which parts of the IP were hit by the surge • Clasification			
Heavy rainfall inducing floods, landslides, rock falls, subsidence etc.	• Frequency • Strength / intensity • Duration • Classification	• Which parts of the IP were flooded • Which parts of the IP were exposed to other impacts such as subsidence, erosion, landslides, Rock-falls • Classification			
Droughts	• Frequency • Strength / intensity • Duration • Classification				
Heat waves	• Frequency • Strength / intensity • Duration • Classification				
Sea level rise	• Observed rise • Dimension of predicted rise • Classification				
Water shortage due to depletion of water resources	• Frequency • Strength / intensity • Duration • Classification	• Which industries / parts were affected • Classification			

Key findings of the climate risk assessment in Andhra Pradesh

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.

Key findings of the climate risk assessment in Telangana

Element	Key findings
Exposure	• Droughts: the frequency of drought incidents has increased; drought causes reduction in ground water level and several other water quality and availability issues • Heat waves: heat wave situations have become worse in last decade; during consultations IP Jeedimetla, IP Madhapur and IP Pashamylaram experienced high exposure levels to heat wave. Heat waves can potentially worsen drought conditions and may result in fatigue and heat stroke of employees. • Precipitation: Overall, the rainfall pattern of Hyderabad and other regions in Telangana has changed with delayed monsoon, more wide spread rainfall and decreased overall rainfall. Thus, the instance of water logging and flash flooding that IPs get exposed got usually low scoring. • Salinization, lighting and thunderstorms not perceived as relevant or no changes experienced by the IPs. • IP Madhapur and IP Jeedimetla have highest exposure to climatic hazards.
Susceptibility	• IPs internal road systems, storm water management system, waste water management system and energy were found to be climatically most susceptible areas among the main 9 climatic susceptibility measures studied • Water management was found to be the next most susceptible parameter consistently across all IPs. • IP Jeedimetla has highest susceptibility. IP Cherlapally is ranked 2nd in susceptibility. Similarly, IP Rampur and IP Madikonda have high susceptibility. Age, design and type of industries are influencing this ranking.
Resilience	• IP Jeedimetla and IP Rampur and IP Madikonda are least resilient to climatic changes across all six parameters. Governance and management, human resource, awareness and knowledge levels at this IP are poor. • IP Madhapur is financially robust, it has a well-designed system for supply of essential services, thus the resilience of this park is highest and ranked as number 5.

Tool 2.A3 Generic preliminary impact analysis for the new IP

For the generic preliminary impact analysis expected exposure and susceptibility of industrial sectors expected are combined to deduct possible impacts and to provide orientation for further planning steps (Master Planning, CCA Planning). Because available information at this time is quite general, analysis and classification will remain quite general either.

Analysis of impacts includes builds on the following previous outputs:

1. Analysis of prospective exposure to climate hazards (temporal and spatial exposure)
2. Generic analysis of susceptibility of industries expected to be located in the IP and generic susceptibility of standard sub-systems of an IP related to the prevailing hazards

This information has to be combined classifying the impact in three-(five) classes according to below matrix

Expected impact		Susceptibility		
		(very low)-low	medium	high – (very high)
Exposure	(very low)-low	low	low	medium
	medium	low	medium	high
	high – (very high)	medium	high	high

For general classification use below table.

Spatial information on specific exposure areas can be used to define prospective impact areas related to specific industries or sub-systems to be considered during subsequent planning.

Table 22: Generic Impact matrix for IP sub-systems and industrial sectors

Hazards: Systems:	Cyclones and storms; storm surges	Heavy rainfall, floods, landslides, rock falls, subsidence etc.	Drought	Heat wave	Sea level rise	Stroke of lightning
All kinds of buildings						
Roads						
Drainage systems Sewers						
Energy and water supply						
Greenery						
Workforce						
Industry sector 1						
Industry sector 2						
…						
…						
…						
…						
…						
Industry sector X						

Tool 6.E18 Examination of resilience of the planned IP

During this step, the various elements defining the resilience of an IP have to be assessed and summarized. Resilience of the capacities of the IP considering both the IALA and park management, as well as single industries shall summarized highlighting strengths, weaknesses, opportunities and threats related to the various hazards and be classified in three-(five) classes: **(very high)-high** – **medium** – **low – (very low)** using the table below.

As part of this phase, resilience needs to be assessed including the related concept for governance, administration and management. I.e. all CCA policies, processes and measures that have been put into place within the previous phases should be included here!

Table 23: Examination of planned IP resilience

Capacities	Summary and assessment
Rules and Regulations	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Supply structures (particularly water and energy / power)	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Governance and management	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Resources	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Awareness, knowledge	• Cyclone / storm:

Capacities	Summary and assessment
	• Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Spatial	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:
Production	• Cyclone / storm: • Storm surge: • Flooding: • Drought: • Heat wave: • Stroke of lightning: • General increase in temperature: • Long-term increase of temperature: • Changes in rainfall patterns: • Depletion of water resources: • Sea level rise:

Tool 7.E18 Examination of vulnerability of the planned IP

In the next step impact and resilience will be combined to deduct the vulnerability.
This should include all policies, processes and CCA measures developed in the previous phases!
This will be done by using following combination rule:

Vulnerability		Resilience		
		(very high)-high	medium	low – (very low)
Impact	(very low)-low	low	low	medium
	medium	low	medium	high
	high – (very high)	medium	high	high

The analysis has to consider:

- Impacts to various sub-systems caused by specific hazards, and
- Resilience of the IP, and if possible of single sub-systems against the various hazards.

Outputs of step 7:

- Specific assessment of vulnerability of the various systems explored

Table 24: examination of planned IP vulnerability

	Climatic hazard:						
Capacities: Systems:	**Rules and regulations**	**Supply structures**	**Governance and management**	**Resources**	**Awareness and knowledge**	**Spatial**	**Production**
All kinds of buildings							
Roads							
Drainage systems Sewers							
Energy and water supply							
Greenery							
Production / value chain / Machines Equipment							
Workforce							
Industrial community at site							

- Vulnerability map showing the hot spots produced through intersection of impact maps with resilience parameters
- General assessment of the vulnerability of the site summarizing both specific and spatial elements of vulnerability

Tool 8.E18 Assessment of remaining risk for the new IP

For a “classical” risk analysis vulnerability has to be combined with the probability of the various events and monetarization of the expected impacts.

Future probability of the various events is already included in the first step, specifically in the future part of the temporal dimension. Hence, there is no need to again consider probability.

For the current project, it seems to be highly ambitious to include the monetary dimension into the analysis. However, if exchange with stakeholders would allow performing a preliminary, rough quantification (or even just ranking of risks), this can be included and combined with the vulnerability analysis.

At EIA / environmental clearance stage, this would show the residual risk, after CCA measures have been included in previous planning phases.

A discussion is then required, whether these remaining risks are within the risk tolerance of the respective IP.

THE FOLLOWING "ANNEX 1 TO XI" ARE APPLICABLE TO BOTH EXISTING AND UPCOMING IPS

Annex- I. Results of the Rapid Climate screening of Industrial Parks in AP and TS

Methodological Approach

The Rapid Climate Risks Analysis applied consists of a three step approach:

Step 1: Preliminary Screening to exclude IPs of minor relevance and suitability for the subsequent Climate Risk Analysis. The preliminary screening focused on:

- Criterion 1: Exposure to climatic hazards and observed impacts thereof
- Criterion 2: Capacities and capabilities of the industrial park to implement climate change adaptation measures, and
- Criterion 3: The representativeness of the industrial park.

Step 2: Scoring of selected IPs: All the IPs which passed step 1 were given a section-wise scoring and ranked based on the score achieved. Ranking was done as per sections 2 (Climatic exposure), 3 (Climatic impact) and 4 (Adaptive capacity and capability) of the preliminary screening.

Andhra Pradesh (AP)

Based on screening out of 201 existing IPs, 100 IPs (considering all phases of an IP to be one single IP) were selected for the survey. For example, AN Gajuwaka has 7 Blocks Phase A to G, which was considered by APIIC as 7 IPS, but for analysis, the entire AN Gajuwaka is considered as single IP. Applying similar procedure to the entire Industrial Parks across AP, the number parks including all blocks / phases comes to be 200, if these blocks / phases are consider to be one single IP as it is represented by single IALA, then the total number of IP in AP is about 100**.**

These 100 IPs were further validated with the secondary data available for cyclone, heat wave, floods, drought, temperature change and rainfall.

Out of 100 IPs remaining after Criterion 1, 35 IPs did not pass through Criterion 2 and hence are excluded from any further analysis, leaving 64 IPs getting selected for Criterion 3.

Out of 64 IPs remaining after Criterion 2 and screened for criteria 3, 47 passed the Criterion 3 and are selected for scoring and ranking. Balance 17 IPs did not pass Criterion 3 and hence are excluded from any further analysis.

Table 25: CRA Screening for AP

Total no. of IPs	201
Selected for step 1	100
Selected for step 2	47

All the 47 IPs selected from step 1 of the methodology are given a scoring based on 3 climate parameters , i.e. **climatic exposure, climatic impact and adaptive capacity & capability**. The final score for each IP was derived by adding the points against each question/Criterion. Scoring for all these sections were normalised by dividing with the maximum score of the section for indices. The scores for the three parameter indices are then aggregated into a composite index using geometric mean for ranking. IPs with highest score index was marked as 1 and so on. Top Seven IPs were selected through a preliminary screening

process and have been analysed in more detail through the Rapid Climate Risk Analysis Methodology.

Table 26: Key findings of the climate risk assessment in Andhra Pradesh

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.

Telangana (TS)

Telangana has the history of experiencing droughts in a cyclic manner. However, in the recent decades the frequency of these drought incidents has increased. Drought causes reduction in ground water level and several other water quality and availability issues. In non-agriculture sectors drought is experienced through water stress conditions.

Based on screening out of 201 existing IPs, 100 IPs (considering all phases of an IP to be one single IP) were selected for the survey. For example, IP Cherlappaly has 5 Phases 1 to 5, which was considered by TSIIC as 5 IPS, but for analysis, the entire IP Cherlapally is considered as single IP, as it is represented by Single IALA. Applying similar procedure to the entire Industrial Parks across TS, the number parks including all blocks / phases comes to be 131, if these blocks / phases are consider to be one single IP as it is represented by single IALA, then the total number of IP in TS is about 53.

All the 53 IPs surveyed were subjected to Step 1 of the analysis, after which 27 IPs were selected for Step 2. All the IPs which had passed step 1 i.e. Criterion 1, 2 and 3 were given a section-wise scoring for the three section, i.e. climatic exposure, climatic impact and adaptive capacity & capability. The final score for each IP was derived by adding the points

against each question/Criterion. Scoring for all these sections were normalised by dividing with the maximum score of the section for indices. The scores for the three section indices are then aggregated into a composite index using geometric mean for ranking. IPs with highest score index was marked as 1 and so on.

Top Five(5) IPs were selected through a preliminary screening process and have been analysed in more detail through the Rapid Climate Risk Analysis Methodology

Table 27: CRA Screening for TS

Total no. of IPs	131
Selected for step 1	53
Selected for step 2	27

Table 28: Key findings of the risk assessment approach for existing IPs in Telangana

Element	Key findings
Exposure	• Droughts: the frequency of drought incidents has increased; drought causes reduction in ground water level and several other water quality and availability issues • Heat waves: heat wave situations have become worse in last decade; during consultations IP Jeedimetla, IP Madhapur and IP Pashamylaram experienced high exposure levels to heat wave. Heat waves can potentially worsen drought conditions and may result in fatigue and heat stroke of employees. • Precipitation: Overall, the rainfall pattern of Hyderabad and other regions in Telangana has changed with delayed monsoon, more wide spread rainfall and decreased overall rainfall. Thus, the instance of water logging and flash flooding that IPs get exposed got usually low scoring. • Salinization, lighting and thunderstorms not perceived as relevant or no changes experienced by the IPs. • IP Madhapur and IP Jeedimetla have highest exposure to climatic hazards.
Susceptibility	• IPs internal road systems, storm water management system, waste water management system and energy were found to be climatically most susceptible areas among the main 9 climatic susceptibility measures studied • Water management was found to be the next most susceptible parameter consistently across all IPs. • IP Jeedimetla has highest susceptibility. IP Cherlapally is ranked 2nd in susceptibility. Similarly, IP Rampur and IP Madikonda have high susceptibility. Age, design and type of industries are influencing this ranking.
Resilience	• IP Jeedimetla and IP Rampur and IP Madikonda are least resilient to climatic changes across all six parameters. Governance and management, human resource, awareness and knowledge levels at this IP are poor. • IP Madhapur is financially robust, it has a well-designed system for supply of essential services, thus the resilience of this park is highest and ranked as number 5.

Annex-II. Climate Information

Past and current climatic data

Generally, there is good information available regarding past climatic data for the former State of Andhra Pradesh including Telangana.

Table 29: Climate data sources

Sl. No.	Climate Data	Source / Organization	Website
1	Daily Rainfall, Temperature, and other Meteorological data	Indian Meteorological Department	http://www.imd.gov.in/
2	Map-based climatic information of Flood-prone areas drought and drought-prone	Indian Meteorological Department	http://www.imdaws.com/viewawsdata.aspx
3	Storm surge inundation, Flood inundation, Drought situation, Cyclone information	Disaster Mitigation Unit of the **Andhra Pradesh** State Development Planning Society	http://www.apsdps.ap.gov.in/vm.htm
4	Floods and Drought Units	Disaster Mitigation Unit of the **Telangana** State Development Planning Society	http://117.247.178.102/tsdps/fu.html
	Future Climate Data		
5	Free climate data for ecological modeling and GIS	WorldClim - Global Climate Data	http://www.worldclim.org/
6	The DDC provides climate, socio-economic and environmental data, both from the past and also in scenarios projected into the future.	Intergovernmental Panel on Climate Change (IPCC)	http://www.ipcc-data.org/
7	CCAFS brings together the world's best researchers in agricultural science, climate science, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between climate change and agriculture. The data distributed here are in ARC GRID, and ARC ASCII format, in decimal degrees and datum WGS84	Data Provided by the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)	http://www.ccafs-climate.org/data/
8	IITM is a premiere research Institute to generate scientific knowledge in the field of meteorology and atmospheric sciences that has potential application in various fields such as agriculture, economics, health, water resources, transportation, communications, etc	Indian Institute of Tropical Meteorology (IITM)	http://www.tropmet.res.in/History-1-Page
9	international greenhouse gas emissions data	World Resources Institute	http://cait.wri.org/
Industry Data			

1	Industrial parks, Line of activities, list of industries etc.	APIIC and TSIIC	www.apiic.in; www.tsiic.telangana.gov.in
2	Impact on industries, industrial parks	Commission rate of Industries, APIIC and TSIIC	http://industries.telangana.gov.in/KeyContacts1.aspx https://www.apindustries.gov.in/APIndus/Default.aspx
3	Polluting industries	APPCB, TSPCB	appcb.ap.nic.in tspcb.cgg.gov.in

Annex-III Relevant Acts, Regulations, provisions and incentive schemes

Table 30: Relevant acts, regulations, provisions and incentive schemes

	Document	Title	Scope	Website
Laws, Acts and Rules				
1	Environment Impact Assessment	Ministry of Environment and Forests, Environmental Impact Assessment Notification -2006	EC Clearance	http://envfor.nic.in/legis/eia/so1533.pdf
2	SWM Rules 2015	Solid Waste Management Rules, 2015;	Solid Waste Management Rules	http://www.moef.nic.in/sites/default/files/SWM%20Rules%202015%20-Vetted%201%20-%20final.pdf
3	EPA Act	The Environment (Protection) Act, 1986	Environment protection act	http://envfor.nic.in/legis/env/env1.html
4	CRZ Notification	Coastal Regulation Zone Notification Ministry Of Environment And Forests	CRZ Clearance	http://www.moef.nic.in/downloads/public-information/CRZ-Notification-2011.pdf
5	Water (Prevention and Cont rol of Pollution) Act, 1974	Water (Prevention and Cont rol of Pollution) Act, 1974	Water Act	http://www.moef.nic.in/legis/water/wat1.html
6	Air (Prevention and Control of Pollution) Act, 1981	Air (Prevention and Control of Pollution) Act, 1981	Air pollution Act	http://www.envfor.nic.in/legis/air/air1.html
7	National Land use Planning (NLP)	National Land Utilisation Policy	overall approach for Land use planning, identification of land utilization and management areas.	http://dolr.nic.in/dolr/guidelines.asp
8	National Manufacturing Policy	National Manufacturing Policy	Promoting Indian Manufacturing Sector	dipp.nic.in/english/policies/national_manufacturing_policy_25october2011.pdf
9	Special Economic Zone (SEZ) Act	Special Economic Zone (SEZ) Act - 2005	Promotion of export products through establishment of industries under SEZ	sezindia.nic.in/goi-policies.asp
10	Forest (Conser-	Forest (Conservation) Act,	An Act to provide	http://envfor.nic.in/legis/forest/forest2.ht

	Document	Title	Scope	Website
	vation) Act	1980 with Amendments made in 1998	for the conservation of forests and for matters connected therewith or ancillary or incidental thereto.	ml
Andhra Pradesh and Telangana State				
11	TSIIC Industrial Policy	industrial policy framework for the state of telangana - 2014	Industrial Policy	http://tsiic.telangana.gov.in/pdf/Industrial-Framework-2014-Version-1.pdf
12	APIIC Industrial Policy	industrial development policy 2015-20	Industrial Policy	http://www.apiic.in/wp-content/uploads/2016/02/Indl-dev-policy-2015-20.pdf
13	AP-Industrial Water Supply orders	Govt. of AP "Industrial Development Policy 2015-2020"	Water Allotment for industrial areas	https://www.apindustries.gov.in/APIndus/Data/GO/G.O%20for%20Industrial%20Development%20Policy%202015-2020.pdf
14	Telangana Solar power policy	Telangana Solar Power Policy 2015	Solar rooftop for industrial establishments	http://mnre.gov.in/file-manager/UserFiles/state-power-policies/Telangana-Solar-Power%20Policy.pdf
15	Andhra Pradesh Solar Power Policy	Andhra Pradesh Solar Power Policy, 2015	Solar rooftop for industrial establishments	www.ireeed.gov.in/policyfiles/436 AP%20SOLAR_POWER_POLICY.pdf
16	TS-iPASS	Telangana State Industrial Project Approval and Self Certification System (TS-iPASS) Rules, 2015		https://tsipass.cgg.gov.in/images/TS-iPassupdated.pdf
Guidelines and Other Relevant Documents				
17	Directorate of Town and Country Planning	Municipal Administration and Urban Development (MA&UD) Building Rules, 2012 – Orders – Issued.	Planning guidelines	http://www.dtcp.telangana.gov.in/G.O.Ms.No.168,Dt.07-4-2012-AP%20Building%20Rules.pdf
18	Planning for sustainable industrial parks	Planning for Sustainable Industrial Parks	Site Master Planning	http://www.igep.in/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e62975/20150629_PlanningofSustainableIndustrialParksa.pdf
19	Planning of GIP Jedcherla	Greening of GIP Jadcherla, Telangana	Planning Document	http://www.igep.in/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e62973/20150630_GIPJadcherlacaseexample.pdf
20	CETP Guidelines	Revised Guidelines for the Centrally Sponsored Scheme of Common Effluent Treatment Plants (CETPs)	CETP Guidelines	http://www.moef.nic.in/downloads/public-information/revised-cetp.pdf www.moef.nic.in/downloads/public-information/revised-cetp.pdf
21	VCIC Corridor	Vizag–Chennai Industrial corridor Conceptual Development Plan	Concept note	https://www.apindustries.gov.in/APIndus/Data/Vizag-Chennai%20Industrial%20Corridor_Full%20Report.pdf
22	India's INDC	india's intended nationally determined contribution:	INDC	http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDI

	Document	Title	Scope	Website
		working towards climate justice		A%20INDC%20TO%20UNFCCC.pdf
23	IALA Guidelines	Revised Guidelines for the Functioning of Industiral Area Local Authorities (IALAs) and Service Societies	IALA Guidelines	http://www.apiic.in/wp-content/uploads/2014/06/IALA-GUIDELINES-WITH-AMENDMENTS-AP.pdf
24	Urban and Regional Development	urban and regional development plans formulationand implementation (urdpfi) guidelines	URDPFI Guidelines	http://moud.gov.in/URDPFI
25	Ministry of Environment & Forests, Government of India	Environmental Guidelines for Industries	Siting guidelines	http://www.moef.gov.in/citizen/specinfo/enguin.html
26	Central Pollution Control Board	CPCB Industry Siting Guidelines	Siting guidelines	http://www.cpcb.nic.in/Env_Planning.php
27	Guidelines for Common Effluent Treatment Plant (CETP),		Promotion of Zero Liquid Discharge (ZLD) in common effluent treatment plants through financial incentives	
28	Guidelines for integrated processing development scheme for promoting textiles industries (Ministry of Textiles)	guidelines for centrally sponsored scheme for integrated processing development scheme (ipds)	Promotion of water and effluent management in textile cluster	texmin.nic.in/sites/default/files/**GUIDELINES**_FOR_IPDS.pdf
29	Modified Industrial Infrastructure Upgradation Schemes	Modified Industrial Infrastructure Upgradation Scheme	to enhance competitiveness of industry by providing quality infrastructure through public private partnership	dipp.nic.in/English/**Schemes**/IIUS/IIUS_**modified**_01August2013.pdf

Annex-IV Important actors and their responsibilities

As there are many officials working at different level and areas of expertise, they have a well-defined role and contribution in developing new and existing parks. The table below indicates the roles and responsibilities of various officials of IICs and other related government organisations.

Table 31: Important actors in planning of new and existing IPs

Sl no	Stakeholder	Role	Current responsibilities during planning of New Industrial Parks	Current responsibilities during planning of Existing Industrial Park
Industrial				

Sl no	Stakeholder	Role	Current responsibilities during planning of New Industrial Parks	Current responsibilities during planning of Existing Industrial Park
	IIC			
1	**Head Office**	Board	Any major decisions and grants/ loans which is routed through the government / international agencies for the development of IPs	Any major decisions and grants/ loans from the government / international agencies for development or retro-fitting of IPs
2		Managing Director	Decision on location of park, park details, requirements, etc. Approves the Overall Layout of the New industrial park and all administrative sanctions	All administrative sanctions. Approval of any changes in Master plan of existing park. Also, for IPs without IALAs
3		Executive Director	Executing and directing heads of department of all decisions by Managing director. Also, Chair of Price Fixing Committee	Executing and directing heads of department of all decisions by Managing director
4		Chief engineer	All technical sanctions of IPs including planning, designing and estimation and as a member of price fixation committee	Planning, designing, estimates, implementation and monitoring of all the execution works. Building approvals
5		GM (Engineering)		
6		DGM (Engineering)		
7		Chief General Manager (Finance)	Financial assessment and approvals. Also, as a member of price fixation committee	Financial approvals for all development works.
8		Manager (Finance)		
9		Chief General Manager (Projects)	**S**ite identification, analysis, development of DPR and master plans in coordination with Engineering division	Approvals on up-gradation of IPs, assessing budgetary limits
10		GM (Projects)		
11		Chief General Manager (Asset Management)	Identification and acquisition of land for industrial areas, legal issues, land transfers / cancelation, marketing	Change of products, line of activity, sick industries, vigilance, cancelation, constitution of committees
12		GM / Manager (Projects)		
13		GM(LAC)	Pursue with the Government for getting IALA status for new IPs.	Coordinating with IALA commissioners through ZMs for giving any approvals at H.O. level
14		GM (EMP) Environment Engineers	Environmental Planning, development for Environmental Clearances	Any environmental issues, planning, consultations, preparing DPRs for environment infrastructure like CETP, Waste Management, Plantations, etc.
15	**Zonal Office**	Zonal Manager	Planning, design and development of industrial park including cost estimation, execution	Building approvals up to 5 storey and Technical sanction of infrastructure in IPs up to 25 Lakhs
16		Deputy Zonal Manager (Engineering & Asset management)	Designs, Cost estimations, site visits, implementations,	Development of Plan, designs, cost estimates and implementation
17		Asset Management) Manager (E)		
18		Asset Management	Land identification, approvals, allotment	Change of products, line of activity, sick industries, vigilance, cancelation, constitution of committees
19		Commissioner / Executive Officer	Not Applicable	Formation of IALAs, coordination with Industries and IALAs on day-to-day management and decision making, including any further initiatives or maintenance of infrastructure

Sl no	Stakeholder	Role	Current responsibilities during planning of New Industrial Parks	Current responsibilities during planning of Existing Industrial Park
				in IPs
20	IP Associations	IALA, (for existing IPs)	Not Applicable	Act as advisory role in management of IALAs and its functions
21		Chairman,		
22		Secretary,		
23		Treasurer		
24	FTAPCCI & other associations	President and Secretary representing specific sectors,	liaising between with governments and SMEs, role in developing policies, grants, any specific requirements / issues or sector specific IPs	Promoting SMEs or sector specific industrial parks,
Governmental				
1	SPCB / SEAC / CEAC Planning Department	Issuing consent to establish and operate/ Environmental Clearance to IPs and industries and enforce the environmental norms for compliance through inspections and monitoring. Also, regulatory body to provide consent for establishment and operate for IPs and industries	Approval for Environmental Clearances and Consent for Establishment for IPs	Regulatory authority for managing environmental issues in IPs.
2.	Directorate of town and country planning	Approval authority for site layouts in accordance to the Govt. regulations In brief, the state town and country planning division provides technical assistance to various departments including IICs in matters of land use proposals, alienation of lands.	Approval for the site layouts	Any change of layout will be approved by Zonal / District DTCP
3	HMDA, other municipal / gram panchayat	For approval on utilities and maintaining the infrastructure (35% of total tax collected goes to municipal corporation / gram panchayats)	Land approvals, land conversion, planning, designing and implementation of connecting utilities / networks to the industrial parks. Layout approval will be done by HMDA, GHMC within their jurisdiction.	Maintenance of infrastructure connecting to the IPs like sewage, roads, etc
4	Commissioner of Industries (DIC)		Authority to provide various licenses for construction, operation and other related licenses under factories act. All central and state grants for upgradation of IPs are approved through DIC.	All central and state grants for upgradation of IPs are approved through DIC. Providing funds for external infrastructure like power, water etc.,
5	Power Transmission Corporations (TRANSCO)		Telangana State Power Transmission Corporation (or its subsidiaries) setup dedicated substation for the respec-	

Sl no	Stakeholder	Role	Current responsibilities during planning of New Industrial Parks	Current responsibilities during planning of Existing Industrial Park
			tive industrial park based on the IP demand.	
6	Dept. of Water Supply		Providing 10% of reserved water for industrial use for both existing and upcoming projects by municipal water supply in urban areas / Rural Water Supply in rural areas.	
7	State and District Allotment Committee		Approvals on land allotment	No Role
8	Planning Department		Planning of land use, development of city / district master plan	No Role
9	Disaster Management			Approvals to industries for mitigation plans for disasters, mainly fire
10	Irrigation		Approvals, if IPs cover any streams or water bodies under minor or major irrigation department	Maintenance and monitoring of water bodies, if any within industrial park
11	District Collector		Prime responsible to Land acquisition process and approvals and handing over the land to IIC	
12	Registration and Stamps Department / Revenue Department	Under District Collector	Land acquisition, conversions, transfers	
13	Andhra Pradesh Coastal Zone Management Authority (APCZMA)	Issuing CRZ clearance for the industrial parks / SEZs proposed at coastal areas of AP which attracts Coastal Regulation Zone (CRZ) notification 2012 and amendments thereof.	Approval authority for establishing Industrial Parks if the IPs comes under CRZ areas	

Annex V : Background information for stakeholder consultation in existing industrial parks

Andhra Pradesh

In stakeholder consultations, the participants were briefed on climate change and its relevance for the industries and people, the objective of the Climate Change Adaptation (CCA) project, work completed so far and the need for this stakeholder consultation meeting. The risk analysis questionnaire was explained to all participants to enable them to respond appropriately to the questionnaire. A brief overview of the stakeholder consultation meetings conducted at each of these parks is provided below.

Some of the common observations from stakeholder consultation process at the IPs in Andhra Pradesh are:

- All IPs in the coastal are impacted by cyclone
- Poor drainage system is a concern for most of the IPs considering heavy ranfall and cyclone induced conditions
- Road condition, its operation and maintenance, is generally an area of concern
- The industry feels is a need to improve governance and operaitona arrangement between IALAs and APIIC

Case 1: IP Kurnool

IP Kurnool is located in Kurnool industrial zone in Kurnool district of AP. It is a small industrial park spanning an area of about 92acres and a working population of about 500 people. It houses granite, Aluminium, Bricks, slabs, ricemills, Engineering, chemicals industrial units.

Case 2: Growth Centre Ongole

Growth Centre Ongole is located in Prakasham district. It has an area of about 1000 acres and was established in 1998. It is relatively new IP and several industrial plots have still not been developed.

During the stakeholder meeting it was understood that tough the IP is about 30km from the coast line, it has been impacted by cyclones in the past. High speed winds and heavy rainfall impacted the IP in times of cyclone. Due to these high speed winds, window panes and doors were broken and roofs of several sheds flew away. Granite industry was the worst affected in this incident.

IP lies in the vicinity of a river, and has low surrounding population density. On one incident the backwaters of river Gundlakamma swelled and the water came close to the IP. Thus, climatic hazards have been impacting the IP.Industries in the IP provide transportation facility to it's employees till the entrance of IP.

Case 3: IP Gajulamandyam

IP Gajulamandayam is located in Reinigunta in Chittoor district and Tirupati zone. It is a medium size IP with a working population of about 4000 people. It is home to various types of industries like Bulk drug, Thermal, Paper board processing, Chemical, Thermacol, Lead, Plastic, Pharma (sick), Plastic, Granites, Industrial gases. Some of the industrial units like Pharma are sick industries.

Few of the responses received during stakeholder consultation are:

- Industries are willing to undertake measures to reduce the impact of heat island. Some of them have taken up to changing building color for the same.
- Industries experience man power problem during summer due to excessive heat
- Industries experience loss of efficiency during summer time
- IP does not have any first aid centre, shelter or hospital to cater to heat stroke.

Case 4: Autonagar Visakhapatnam

AN-Visakhapatnam is located in Gajuwaka industrial zone in Visakhapatnam district of AP. It is a medium size industrial park spanning an area of about 1230 acres. It houses Auto, food, textile, fabrication and plastic manufacturing industrial units. This industrial park was established about 40 years ago.

AN-Visakhapatnam is highly exposed to cyclonic climate hazardous and the IP has been severely impacted by cyclones in the past. The general opinion of the participants of the survey was that the incident of cyclonic activity had increased over the years. Cyclones have caused the infrastructure damage and power outrage to the IP as well as water logging inside IP due to heavy rainfall, which resulted in flood like situation. The IP has also faced impacts of gradually increasing heat waves over the years. The IP has a proper drainage system in place and there are industries who have taken up green initiatives on their own, which shows their willingness to adopt measures to mitigate climate change and its effects. There is underground chemical storage in the IP, which can be impacted during extreme climatic events. The IP fulfils their water requirement through private water tankers and underground water and there is no water scarcity in IP.

Participants also voiced concern about the poor infrastructure management (Roads, drainage systems, street lights etc.) of the IP. They have basic knowledge about climate change and its impacts and are willing to adopt measures to minimise it.

Case 5: Growth Centre Bobbili

GC Bobbili is located in Bobbili in Visakhapatnam district and Bobbili zone. It is a medium size IP with a working population of about 4200 people spread around 1149 Acres. It is home to various types of industries like Bulk drug, Fabrication and Ferro alloys.

GC-Bobbili is highly exposed to cyclonic climate hazardous and the IP has been severely impacted by cyclones in the past. The general opinion of the participants of the survey was that the incident of cyclonic activity had increased over the years. Cyclones have caused the infrastructure damage and power outrage to the IP as well as water logging inside IP due to heavy rainfall, which resulted in flood like situation. Drought is another climate hazard, which has impacted the IP in recent past and duration of drought period has increased over time. The IP has also faced impacts of gradually increasing heat waves over the years. The IP has also been randomly affected by thunderstorms; and struck by lightning. However, around 80% of the industries in the IP have installed lighting conductors in order to combat such events.

The IP has a proper drainage system in place and there are industries who have taken up health and safety initiatives on their own, which shows their concern towards the society and environment. The IP fulfils their water requirement through underground water and there is no water scarcity in IP. In addition, the buildings in the IP are not more than 10 years old and in good condition.

Participants voiced concern about the infrastructure management not being regular enough and being only need based. They have basic knowledge about climate change and its impacts and are willing to adopt measures to minimise it.

Case 6: Vakalapudi (Phase III), Kakinada

IP Vakalapudi (Phase III) is located in Kakinada in East Godavari district. It is a medium size IP spread around 653 Acres. It is home to various types of industries like Edible oil, cold storage and biodiesel.

Vakalpudi (Ph-III) Kakinada is highly exposed to cyclonic climate hazardous and the IP has been severely impacted by cyclones and storm surge in the past. The general opinion of the participants of the survey was that the incident of cyclonic activity had increased over the years. Cyclones have caused the infrastructure damage and power outrage to the IP as well as water logging inside. Also due to heavy rainfall and poor maintenance of drainage system, it has resulted in flood like situation. The IP has also faced impacts of gradually increasing severe heat waves over the years. The IP has also been randomly affected by thunderstorms; and struck by lightning. However, around 40% of the industries in the IP have installed lighting conductors in order to combat such events.

The IP fulfils their water requirement through private and municipal water tankers and there is no water scarcity in IP. In addition, the buildings in the IP are not more than 10 years old and in good condition also building stability assessment is being carried out by around 10% industries. IP has been built on degraded land and ground water is saline in nature. Rain water harvesting system is also in place in industries.

Participants voiced concern about the infrastructure management not being regular enough and very poor. They have basic knowledge about climate change and its impacts and are willing to adopt measures to minimise it.

Case 7: Ramanepeta (IP Kakinada & IP Kakinada Expansion (Ph. II)), Kakinada

IP Ramanepeta (Phase II) is located in Kakinada in East Godavari district. It is a small size IP spread around 70 Acres. Most of the infrastructure is 10-20 years old in the IP.

During the stakeholder meeting it was understood that the IP is about 8 km from the coast line, it has been impacted by cyclones in the past. High speed winds and heavy rainfall impacted the IP in times of cyclone. Due to these high speed winds, window panes and doors were broken and roofs of several sheds flew away.

Apart from cyclone, IP has been impacted by heat waves and floods during high rainfall. Thus, climatic hazards have been impacting the IP. Ground water is saline in nature inside the IP. Share auto and Bus are the common transport used by the workforce.

Telangana

In stakeholder consultations, the participants were briefed on climate change and its relevance for the industries and people, the objective of the Climate Change Adaptation (CCA) project, work completed so far and the need for this stakeholder consultation meeting. The risk analysis questionnaire was explained to all participants to enable them to respond appropriately to the questionnaire. A brief overview of the stakeholder consultation meetings conducted at each of these parks is provided below.

Some of the common observations from stakeholder consultation process at the six(6) IPs in Telangana are:

- All industrial parks are facing water scarcity
- Source of water and alternate source for all industrial parks are either ground water, municipal tankers (or few piped sources) and private tankers
- Road condition, its operation and maintenance, is generally an area of concern
- The industry feels there is a need to improve governance and operation arrangement between IALAs and TSIIC

Case 1: IP Pashamylaram

IP Pashamylaram is located in Patancheru industrial zone in Medak district of Telangana. It is a large industrial park spanning an area of about 1645acres and a working population of about 50,000 people. It houses some of the important industrial sectors of Telangana like bulk drug and pharmaceutical, chemical, engineering, automobile and foundry. This industrial park was established about 30-40 years ago.

In addition to the climate related response, the stakeholders expressed concerns regarding entry/exit as the IP has only one entry and exit. Daily, about 15000 trucks and vehicles ply in and out of the industrial estates. Some of these trucks carry hazardous chemicals. A single road, for a large industrial estate leads to traffic jams leading to very slow movement of vehicles during peak hours. This may be a critical aspect in case of a climate change related natural disaster considering limited access and exit to industrial park and escape routes.

Some other findings were:

- The Industrial association described that a land has been identified within the IP for installation of effluent treatment plant (ETP). The overall greenery in the IP is less and should be increased.
- IP has a small dispensary and an ambulance to manage medical situations. However, single entry and exit point could be a hazard in case of medical situations.

Case 2: IP Jeedimetla

IP Jeedimetla was established more than 40 years ago. It is located in the Rangareddy district of Telangana. In the last 4 decades, Hyderabad city has expanded in size and the industrial park is now within the city limits. Population density around the park has also grown and the area has become densely populated. IP is about 900 acres in area and houses nearly 1100 industries.

The groundwater in and around IP Jeedimetla has been polluted due to industrial growth and is not suitable for any use. This leaves the industries in IP with only two options for obtaining water; one is supply from municipality (mainly through tankers) and other being private tankers. At the same time, IP Jeedimetla is home to many small and big companies which need high quality process water like bulk drug, pharma, chemicals and pesticide industry. The water crisis accompanied by climatic changes impacts increases the concerns related to water.

During stakeholder consultation it was established that IP Jeedimetla is the only IP which has a common effluent treatment plant for the IP. It is operated by an independent entity called Jeedimetla Effluent Treatment Limited (JETL). There a need to review the adequacy of the ETP's ability to handle and treat all the wastewater generated from the IP.

Case 3: IP Hi-tech city Madhapur and Software Unit Layout, Madhapur

Hi tech city Madhapur and software unit layout, Madhapur are young industrial parks which were established in the late 1990's i.e. around 1998 (about 18 years ago). These parks are unique as they do not have any manufacturing units. They are specially designed for Information Technology (IT) and ITES type of companies. They span in an area of about 215 acres.

This IP does not have any process water requirement. The energy consumption is also limited to office spaces. HVAC cooling system, computers and laptops are the major consumers of power in this IP. From the stakeholder consultations it was found that:

- The IP has a better financial capability to address climate change
- The road and building infrastructure of this park was better maintained as compared to other parks.
- The storm water drainage systems are in place and development of a common sewerage treatment plan is under process.

Along with GIZ, TSIIC has initiated a five point program in the IPs in Cyberabad zone. Five points of the program are:

- Retrofitting of existing office/factory building to green buildings and barrier free work spaces
- Solid waste management and e-waste management
- Promotion of "cycle to work"
    - Greening of industrial parks
    - Storm water management and rain water harvesting

Case 4: IP Rampur and IP Madikonda

In Telangana, most of the IPs are located in four industrial zones which are within 40 to50 km radius of Hyderabad city. Two industrial zones Karimnagar and Warangal are the only two zones which are located beyond 100 km distance from Hyderabad. IP Rampur and IP Madikonda are located at Warangal, which is the next big city after Hyderabad in Telangana.

IP Rampur and IP Madikonda are similar in size (about 180 acres each), with similar type of industries and are located nearby. Thus, the stakeholder consultation for both these industrial parks was conducted through a joint meeting and is considered as one consultation meeting in the Rapid Climate risk analysis. Both the IPs have granite sheet cutting, polishing, rice mills and other processing industry.

Stakeholders have cited scarcity of water as one of the major concerns in these industrial parks. The ground water is depleting fast, forcing the industries to rely on private water tankers to meet their water demand. Unlike, other industrial zones, municipal water supply is unavailable at these parks. Industries and TSIIC observe the need to have a good storm water management system in place to partially meet the need for water.

Case 5: IP Cherlapally

IP Cherlapally like IP Jeedimetla and IP Pashamylaram is more than 40 years old and is home to chemical, pharma, engineering, electronic, food processing, engineering and many other types of industries.

The industry and association pointed out that under Harita Haram, flagship project of government of Telangana, large plantations were undertaken at the park. However, it could not be sustained as the tender for watering the plants took a long time for clearance. It was pointed out that the governance system like powers of IALA need to be strengthened to enable speedier implementation of time bound activities. The stakeholder also identified issues of ground water pollution at some places.

Annex-VI Best Practices / Available CRA Tools

Climate Expert Tool[1]

The Climate Expert website provides

- **Materials, tools** and **guidance**
- For **SMEs** and **multiplier organisations**
- Aimed at raising **awareness** and building **practical skills** of SMEs to prepare for the impacts of climate change.

For this purpose the website contains the **online learning programme "Becoming a Climate Expert"** for companies as well as a **Toolbox** with materials and further information on a related training programme.

SMEs which complete the Climate Expert online course or related training programmes will be able to answer the following questions:

Climate change and its impacts

- Why does climate change matter to SMEs and my business?
- How does it affect my business' survival and growth?

[1] http://www.climate-expert.org

Climate change adaptation strategies

- How can I identify vulnerabilities resulting from climate change for my business?
- How can I conduct a risk assessment for my business? How can I develop a strategy for climate change adaptation with key stakeholders?
- How can I monitor and evaluate my adaptation activities?

Annex. VII Applicable Codes and Standards

Site Planning:

- URDPFI Guidelines
- SEZ Rules Incorporating Amendments, July 2010 (Part II, Section 3, Subsection (i) of the Gazette of India Extraordinary, February 2006

Industrial Location and Site selection :

- Schedule for Industries in Various local approvals & clearances required for large scale project in metro cities – CPWD 2013.

Site selection near Coastal areas :

- Coastal Regulation Zone notification : Ministry of Environment and Forests

Architecture and Structural Works :

- CPWD Works Manual 2014 – providing basic framework of planning, designing and execution of construction works adopted in CPWD and other Government organisations.
- CPWD Specifications (2009) Vol -1 (Earthwork, mortars, concrete work, RCC work, brick work, stone work, wood work, PVC work, steel work, flooring, roofing)
- CPWD Specifications (2009), Vol -2 (Finishing, repairs to buildings, dismantling and demolishing, road work, sanitary installations, water supply, drainage, pile work, aluminium works, waterproofing treatment, horticulture and landscape
- IS 4326:1993 (Reaffirmed 2003) Edition 3.3 (2005.01) (Earthquake resistant design and construction of buildings – Code of Practice)
- IS 7784 (Part 1):1993 (Design of Cross Drainage Works – Code of Practices)
- IS:875 Part II.
- IS 15498:2004 Guidelines for improving the cyclonic resistance of low rise houses and other buildings / structures
- National Building Code : 2005, Bureau of Indian Standards
    - PART 4 Fire And Life Safety
    - PART 5 Building Materials
    - PART 6 Structural Design
        - Section 1 Loads, Forces and Effects
        - Section 2 Soils and Foundations
        - Section 4 Masonry
        - Section 5 Concrete: 5A Plain and Reinforced Concrete

- Section 5 Concrete: 5B Pre-stressed Concrete
- Section 6 Steel
- Section 7 Prefabrication, Systems Building and Mixed/Composite Construction:
- 7A Prefabricated Concrete
- 7B Systems Building and Mixed/Composite Construction

- PART 7 CONSTRUCTIONAL PRACTICES AND SAFETY
- PART 8 BUILDING SERVICES
  - Section 1 Lighting and Ventilation
  - Section 2 Electrical and Allied Installations
  - Section 3 Air Conditioning, Heating and Mechanical Ventilation
  - Section 4 Acoustics, Sound Insulation and Noise Control
  - Section 5 Installation of Lifts and Escalators
- PART 9 PLUMBING SERVICES
  - Section 1 Water Supply, Drainage and Sanitation (Including Solid Waste Management)
  - Section 2 Gas Supply
- PART 10 LANDSCAPING, SIGNS AND OUTDOOR

  DISPLAY STRUCTURES
  - Section 1 Landscape Planning and Design
  - Section 2 Signs and Outdoor Display Structures
  -

Electrical Works :

- Energy Conservation Building Code (2007, updated in 2015) published by Bureau of Energy Efficiency : for Electrical System

Inspection and Quality Assurance :

- CPWD Quality Assurance Manual 2002, for construction of concrete structures

Suitable Execution Agency Selection :

- CPWD Enlistment Rules 2005 – for the enlistment of Contractors

Scheduled Rates for Cost Estimation :

- Schedule of Rates for Building Works : 2015–16 (effective from 1st June 2015), Govt. of Andhra Pradesh

  Part - I Building Items

  Part - II Water Supply & Sanitary Items

  Part - III Electrical Items

  Part - IV Public Health Items
- Common Schedule of Rates as per Govt. of Andhra Pradesh - 2014-15 : Irrigation and CAD Works (revised standard data)

- Common Schedule of Rates as per Govt. of Andhra Pradesh - 2015-16 : Part - I (Water Resources Department Work Items
- Common Schedule of Rates as per Govt. of Andhra Pradesh - 2015-16 : Part – II (Roads & Bridge Works)
- DSR : Adopt the items of works mentioned in the DSR (Delhi Schedule of Rates) published by CPWD, In the absence of the items of works, which are very essential for adaptation purpose but not covered in the above SoR.
- Non-schedule Items : Draft the items of works, as special items (commonly termed as *non-schedule items*) with appropriate specifications of components, such as materials, Labour, equipment etc., arriving at the unit rate (supported with rate analysis based on the current market rates). Obtain the approval of the execution authority designated by APIIC / TSIIC / IALA.

Annex. VIII Roles and Responsibilities

Policy Level

State Cabinet : Government level Policy makers

- Industrial Policy making
- Creating mandate for CC adaptation at the state level for all industrial parks and constituent industries

Andhra Pradesh Industrial Infrastructure Corporation (APIIC) /

Telengana State Industrial Infrastructure Corporation (TSIIC) Head Offices :

Managing Director

Role : Supervise, review, guide and advise overall functioning of IALA and SS

Role : provide directions, guidance to IALA / Service societies for taking new initiatives for industrial development, provide funding for undertaking priority works

APIIC / TSIIC Zonal Offices (ZO) :

Zonal Manager

Role : Administrative Head of each zone, supervise, review, guide and advise overall functioning of IALA/SS, revenue and expenditure, maintain enforcement cell to provide asset protection/encroachment removal assistance to IALA/SS. Tendering for maintenance works (streetlight/sweeping/garbage collection) in IPs. E-procurement and tendering of works.

Nodal officer at each zone

Role : review functioning of IALA during inspection visits to the zone and offer remarks,

- Administrative Head of each zone, supervise, review, guide and advise overall functioning of IALA/SS, revenue and expenditure
- Initiate and facilitate IP impact assessment, and need assessment for CC adaptation.
- Site Selection, Industry Allocation,
- Maintain enforcement cell to provide asset protection/encroachment removal assistance to IALA/SS.

- Tendering for maintenance works (streetlight/sweeping/garbage collection) in IPs. E-procurement and tendering of works.
- Review functioning of IALA during CCA specific inspection visits to the zones.
- Marketing and Publicity to attract industrial investors
- Announce rewards for the individual units who comply with the CC adaptation process.

- Initiate CC adaptive IP development
- Site Selection, layout planning, Infrastructure provision
- Industry Allocation, Execution / Construction, Supervision, Site Management / Maintenance, Infrastructure management / Maintenance, Infrastructural Retrofitting
- Maintenance of all civic services in IALA areas with and make them CC adaptive.
- Approval of building plans, assessment with CCA focus.
- Develop mechanisms for levy and collection of property taxes with due consideration to offering incentives for adaptation of CC measures.
- Create a checklist of CCA measures requirement for the IALA/SS based on the maintenance of records.
- Report and represent the need for IP level CCA need to ZO/HO of APIIC/TSIIC.
- Coordinate with the local level functioning authorities such as municipal corporation / municipality / Gram Panchayat
- Work out the cost / revenue sharing model with the local authorities resulting from CC adaptation.
- Provide fast-track administrative sanction of the CCA works recommended by SS works committee.
- Appoint urban planning agencies for preparation of layout, engineering details, tender documents, and cost estimates.

Industrial Area Local Authority (IALA) :

Commissioner / Executive Officer (for each IALA)

Role :

- Maintenance of all civic services in IALA areas,
- Approval of building plans, assessment, levy and collection of property taxes.
- Maintenance of records for the IALA/SS.
- Reporting to ZO/HO of APIIC/TSIIC
- Function of Municipal Corporation / municipality / Gram Panchayat with revenue sharing
- Administrative sanction of the works recommended by SS works committee,

- Initiate CC adaptive IP development
- Site Selection, layout planning, Infrastructure provision
- Industry Allocation, Execution / Construction, Supervision, Site Management / Maintenance, Infrastructure management / Maintenance, Infrastructural Retrofitting

- Maintenance of all civic services in IALA areas with and make them CC adaptive.
- Approval of building plans, assessment with CCA focus.
- Develop mechanisms for levy and collection of property taxes with due consideration to offering incentives for adaptation of CC measures.
- Create a checklist of CCA measures requirement for the IALA/SS based on the maintenance of records.
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- Provide fast-track administrative sanction of the CCA works recommended by SS works committee.
- Appoint urban planning agencies for preparation of layout, engineering details, tender documents, and cost estimates.

Service society (SS) :

Chairman of Service Society

Role :

Self-governance involving the industrial units located in the IP/IE/SEZ for various management aspects., involve constituent industrial units in different development activities within IALA area to achieve transparency in working processes.

Chairman / Works Committee / Resource Committee / Human Resource Committee

- Motivate and Involve constituent industrial units in each IP for CC adaptation process.
- Identify development works on priority basis, examining the estimates,
- Supervise quality of works undertaken by the contractors, monitoring payment process,
- Formulate annual budget for CCA measures in phases..
- Maintain open spaces and make them suitable for Evacuation zones during disaster.
- Generate awareness among individual industrial unit for appropriate use and maintenance of common facilities, and making the units CC adaptive.
- Make use of enforcement cell for protection of open spaces and prevention of encroachments.
- Monitor unauthorised constructions and deviations from approved CCA plans at IPs.
- Through enforcement cell - protect open land, and leftover plots of APIIC-IALA, stop discharge of hazardous wastes on road, drains and open places, discourage illegal parking of vehicles on the roadside.
- Appoint domain experts for guidance towards execution, supervision, management, maintenance and retrofitting.

Works Committee (WC)

Role :

- Identify development works on priority basis, examining the estimates,

- Supervise quality of works undertaken by the contractors, monitoring payment process,

Resource Committee (RC)

Role :

- Formulation of annual budget for upkeep and maintenance of IALA areas.
- Responsible for maintenance of layout open spaces and CFC area,
- Awareness generation among individual units for appropriate use and maintenance of common facilities.
- Make use of enforcement cell (at ZO) for protection of open spaces and prevention of encroachments.
- Monitor unauthorised constructions and deviations from approved plans at IPs, and recommend to Commissioner/EO for penal actions.

Human Resource Committee (HRC)

Role :

- Through enforcement cell - protect open land, and leftover plots of APIIC-IALA, stop discharge of hazardous wastes on road, drains and open places, discourage illegal parking of vehicles on the roadside.

Environment Sub-committee (ESC)

Role :

- Plan and implement various environment improvement initiatives as a mandate for CCA measures, such as,
  a) Retrofitting of existing buildings as green buildings, and as CC adaptive
  b) Undertaking reuse and recycling activities
  c) Tree plantation in open spaces and within the premises of all Industrial units d) construction of water harvesting structures
  e) Safe disposal of electronic wastes
  f) Energy efficiency programs – in each IU / street lights
  g) Special programs – cycle to work, health, sanitation etc.
- Monitoring day-to-day sanitation work of IALA
- Supervise the function of sanitation agency

Forest / Horticulture Department

- Provide supports by supply of vegetation saplings, cuttings etc. and guidance for vegetation.

Consultant (Urban Planning and Engineering)

- Site Selection, Layout Planning, Industry clustering, space allocation, supervision,
- Impact Assessment, Engineering Design, Supervision, infrastructure Retrofitting
- Landscape Design, Supervision

Infrastructural service provider (PWD, Roads, water supply, drainage, sanitation, telecom, Horticulture)

- Site Selection, Layout Planning, Supervision, Infrastructure management/Maintenance, Infrastructural Retrofitting, Industrial Operation
- Supervision, Landscape Management/Maintenance

Industrial Units (IU) :

Individual Industry Property Owner

- Create corpus, allocate fund for CC adaptation and mitigation measures, facilitate Design development and maintenance of buildings at industrial unit level

Consultants (Architecture, Engineering : Civil, Mechanical, Electrical)

- Building Layout Planning, Landscape design, Engineering Design, Supervision, Infrastructural Retrofitting
- Building Impact Assessment, Engineering Design, Supervision, Building Component Retrofitting

Industrial Facility Manager

- Infrastructure management/Maintenance
- Building management/Maintenance

Construction Agencies

- High quality execution / construction, Supervision, Infrastructural Retrofitting, Building Component Retrofitting

Execution Monitors (Project Managers, Domain Supervisors)

- Supervision and monitoring of high quality execution / Construction, Building Component Retrofitting

Federation of Indian Chambers of Commerce & Industry (FICCI)

- Awareness generation among Industrial units and the community
- Quality inspection
- Activities under Corporate Social Responsibilities (CSR)

Annex. IX Planning and Analytical Tool

Flood:

- **Flood Frequency analysis:** flood frequency analysis is carried out with recorded flow data.
- **Flood flow model** : through the floodplain
- **IFAS (Integrated Flood Analysis System) :** a toolkit for more effective and efficient flood forecasting providing interface with satellite as well as ground based rainfall data, and GIS functions.
- **PeakFQ ver 7.1** software : Flood Frequency analysis software (USGS – US Geological Survey)

- **FLO-2D** software : a comprehensive, fast, user friendly, hydraulic and hydrologic model for flood routing, developed with FEMA support.
    - FLO-2D simulates the complexity of urban flooding through an array of diverse components including integrated surface water and storm drain system modelling.
- **XP2D :** 2-dimensional overland flow module for xpswmm and xpstorm, offers the power to analyse and predict potential flood extents, depth and velocity and accurately model the interaction of surface and underground systems in an integrated 1D/2D modelling environment.
    - The software has the potential for effective use to simulate and analyse tidal surges, dam breaks and breaches on sewer networks.
- **XPSWMM :** predict potential flood extents, depth and velocity and accurately models the interaction of surface and underground systems in an integrated 1D/2D modelling environment. The software can also be effectively used to simulate and analyse tidal surges, dam breaks and breaches on sewer networks.
- **Runoff model** : to convert rainfall to runoff through runoff analysis,
- **Propagation model :** of the runoff hydrograph by calculating river flood propagation,
- **Flood flow model** : to ascertain the flood flow through the floodplain.
- **Drainage model** : to ascertain the of the inland water flow pattern.

Coastal inundation / Storm surge :

- **Inundation phenomenon model** : from rivers to floodplain
- **SLOSH** and P-Surge computational models for storm surge from tropical systems,
- **ETSS** and **ESTOFS** models for extratropical systems, **WAVEWATCH III®** for modelling waves. The models facilitate simulation of many different storms in order to understand the risks involved and forecast storm surge.
- **XPstorm :** xpstorm is a versatile software package for dynamic modelling of urban storm water systems, river systems and floodplains including ponds, rivers, lakes and interaction with groundwater. This combined 1D (for upstream to downstream flow) and 2D (for flow over land) software is widely used by private consultants and public agencies responsible for storm water and flooding regulation.
- **Dvorak technique :** to calculate the intensity of the cyclone including depression and tropical storm
- **Hazard mapping techniques :** to identify the locations most susceptible to the impact
- **Tropical cyclone wind field analyses** : for accurate simulation of wind field, which is a key component in understanding and predicting the damage associated with land falling storms
- **Inundation phenomenon model** from rivers to floodplain.
- **Water Level Stations** : for information on real-time and event-driven data and measures of still water
- **High Water Marks :** The lines left by the previous storm surge or tide on trees and structures marking the highest elevation of the water surface from a flood event.
- **GPS methods** : used to determine the location of these marks and then mapping relative to a vertical reference point

- **Pressure water level Sensors :** which provide real-time information regarding the duration of a storm surge, the time of its arrival and retreat and the maximum depth of the surges. The sensors help to provide large quantity of customised data at a rapid speed.

High Wind:

- **Tropical cyclone wind field analyses :** This analysis does an accurate simulation of wind field, which is a key component in understanding and predicting the damage associated with land falling storms
- **Autodesk®CFD** computational fluid dynamics software provides flexible fluid flow and thermal simulation tools, compares design alternatives, and offers better understanding of implications of design choices before construction or during post-construction vulnerability analysis.
- **Dvorak technique** to calculate the intensity of the cyclone including depression and tropical storm
- **ArcGIS** Pro10 for hazard mapping techniques to identify the locations most susceptible to the impact

Soil Erosion Models

Slope stability Models

- **LISA** : Stability Analysis
- **DLISA** : Deterministic stability analysis

Soil Erosion Models

- **FS WEPP** :
- **SWAT** : Soil – Water Assessment Tools
- **SWAT-MODFLOW** : is an integrated hydrological model that couples SWAT land surface processes with spatially-explicit groundwater flow processes.
- **SLEEP** : Soil-Landscape estimation and evaluation program for ArcGIS 10.1
- **ArcSWAT** : is an ArcGIS-ArcView extension and graphical user input interface for SWAT.
- Runoff model where rainfall is converted to runoff through runoff analysis,
- **USG Model:** Hourly rainfall, stream flow and sediment concentration data would be collected to estimate the suspended sediment concentration in a region.
- **MUSLE Parameters Analysis :** Integrated Land and Water Information System in GIS could be used to estimate MUSLE (modified universal soil loss equation) parameters and average soil loss

- **WEPP Model:** This application analyses the characteristics of climate, cropping/management, soil, slope and channel including type of soil, hydraulic conductivity, soil albedo, initial saturation, number of soil layers, thickness, bulk density, sand, clay, and organic matter percentage, etc.

Lightening and Fire:

- SmartDraw : is an emergency and disaster planning tool creating exit or evacuation plan from Site / Buildings
- FEKO : capable of simulating lightning strikes to help designers analyse the current and field effects of lightning strikes
- Earthing Tool : for calculation of the length of earth electrodes
- Air-Termination Tool : for calculation of the length of air-termination rods
- Predictive Maintenance (PdM) Tools : electrical maintenance diagnosis
- Electrical Safety Self-assessment tool prepared by ESFI (electrical safety foundation international)

Emergency Planning:

- **EAP** (Emergency Action Plan) of **OSHA**'s Expert System (Occupational Safety & Health Administration of US Department of Labour.
- **SmartDraw** software is a emergency and disaster planning tool for evacuation plan
- **ConceptDraw PRO** : Natural disasters, fires, hazardous leaks and other disaster events are reasons for companies to have a safe evacuation that needs the designing of an emergency plan. First of all, in drawing an emergency plan is to put an evacuation manager that will develop an emergency evacuation procedure.

Site Selection & Analysis:

- **ArcGIS Pro 1.0** for land-use and land-cover analyses, database management
- **Surfer 13** (Contouring, Gridding, and 3D Surface Mapping Software site analysis, engineering)
- Land suitability Analysis

Site Planning & Layout:

- BIM (Building Information Modelling) through software, e.g. Autodesk Revit
- Pareto analysis : site analysis

Location Analysis:

- Multi-criteria analysis: AHP (analytical hierarchical process), ANP (analytical network process), TOPSIS, Concordance – Discordance Analysis for comparing between alternative site locations.

Building Planning / Layout:

- BIM (Building Information Modelling) through software, e.g. Autodesk Revit

Building Defects

- Geomorph v0.22 : an enhanced "fault pen" which can separate the fault in two walls for creating cracks and fissures

Construction Process:

Materials / Specification:

- BIM (Building Information Modelling) through software, e.g. Autodesk Revit
- Infrared Thermography, Infrared Imagers : for building components – walls, roofs
- Non-destructive tests
- Ultrasonic tests

- Splitting failure capacity tests

Landscaping:

- **DTM** (Digital Terrain Modelling) : Site levelling, cut-fill optimisation,

Annex-X. Climate Risk Assessment Matrix

Table 32: Climate Risk assessment Matrix

Climate Risk Assessment situation	LEVEL OF IMPACT OF HIGH WIND						
	Depression	**Deep Depression**	**Cyclonic Storm**	**Severe Cyclonic Storm**	**Very Severe Cyclonic Storm**	**Extremely Severe Cyclonic Storm**	**Super Cyclonic Storm**
	1kmph o 9kmph	**50Kmph to 61kmph**	**62kmph to 88kmph**	**89kmph to 117kmph**	**118kmph to 166kmph**	**180kmph to 200kmph**	**>222kmph**
Duration	Low	Low	Low to Moderate	Moderate	High	High	High
	No disruption to normal activities	Disruption to normal activities for few to several weeks	Disruption to normal activities for several weeks	Disruption to normal activities for several months	Disruption to normal activities for a year or more	Disruption to normal activities for more than a year	Disruption to normal activities for more than a year
Extent of damage	Nil	Minimal	Minimal	Medium	Significant	Significant	Substantial
	Area of influence of effect is localised at Industrial park level and limited to the footprint of the effect and its immediate vicinity	Area of influence of effect is localised at Industrial park level and limited to the footprint of the effect and its immediate vicinity	Area of influence of effect is regional and extending to a large portion of the geographical area	Area of influence of effect is regional and extending to a large portion of the geographical area	Area of influence of effect is extensive, beyond the region and extending over a large portion of the geographical area	Area of influence of effect is extensive, beyond the region and extend tend-	Area of influence of effect is extensive, beyond the region and extending over a large portion of the geographical area

						ing over a large portion of the geo-graph-ical area	
Magnitude	Very Low	Low	Low	Medium	High	High	Extreme
	Negligi-ble im-pact	Can cause some amount of local-ised impact at industrial park level	Can cause some amount of local-ised impact at industrial park level	Can cause impact at the regional level	Can cause impact at the re-gional level	Can cause impact at the re-gional level	Can cause impact be-yond the regional level
Structural damage	No dam-age	Negligi-ble	Repaira-ble	Repair-able	Significant	Signif-icant	Substantial
	safe to occupy	safe to occupy	safe to occupy	re-occu-pancy after some days	re-occupancy can be expected	re-occu-pancy can be ex-pected	re-occupancy cannot be expected
Non-Structural damage	No dam-age	No dam-age	No dam-age	Mini-mum	Significant	Signif-icant	Extreme
	Facilities fully opera-tional	Facilities fully opera-tional	Facilities fully opera-tional	Facili-ties fully opera-tional	facilities inoperable, except emergency systems	facili-ties inop-erable	Facilities non-functional
Reversibility	Nil	Low	Low	Medium	Significant	Signif-icant	Substantial
	No im-pact	Impacts would decrease within one year. No resto-ration work needed	Impacts would decrease within one year. No resto-ration work needed	Impacts would de-crease within two years. Some amount of resto-ration work needed	Impacts would be irreversible or would decrease after multi-ple years. Large amount of restoration work needed	Im-pacts would be irre-versi-ble or would de-crease after multi-ple years. Large amoun t of resto-ration work need-ed	Impacts would be irreversible Extensive amount of restoration work needed

Communi-cations	Nil	Nil	Low	Low	Mild	Mod-erate	High
	No disor-der of ICT and commu-nications	No disor-der of ICT and commu-nications	No dis-order of ICT and commu-nications	Short span or no dis-order of ICT and com-munica-tions	Short span or no disorder of ICT and communi-cations	Short span disor-der of ICT and com-muni-cati-ons	Complete disorder of ICT and communica-tions

Climate Risk Assessment situation	**LEVEL OF IMPACT OF LIGHTNING ACTIVITY (IMPACT WOULD BE SAME FOR ALL THE SITUATIONS)**					
	No thunder-storms	**Isolated thunder-storms**	**Scattered thunder-storm**	**Scattered thunder-storm**	**Numerous thunder-storms**	**Cloudy with No rain**
	No lightning	**Very Frequent lightning**	**Frequent lightning**	**Frequent lightning**	**Frequent and in-tense lightning**	**Dry light-ning**
Duration	0 cloud to ground strikes/five minutes	1-5 cloud to ground strikes/fiv e minutes	6-10 cloud to ground strikes/fiv e minutes	11-15 cloud to ground strikes/fiv e minutes	> 15 cloud to ground strikes/five minutes	11-15 cloud to ground strikes/five minutes
Extent of damage	NA	Signifi-cant	Signifi-cant	Signifi-cant	Significant	Significant
	-	Area of influence of effect is localised and lim-ited to the footprint of the effect and its imme-diate vi-cinity	Area of influence of effect is localised and lim-ited to the footprint of the effect and its imme-diate vi-cinity	Area of influence of effect is localised and lim-ited to the footprint of the effect and its imme-diate vi-cinity	Area of influence of effect is localised and limited to the foot-print of the effect and its immedi-ate vicinity	Have the potential for starting fires Area of influ-ence of effect is localised and limited to the footprint of the effect and its im-mediate vi-cinity
Magnitude	NA	High	High	High	High	High
	-	Can cause high amount of localised impact	Can cause high amount of localised impact	Can cause high amount of localised impact	Can cause high amount of localised impact	Can cause high amount of localised impact

Structural damage	No damage	Repairable	Repairable	Repairable	Repairable	Repairable
	safe to occupy	re-occupancy after some time	re-occupancy after some time	re-occupancy after some time	re-occupancy after some time	re-occupancy after some time
Non-Structural damage	No damage	Significant	Significant	Significant	Significant	Significant
	Facilities fully operational	facilities inoperable,	facilities inoperable,	facilities inoperable,	facilities inoperable,	facilities inoperable,
Reversibility	Nil	Severe	Severe	Severe	Severe	Severe
	No restoration work needed	Irreversible Need replacement	Irreversible Need replacement	Irreversible Need replacement	Irreversible Need replacement	Irreversible Need replacement
Communications	Nil	High	High	High	High	High
	No disorder of ICT and communications	Facility needs replacements	Facility needs replacements	Facility needs replacements	Facility needs replacements	Facility needs replacements

Climate Risk Assessment situation	LEVEL OF IMPACT OF STORM SURGE AND COASTAL INUNDATION		
	Normal High Tide	**Storm Surge**	**Storm Tide**
	2 feet	**15 feet**	**17 feet**
Duration	Low	Moderate	High
	No disruption to normal activities	Disruption to normal activities for few to several weeks	Disruption to normal activities for several months
Extent of damage	Minimal	Medium	Significant
	Area of influence of effect is localised at Industrial park level and limited to the footprint of the effect and its immediate vicinity	Area of influence of effect is regional and extending to a large portion of the geographical area	Area of influence of effect is extensive, beyond the region and extending over a large portion of the geographical area
Magnitude	Low	Medium	High
	Negligible impact	Can cause some amount of localised impact	Can cause impact at the regional level
Structural damage	No damage	Repairable	Significant
	safe to occupy	re-occupancy after some days	re-occupancy can be expected
Non-Structural damage	No damage	Minimum	Significant
	Facilities fully operational	Facilities fully operational	facilities inoperable, except emergency systems
Reversibility	Low	Medium	Significant
	Impacts would decrease within one year. No restoration work needed	Impacts would decrease within two years. Some amount of restoration work needed	Impacts would be irreversible or would decrease after multiple years. Large amount of restoration work needed
Communications	Nil	Low	Moderate
	No disorder of ICT and communications	Short span or no disorder of ICT and communications	Short span disorder of ICT and communications

Climate Risk Assessment Situation	LEVEL OF IMPACT OF SOIL EROSION		
	Low / Mild	**Moderate**	**High**
	Top soil Greater than 7 inches	**Top soil 3 to 7 inches**	**Top soil less than 3 inches**
Duration	Negligible	Low	Moderate
	No disruption to normal activities	Disruption to normal activities for few weeks	Disruption to normal activities for several months
Extent of damage	No or Slight Erosion	Moderately Eroded	Severely Eroded
	Area of influence of effect is localised at Industrial park level	Area of influence of effect is regional and limited to a small portion of the geographical area	Area of influence of effect is regional and extending to a large portion of the geographical area
Magnitude	Low	Low	Medium
	Can cause some amount of localised impact at industrial park level	Can cause some amount of localised impact at industrial park level	Can cause localised impact t industrial park level but at a broader level
Structural damage	No damage	No damage	Repairable damage
	safe to occupy	safe to occupy	re-occupancy after some days
Non-Structural damage	No damage	Minimum repairable damage	Minimum repairable damage
	Facilities fully operational	Facilities fully operational	Facilities fully operational
Reversibility	Low	Low	Medium
	Impacts would decrease within few months. No restoration work needed	Impacts would decrease within one year. No restoration work needed	Impacts would decrease within two years. Some amount of restoration work needed
Communications	Nil	Low	Mild
	No disorder of ICT and communications	No disorder of ICT and communications	Short span or no disorder of ICT and communications

Annex-XI. Quantitative assessment of Climate Change Impacts in Industrial Aras

Name of the Industry		**No. of Employees**	
Line of Activity		**Address**	
Year of Establishment		**Year of Commence-ment**	
Name		**Contact Details**	

Table 33: Quantitative assessment of Climate Change impact in IPs

	Type of Disaster / Impacts	**Unit**	**Flood**	**Heat Wave**	**Drought**	**Cy-clone**	**Any oth-er**
A	**INDUSTRY**						
1	What was impact on industry						
2	How many days Industry was closed	Days					
3	How many days it took to industry to back to normal	Days					
4	Damage to on-site Electricity lines and generator	In meters					
		Cost in Rs.					
5	Damage to Water Pipeline	In meters					
		Cost in Rs.					
6	Damage to Buildings like doors, windows, roof, walls, etc.	Cost in Rs					
7	Plantation	Numbers					
		Whether is it ade-quate					
8	Recovery Cost	Cost					
9	Claims / Insurance compensa-tions	Cost					
B	**PRODUCTION**						
1	Losses in Production due to Pow-er failure	Cost in Rs.					
2	Losses in Production due to Wa-ter Shortage	Cost in Rs.					
3	Excess cost incurred due to Gen-erator during power failure	Cost in Rs.					
4	Damage to Machinery	Cost in Rs.					
5	Cost of Repair	Cost in Rs.					
6	Cost of Replacement	Cost in Rs.					

7	Damage to Raw materials / finished products / materials	Cost in Rs					
6	Claims / Insurance (if any)	Cost in Rs.					
C	**TRANSPORT / VALUE CHAIN**						
1	Delay / Loss in Raw Material	No. of Days					
		Cost in Rs.					
2	Loss of Production due to delay in transport	No. of Days					
		Cost in Rs.					
3	Delay / Loss of Finished Products	No. of Days					
		Cost in Rs.					
4	Claims/ Insurance (if any)	Rs.					
D	**PEOPLE**						
1	No. of Causalities						
2	Injury / health related problems persons	Numbers					
		Cost in Rs.					
3	No. of Absentee	numbers					
4	Changes in Working hours	Hours					
5	Claims/ Insurance (if any)	Rs.					

INDUSTRIAL PARK							
	Type of Disaster / Impacts	Unit	Flood	Heat Wave	Drought	Cyclone	Any other
A	**INDUSTRIAL PARK**						
1	What was impact on industrial park						
2	Total area of Industrial Park Affected	Days					
3	How many days it took to industrial park to back to normal	Days					
4	Damage to Electricity lines	In meters					
		Cost in Rs.					
5	Damage to Water Pipeline	In meters					
		Cost in Rs.					
6	Damage to Road Infrastructure	In meters					
		Cost in Rs					

7	Damage to Plantation	Numbers					
		Whether is it adequate					
8	Damage to Storm Water Drains	In Meters					
		Cost in Rs.					
8	Any other common infra-structure damage	Nos. /					
		Cost in Rs.					
8	Recovery Cost	Cost					
9	Claims / Insurance/ from Govt.	Cost					
1	Number of Industry Shut down	Cost in Rs.					
2	Cost of Repair	Cost in Rs.					
5a	Water						
5b	Electricity						
5c	Road						
5d	Buildings						
5e	Storm Water						
5f	Any other Infrastructure						

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