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Preamble

Industrial development is one of the important drivers of economic growth worldwide. However, if not properly planned, the industrial areas have potential to pose tremendous risks on natural resources, environment and the people. The key issues of concern can be social conflicts due to the sites chosen for industrial development, environmental conflicts and negative impacts due to pollution and resources consumption (energy, water, materials), impacts on biodiversity (loss of ecosystem services, loss of species, changes in biodiversity etc.), and issues of climate change. Basically, such issues areas due to lacunae in the planning processes. An industrial area that does not have a proper site master plan is likely to face serious problems due to lack of provisions for environmental and other related infrastructure. Such problems include traffic congestions and accidental risks due to lack of parking provisions for the hundreds of trucks entering the industrial areas, lack of land provisions for waste and wastewater management, lack of buffer zones with surrounding areas and lack of social infrastructure for workers.

A well planned and organised industrial area, defined by set of quality parameters such as economic efficiency, environmental quality and social quality, could be an answer to sustainability. Also, such an area could support sustainability of individual industries housed in them with high performance workplaces so as to enable industries strive for efficiencies and profitability, reduced environmental litigation risks and improved market image as well as public image.

The present document, summarizes the collective knowledge and experiences, including methods, tools, case studies etc. It intends to guide an industrial area as a whole to become more sustainable and are less dealing with the individual companies. The guidelines in the document are directed to industrial park operators, planners of industrial areas, public administrators in charge of regulating industrial areas and experts advising on industrial development. The guidelines provide a first overview of what sustainability in an industrial area is all about.

The guidelines are divided into broad sections dealing with introduction, standards, site selection processes, site master planning, Infrastructure provision guidelines and documentation guidelines. The section on standards has the benchmarks and rating systems internationally followed for ‘Green Industrial Parks’. The section on site selection process highlights the siting criteria, site suitability assessment and ways to retrofit the existing industrial areas. The site planning guidelines discuss how development can be integrated with the existing context, how it can contribute to the visual image of the area, and how it can address functional requirements such as safe and efficient circulation. Infrastructure provision guidelines are meant to serve as a ready reckoner for all the basic, technical, environment and social infrastructure provisions in the green Industrial parks. The last section on documentation has the essential details of components of site master plan report and map preparation.
Chapter 1: Sustainable Industrial Parks - concept and benefits

India has several existing industrial parks housing thousands of industries and new projects in pipeline as well. Both the existing industrial parks as well as the new industrial parks and investment zones have great potential for technological progress that can result in an increased overall competitiveness of the residing businesses, lower emissions, environment-friendly innovations, resource & energy efficiency and an overall healthier working environment.

To make them sustainable, the industrial areas need to be planned with cost effective infrastructure to support the industries housed in the industrial parks as well as to deal with negative environmental impacts, and issues of climate change and resource efficiency (energy, materials, and water). The existing ones can also be improved so that the existing industries can perform better and fresh investments could be attracted without impacting the environment.

The benefits of site master planning of industrial areas are multiple. Some of them are highlighted below:

Fig. 1.1: Benefits of Sustainable Industrial Areas

Potential Benefits of sustainable industrial parks companies are as follows:

- Membership in a sustainable/green industrial park adds an authentic green image in the marketplace.
- Potential collaboration among some companies in marketing, training, or research and development
- Reduction in resource investment on environment related legislations and plot development
- Shared costs towards solid and liquid waste-management.
- Shared training in new regulations and technologies.
- Shared security and emergency management services.
- Sales of material and by-products increase revenues and reduce disposal costs.
- Business incubators for support in venture financing, marketing, accounting, networking etc.

The key aspects that are covered under site master planning of industrial areas are:

- Site Selection
- Spatial Planning
- Basic infrastructure
- Social infrastructure
- Technical infrastructure
- Environmental infrastructure

Above have been detailed in the subsequent sections.
Chapter 2: Site Selection

2.1 Steps involved

The steps involved in the identification of a suitable site for an industrial area are:

a) Pre-project survey: A search area should be identified where suitable sites for developing Industrial estates for targeted industries might be found. As per the Draft Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines 2014, the delineation of an investment region should follow the steps given below:

- Identification of infrastructure gaps and planning for providing last mile connectivity either at regional or sub regional level as the case may be.
- Identification of main thrust sectors for investment.
- Identification of growth drivers and potential growth centres.
- Market assessment: primary, secondary and tertiary.
- Pre-feasibility of the proposals

b) Detailing environmental sensitivity of the search area and its surroundings.

c) Avoiding areas within the search area which have environmental sensitivity.

d) Identifying potential sites (so called “candidate sites”) for industrial estates based on extent of land required infrastructure available, social considerations etc.

e) Rapid assessment of the sites or their suitability based on social, economic and environmental considerations, and shortlisting of a most suitable site meeting with the targeted industrial development, while not posing any adverse environmental or social impacts. Refer to the “Technical Guidance Manual for Industrial Estates” at its Annexure V.

f) The shortlisted site is required to undergo environmental impact assessment (EIA) in accordance with the provisions of the Environmental (Protection) Act, 1986 and rules made thereunder. The Environmental impact assessment (EIA) is suggested even if the sites are smaller and do not attract provision of the Environmental (Protection) Act, 1986 and rules made thereunder.

For the purpose of undertaking EIA, a Site Master Plan would be required. Before arriving at a final Site Master Plan, alternative “Conceptual Plans” should be first prepared in the required scale, taking into consideration activity structure, estimation of land requirement for different uses and social/economic/environmental land suitability analysis. The Conceptual Plans should be evaluated for selection of the best among alternatives so as to prepare the Site Master Plan accordingly.

Based on the Environmental Impact Assessment and Environmental Clearance obtained from the regulatory authorities, the site should undergo further clearances for land use conversion etc. from the local authorities concerned.

g) Land acquired shall be sufficiently large to provide space for appropriate treatment of waste water still left for treatment after maximum possible reuse and recycling. Reclaimed (treated) wastewater shall be used to raise green belt and to create water bodies for aesthetics, recreation and, if possible, for aquaculture. The green belt shall be of appropriate width around the industrial park.

All the sites for the industrial parks will require Environmental Impact Assessment studies and prior environmental clearance as per the EIA Notification dated 14th September, 2006 [issued by the

1 http://envfor.nic.in/sites/default/files/TGM_Industrial%20Estates_010910_NK.pdf
2 Draft Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines 2014, Ministry of Urban Development, GoI
Government of India under the Environment (Protection) Rules, 1986 of the Environment (Protection) Act, 1986. The Government of India or the State Government, as the case may be, may support in pursuing the State Government or its agencies to prepare land use plans for up to 10 km around the Green Industrial Parks and to regulate land uses so as to avoid land use conflicts and negative impacts due to pollution, resource consumption etc.

2.2 Areas to be avoided

Care should be taken to minimise any adverse impact from the industries on the immediate surroundings as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to industrial impacts because of the nature and extent of fragility. With a view to protecting such areas, industrial sites shall maintain the following distances from the areas listed:

a) Restrictions on siting in ecologically and/or otherwise sensitive areas:

» The industrial site should be at least 25 km from ecologically sensitive areas. Depending on the geo-climatic conditions, the requisite distance shall be increased by the appropriate agency.

» Ecological and/or otherwise sensitive areas include: (i) Religious and Historic Places; (ii) Archaeological Monuments (e.g. identified zone around Taj Mahal); (iii) Scenic Areas; (iv) Hill Resorts; (v) Beach Resorts; (vi) Health Resorts; (vii) Coastal Areas rich in Coral, Mangroves, Breeding Grounds of Specific Species; (viii) Estuaries rich in Mangroves, Breeding Ground of Specific Species; (ix) Gulf Areas; (x) Biosphere Reserves; (xi) National Parks and Sanctuaries; (xii) Natural Lakes, Swamps; (xiii) Seismic Zones; (xiv) Tribal Settlements; (xv) Areas of Scientific and Geological interest; (xvi) Defence Installations, especially those of security importance and sensitive to pollution; (xvii) Border Areas (International) and (xviii) Airports.

» In coastal areas, the industrial site should be at least 1/2 km from the High Tide Line (HTL).

» In flood plains of the riverine systems, the industrial site should be at least 1/2 km from flood plain or modified flood plain affected by dam.

» The industrial site should be at least 1/2 km from highways and railways.

» Restrictions on siting near major settlements: At the time of siting of the industrial park or investment zone, if any major settlement’s (3, 00,000 population) notified limit is within 50 km, the spatial direction of growth of the settlement for at least a decade must be assessed and the industry shall be sited at least 25 km from the projected growth boundary of the settlement.

» Restrictions on forest land: No forest land shall be converted into non-forest activity for the sustenance of the industry (Ref: Forest Conservation Act, 1980).

» Restrictions on prime agricultural land: No prime agricultural land shall be converted into industrial site. Such lands may include:

» Areas characterised by extensive agriculture land use (includes horticulture, poultry farming, raising of crops/fruit/vegetables/ flowers/grass or trees of any kind, breeding of livestock including cattle/horses/donkeys/mules/pigs/breeding of fish/keeping of bees, the use of land for grazing cattle and for any purpose which is ancillary to its cultivation or other agricultural purpose;

» High productivity soils, agriculture/cultivable lands, including soils classifications of Class I, II III and IV;

» High agriculture production areas;

» Command areas of irrigation projects; and

Major share of population (at least 80%) of the area is dependent on agriculture as the major source of livelihood.

b) Restrictions on siting adjacent to railway property:

Right of Way (RoW) of the railways is a no development Zone in itself. The distance between the Railway Property Boundary and the edge of the building shall be 30 m as per the Indian Railways Works Manual or as per No Objection Certificate (NOC) given by the Railway Authorities.

c) Restrictions on siting near Airport areas:

As per the Airport Authority of India (AAI), the heights of the buildings are regulated and hence a no objection certificate (NOC) is required from AAI for any construction activity in 20 km radius of Airports.

Activities such as butcheries, sewage handling and garbage storage are not allowed around airports. For building activity within the Restricted Zone/Air Funnel Zone near the airport, necessary clearance from the concerned Airport Authority shall be obtained. The building heights and other parameters shall be regulated as per the stipulations of the Airport Authority of India as notified in Gazette of India Extraordinary (S.O.1589), dated 30-06-2008 and as amended from time to time by the Ministry of Civil Aviation, Government of India.

Irrespective of their distance from the aerodrome, even beyond 22 km limit from the Aerodrome Reference Point, no radio masts or similar installation exceeding 152 m in height shall be erected except with the prior clearance from the Civil Aviation Authorities.

In respect of any land located within 1,000 m from the boundary of Military Airport, no building is allowed except with prior clearance from the concerned airport authority with regard to permissible building height.

No chimneys or smoke producing factories shall be constructed within a radius of 8 km from the Airport Reference Point.

Slaughter house, butcheries, meat shops and solid waste disposal sites and other areas for activities like depositing of garbage which may encourage collection of high flying birds, like eagles and hawks, shall not be permitted within 10 km from the Airport Reference Point.

Within a 5 km radius of the Aerodrome Reference Point, every structure/installation/building shall be designed so as to meet the pigeon/bird proofing requirement of the Civil Aviation Authorities. Such requirement may stipulate the prohibition of any cavity, niche, or other opening on the exterior of such building/installation/structure so as to prevent the nesting and habitation of pigeon or other birds.

d) Restrictions on sites adjacent to defence establishments:

In the case of Sites within 500 m distance from the boundary of Defence Areas / Military Establishments prior clearance of Defence Authority shall be obtained. In case of Naval Science and Technological Laboratory (NSTL), Visakhapatnam, no building shall be allowed with in a distance of 20 m from the boundary wall of NSTL, Visakhapatnam.

e) Restrictions on sites adjacent to oil/gas pipelines:

In the case of sites in the vicinity of oil/gas pipelines, clearance distance and other stipulations of the Respective Authority shall be complied with. The Oil/Gas Authorities shall also specify the clearances required to Local Body.

f) Restrictions for petrochemical and gas industries:

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4 Andhra Pradesh Building Rules, 2012 issued by the Government of Andhra Pradesh
5 Model Building Byelaws, TCPO
No gas pipeline should be located within 15 meters of any private dwelling or any industrial building or place of public assembly in which persons work, congregate or assemble, unless it is provided with at least 300 mm of cover over and minimum cover as specified by the Petroleum and Natural Gas Regulatory Board Notification, 2009.

No gas or oil well shall be drilled within a minimum distance (to be prescribed by the Central Government) of any railway, pipeline or other right of way, surveyed road, dwellings, industrial plant, air-craft runway, buildings used for military or public purposes, or within three kilometres of any mine, whether active or abandoned, unless the special permission of the Central Government is obtained in advance. About a 90 m x 90 m buffer is to be maintained along the active oil wells, petroleum storage tanks, encompassing all the safety norms for precautions against fire.

g) Restrictions in natural hazard zones:

Areas prone to natural disasters include areas with high-risks of floods, tsunami, earthquakes, etc. There are siting restrictions in natural hazard zones such as river flood plains and water bodies, including wetlands, to restrict the damage caused by floods. The flood plain can be identified based on last 50 or 100 year flooded area of water bodies or river. There can be different considerations for regulations. For example, the area likely to be affected by floods up to a 10-year frequency should be kept reserved only for gardens, parks, playgrounds, etc. Residential or public buildings, or any commercial buildings, industries, and public utilities should be prohibited in this zone.

h) Restrictions in Eco Sensitive Zones:

As per the National Wildlife Action Plan (NWAP) 2002-2016, “All identified areas around protected areas and wildlife corridors are to be declared as ecologically fragile under the Environment (Protection) Act, 1986”. As a general principle, the width of the eco-sensitive zone could go up to 10 km around a protected area as provided in the Wildlife Conservation Strategy, 2002. In case where sensitive corridors, connectivity and ecologically important patches are even beyond 10 km width, these should be included in the Eco-sensitive zones. Further, even in the context of a particular protected area, the distribution of an area of Eco-sensitive Zone and the extent of regulation may not be uniform all around and it could be of variable width and extent.

No Special Economic Zones may be planned in the sensitive areas such as the forests, mangroves, coral reefs, archeologically important sites, sensitive ecosystems, etc. A buffer zone of 1,000 m shall be maintained from such sensitive areas and a greenbelt with tree density of 1,000 trees per acre shall be developed in the said buffer zone.

Further, all such areas that have ecological sensitivity should be avoided for siting of industrial parks. These include environmentally sensitive/fragile areas such as reserved/protected forests, biosphere reserves, national parks, wild life sanctuaries and coastal regulation zones etc. that are protected by various environments and forest Acts. These areas may also include natural resource areas, both renewable and non-renewable, including water bodies (rivers, creeks, lakes etc.), forests, fisheries and marine resources, areas with potential for renewable energy generation etc. These areas may further include areas that provide ecosystem services such as:

- production of food, water, pharmaceuticals, industrial products, wind/wave/hydro-power, biomass;
- support purification of water/air, nutrient cycles, crop pollination, seed dispersal and disease control;
- spiritual and recreational benefits (e.g., ecotourism);
- carbon sequestration, climate regulation, waste decomposition and detoxification; and
- areas with genetic and species diversity that need to be preserved for future generations.

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6 Ancient Monuments and Archaeological Sites and Remains Act, 2010 (AMASR)
7 National Disaster Management Guidelines Management of Floods, NDMA
8 Guidelines for Declaration of Eco-Sensitive Zones around national parks and wild life sanctuaries, MoEF&CC, 2011
9 SEZ Guidelines, Industries Commissionerate, Government of Gujarat
i) Restrictions on siting near religious places\(^{10}\):
In the case of sites located within a radius of 100 m from the notified religious structure, the construction is only allowed up to 10 m height only. For the Sites located within a radius of above 100 m and up to 300 m from the notified religious structures, only non-high rise structures are allowed.

j) Restrictions on siting adjacent to heritage structures\(^{11}\)
In the case of sites located within a distance up to 100 m from protected monuments as notified under Archaeological Monuments and Ancient Sites and Remains Act 1955 and as amended, no construction is allowed.

Every area, beginning from the limit of the protected area/monument\(^{12}\) and extending to a distance of 100 meters in all directions shall be the protected areas and extending up to a distance of 200 meters in all directions shall be regulated area. The protected zone is a no construction zone.

For sites located within distance of above 100 m and up to 200 m from the protected monuments, construction is allowed only after obtaining prior permission from the National Monuments Authority.

Industrial sites should be avoided in tourism areas and heritage areas, which include, amongst others, areas with a high share of attractive landscapes and scenic beauty, historic areas, places of religious importance, areas with monuments (both protected and un-protected) of national/state/local level importance, areas declared as world heritage sites etc.

k) Restrictions on sites protected by legal provisions:

No industrial park should be located in areas which are restricted by legal provisions, including forest lands, national parks etc. In exercise of the powers under the Environment (Protection) Act, 1986 [Ref. Section (3)(2)(v)], the Central Government, in consultation with the state governments (for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution), should identify all such areas in each District/State in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or carried out subject to certain safeguards.

Added to the list of such areas as identified under the Environment (Protection) Act, 1986, the other areas that fall under various other criteria as listed above should also be identified and notified. This will help avoid accepting unsuitable areas for the siting of industrial parks and investment zones.

2.3 Inclusive parameters for site selection

a) Waste lands:

The wastelands could be preferred for developing industrial parks, infrastructure etc. The wasteland\(^{13}\) categories include gullied/ ravenous land, scrub forest (underutilized notified forest land), scrubland (land with or without scrub), waterlogged and marshy land, land affected by salinity/alkalinity, shifting cultivation, sands (coastal/desert /riverine) and mining/industrial wastelands.

b) Designated industrial areas:

The designated industrial areas in urban area master plans, regional plans and district plans should be preferred. However the restrictions on siting near major settlements (25 km from the projected growth boundary of the settlement of 300,000 population and above) should be followed.

\(^{10}\) Andhra Pradesh Building Rules, 2012 issued by the Government of Andhra Pradesh

\(^{11}\) Ancient Monuments and Archaeological Sites and Remains Act, 2010 (AMASR)

\(^{12}\) Ancient Monuments and Archaeological Sites and Remains Act, 2010 (AMASR)

\(^{13}\) Wastelands Atlas of India, 2010, Department of Land Resources, Ministry of Rural Development,GoI, New Delhi
» Proximity to railway stations / state highways to facilitate transport of raw material to, and finished material from the Project.

» Availability of water supply and adequate source of power supply and telecommunication facilities.

» Availability of residential area for the workers in the project in proximity so that they should not be made to travel for more than 8-10 kilometres.

» Flat land (<21% slope).

» Potential zones for industrial siting as per ‘Zoning Atlas for Siting of Industries: based on environmental considerations’ of the Central Pollution Control Board, prepared District-wise in 1:250,000 scale for several districts in the country. These Atlases show ecologically sensitive areas and other unsuitable areas for siting of industries and industrial estates. Also, the Atlases show alternate sites/zones that may be considered for identifying alternate sites for industries or industrial estates.

c) Environmental clearances for siting of industrial parks

As per the provisions laid out under the EIA Notification S.O.1533, Dt.14.9.2006 and its amendment dated 01.12.2009 and Notifications issued from time to time by the Ministry of Environment & Forests, GOI under the Environmental (Protection) Rules 1986 of the Environment (Protection) Act, 1986, industrial estates/parks/complexes/areas, export processing zones (EPZs), special economic zones (SEZs), biotech parks, leather complexes, based on the set threshold limit, will require to undertake Environmental Impact Assessment (EIA) and obtain prior Environmental Clearance (EC). Refer to the table below.

Table no. 2.1: Threshold limits for environmental clearances

<table>
<thead>
<tr>
<th>Project or Activity</th>
<th>Category with threshold limit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Physical Infrastructure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>including Environmental Services</td>
<td></td>
</tr>
<tr>
<td>7(c)</td>
<td>Industrial estates/parks/complexes/areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather complexes.</td>
<td>If at least one industry in the proposed industrial estate falls under the Category A, the entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha and housing at least one Category B industry.</td>
</tr>
<tr>
<td>8</td>
<td>Building /Construction projects/Area Development projects and Townships</td>
<td>≥20,000 m² and &lt;1,50,000 m² of built-up area</td>
</tr>
</tbody>
</table>

14 Modified Guidelines of MSE-CDP; Ministry of Micro, Small and Medium Enterprises (MSME), Government of India (GoI).

15 [http://www.cpcb.nic.in/Env_Planning.php](http://www.cpcb.nic.in/Env_Planning.php)
| 8(b) | **Townships and Area development projects.** | **Covering an area ≥ 50 ha and or built up area ≥150,000 m².** | **All projects under Item 8(b) shall be appraised as Category B1.** |

**Note:**

**General Condition (GC):** Any project or activity specified in Category “B” will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco-sensitive areas, (iv) inter-State boundaries and international boundaries.

**Specific Condition (SC):** If any Industrial Estate/Complex / Export processing Zones /Special Economic Zones/Biotech Parks / Leather Complex with homogeneous type of industries such as Items 4(d), 4(f), 5(e), 5(f), or those Industrial estates with pre –defined set of activities (not necessarily homogeneous, obtains prior environmental clearance, individual industries including proposed housing within such estates/complexes will not be required to take prior environmental clearance, so long as the Terms and Conditions for the industrial estate/complex are complied with (Such estates/complexes must have a clearly identified management with the legal responsibility of ensuring adherence to the Terms and Conditions of prior environmental clearance, who may be held responsible for violation of the same throughout the life of the complex/estate).


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16 [http://envfor.nic.in/sites/default/files/TGM_Industrial%20Estates_010910_NK.pdf](http://envfor.nic.in/sites/default/files/TGM_Industrial%20Estates_010910_NK.pdf)
Chapter 3: Spatial Planning Process

Site master planning of sustainable industrial areas involves multi-disciplinary subjects. Constructive and transparent stakeholder relations are quintessential input for successful site selection, site master planning and its implementation. For all these aspects, it is pertinent to build a strong working relationship with relevant stakeholders at appropriate time. This can be done through participatory and learning processes which encompass not just the decision makers but the whole spectrum of managers, workers and effected people.

As a first step, the promoters/developers of the industrial areas need to identify the relevant partners which are important in terms of decision making and use of the industrial areas. A broad list would include:

- State level and national level institutions for industrial development
- Pollution control boards
- Worker representatives
- Planners, architects, engineers
- Anchor/first companies to invest
- Solid waste management company
- Women entrepreneur representatives
- Waste management and waste water management company
- Local academic institutions and civil society representatives

The site master planning of sustainable industrial areas involves a sequence of steps which ensure that the output will be integrated and inclusive of maximum infrastructure while ensuring economic returns. The major aspects to be covered are: siting and site location of the industrial area, site master planning of the industrial park, operation and management of the industrial park and performance/results aspects of the industrial park.

The main steps of this methodology adopted are mentioned below:

**Fig. 3.1: Broad steps for spatial plan preparation**

- **Stage 1: Development of vision and objectives**
  
  This stage is includes the consultations at the beginning of the project. At the inception, the promoters and the key stakeholders' should be involved to co-create a vision for the industrial area along with development objectives which may correspond to the development goals of the nation as well as the region.

- **Stage 2: Site analysis and need assessment**
A detailed pre-feasibility study must be conducted covering to assess and establish the feasibility/viability of the proposed industrial area. This study should cover aspects like:

- Type and size of the industrial and the associated development to be targeted at the proposed site and in its surroundings,
- Suitability of the site for the proposed development,
- Infrastructure, services and all other requirements required on the site,
- Infrastructure requirements outside of the site,
- Requirements of industries and other proposed development on the site, as well as of the statutory requirements and the national/international standards for incorporation into the site master plan,
- Requirements of the environmental clearance and other statutory clearances and the compliance, and
- Key performance indicators

The pre-feasibility study should be able to answer questions like:

- What is the total targeted investment?
- What is the total targeted tax revenue?
- What is the targeted employment?
- What type of industrial and associated development should be targeted?

The site suitability analysis should cover the aspects of the existing uses of land and its surroundings, pollution from the proposed development, negative environmental impacts, impact on natural resources, presence of sensitive ecosystem including flora and fauna, social impacts etc., and the suitability for planned industrial and associated development should all the elaborately taken into consideration. The aspects of climate change, disaster risks and sustainability should be considered. This analysis should be able to establish the site suitability for the proposed development. If necessary, suggest measures to be taken towards mitigation of any negative impacts and for protection of existing ecological and/or otherwise sensitive areas on site and its surroundings.

The need assessment should cover assessment of the required of the infrastructure and services (example transportation/road connectivity, housing areas, trade & commercial activities, water supply requirement etc.) required. For this purpose, it is necessary to i) collect and compile the necessary information and interact with the concerned departments, ii) check with the proposed urban, local and regional/district plans, iii) assess the requirements of industries and other proposed development on the site, iv) identify the land area requirements for industrial plots, infrastructure, services etc, and v) ensure that the site achieves the following sustainability and quality parameters:

- Economic quality
- Environmental quality
- Social quality
- Technical quality
- Innovation quality
- Process and management quality

As a result of this, following questions should be addressed:

- What standards will be applied for the individual industries and the industrial park?
- Attractiveness to entrepreneurs – what infrastructure & services will be provided to ease business?
- Attractiveness to employees - What infrastructure will be provided to cater to employees?
- Are the issues of international concern addressed: climate change, resource efficiency, gender, pollution?

Stage 3: Concept development

At the concept development stage, planning and design considerations should be elaborated. This should cover following aspects:

- Area programme with proposed land use distributions, provisions for infrastructure etc.
- Zoning concepts with division of different industrial uses and facilities
- Measures for compliance with development controls/bye-laws
- Thematic maps/layers of – land use plan, zoning plan, traffic and transportation plan, parks and open spaces, infrastructure- social, technical, environmental
- At least 6 design concepts (2 dimensional concepts and 3 dimensional visualisations) of- road cross-sections, road avenues, integration of rain water harvesting in landscaped areas, entrance zones, landmarks, signage, public spaces, bus stops etc.

**Stage 4: Preparation of thematic layers**

At this stage, the process of integrating the provisions for infrastructure (basic, environment, technical and socio-cultural) with spatial plans should be undertaken. A GIS based data base should be created with integrated maps/layers namely: land use, basic infrastructure, environmental infrastructure, and social infrastructure. The details of these maps/layers should cover the following:

- Land use showing all the uses of the land within Pharma cluster as per the standards area distribution.
- Zoning plan showing demarcation of zones for different industrial uses within Pharma cluster where in units producing similar products and needing similar infrastructure are co-located in a zone.
- Basic infrastructure
  - Road network showing hierarchies of road-widths as per the estimated passenger car units (PCU) counts, turning radii of suitable for the commercial vehicles etc.
  - Typical geometric design for each road cross sections or roundabouts
  - Standard road cross sections for all hierarchies including utility corridors (foot paths, bicycle tracks, sewage, storm water drainage, broad band lines, waste-bins, toilets, street lights etc.) where required
  - Provision of bus stops for internal mobility of the employees and visitors from public spaces to identified zonal drop points
  - Parking plan for commercial and domestic (motorised and non-motorised) vehicles
  - Railways and terminal facilities, if required
  - Land provision for power infrastructure
  - Business infrastructure: incubators, training centres, meeting rooms, conference halls, guest houses, weigh bridges, automobile service stations, warehouses and product testing facility.
  - Security rooms at the entrance/exit points and at zonal facility centres
- Environmental infrastructure
  - Provisions for waste collection, common disposal points, disposal points for hazardous waste etc.
  - Sites for composting facilities as per estimated bio-degradable waste
  - Conveyance lines for industrial waste water effluent to CETP
  - Contour based location of CETP
  - Storm water drains
  - Provisions for rain water harvesting, ponding and re-use
  - Locations for installing air quality monitoring stations
  - Locations for waste water monitoring systems
  - Location for water and waste water treatment system
  - Distribution of parks, buffer zones along the site boundary, surrounding highly polluting industries and also surface water bodies.
  - Landscape design of the parks, road avenues and rain water harvesting ponds with biodiversity preservation
  - Provisions for urban heat island mitigation and fresh air corridors

- Social infrastructure: Provision for medical facilities, training facilities, child-care centres, public toilets, fire and disaster management services, canteens, driver and worker accommodation etc. should be earmarked.

**Stage 5: Detailed master plan and report**
A detailed master planning report was prepared which is a comprehensive document that can guide development of industrial area. The key contents of the report are:

- **Overview** – location, total area of the site, expected number of industries, expected number of service related industries supporting the main industry, project cost, expected employment generation, targeted investments etc.
- **Land use break-up of the site.**
- **Designation of zones/sites for industries according to types and relative environmental impact etc. Elaboration of permissible industries and restricted industries.**
- **Basic infrastructure** (road network, electricity, water supply, gas, eco–friendly transportation, security, fencing, fire and disaster management etc.).
- **Technical infrastructure** (green factory buildings, renewable energy/energy efficiency provisions, business centre, warehouses, training centre, design centre, incubators etc.).
- **Environmental infrastructure** (storm water drainage, sewerage/wastewater conveyance, wastewater treatment and disposal facilities, solid waste management facilities, green/open spaces/landscapes, environmental monitoring etc.).
- **Social infrastructure** (food and beverages facilities, training/entrepreneurship development facilities, recreational facilities, gender specific infrastructure – provisions for women employees, barrier free infrastructure to enable people with disabilities, guest house, public toilets, health centre etc.).
- **Visualisations (2D/3D drawings)** of the features suggested in the Site Master Plan.
- **Statement on compliance with applicable standards, criteria, guidelines, procedures etc.** (including environmental considerations/criteria, “green” criteria, environmental clearances etc.).
- **Plans and thematic layers in the required scale.**
Chapter 4: Standards and Tools

A Site Master Plan is a comprehensive document that guides development of the industrial estate. These plans are to be integrated with urban/regional plans and ensure continuity with infrastructure and services provisioned in these plans. These site master plans should be reviewed every 5 years or as and when necessary, and statutory approvals obtained.

The key contents of a Site Master Plan report of an industrial park are:

- Overview of the Industrial Park – location, total area of the site, expected number of industries, expected number of service related industries supporting the main industry, project cost, expected employment generation, targeted investments etc.

- Land use break-up of the site.

- Designation of zones/sites for industries according to types, including service industries, general industries, obnoxious and hazardous industries, etc. Elaboration of permissible industries and restricted industries.

- Basic infrastructure (road network, electricity, water supply, gas, transportation, security, fencing, fire and disaster management etc.).

- Technical infrastructure (green factory buildings, renewable energy/energy efficiency provisions, business centre, warehouses, training centre, design centre, incubators etc.).

- Environmental infrastructure (storm water drainage, sewerage/wastewater conveyance, wastewater treatment and disposal facilities, solid waste management facilities, green/open spaces/landscapes, environmental monitoring etc.).

- Social infrastructure (food and beverages facilities, training/entrepreneurship development facilities, recreational facilities, gender specific infrastructure – provisions for women employees, barrier free infrastructure to enable people with disabilities, guest house, public toilets, health centre etc.

- General development control regulation for controlling and regulating the use and development of land within the industrial park, including imposition of conditions and restrictions in regard to the open space to be maintained for buildings, the percentage of building area for a plot, the locations, number, size, height, number of storeys and character of buildings and density of built up area allowed in specified area etc.

- Visualisations (2D/3D drawings) of (atleast some of) the features suggested in the Site Master Plan.

- Statement on compliance with applicable standards, criteria, guidelines, procedures etc. (including environmental considerations/criteria, “green” criteria, environmental clearances etc.).

- Plans and thematic layers in the required scale:
  - site master plan
  - land use plan
  - transportation plan (e.g., roads, parking, service station, petrol pump, mobility plan, pedestrian pathways, bicycle tracks/stations etc.)
4.1 Scale of a Site Master Plan

The Site Plan, Site Master Plan and various thematic layers of the Site Master Plan should be in appropriate scales as below:

- A Site Plan should be drawn at a scale of not less than 1:1,000 showing all physical details of the land, boundaries of the land, the surrounding existing layouts/lands, and existing approach road to the land where the layout is proposed.

- A Site Master Plan (or sometimes called as Layout Plan) should be drawn to a scale of not less than 1:500 showing boundaries of land, proposed number of building plots with dimensions and area of each plot and its uses, alignment and width of the proposed streets/roads, dimensions and areas of open space/green areas provided, infrastructure provided etc. and all the other uses of land.

If the plan approving authority prescribes a scale more detailed than the above, then the same should be adopted. The plans should be in digital form so that optical reductions (and not enlargement) of size of maps can be done as per requirement.

4.2 Land Use Break-up

The broad distribution of the land use within the an Industrial Park is:

- Industrial (plots) : 55 - 60%
- Parks and open spaces : 10%
- Common infrastructure zones : 10 - 17%
- Roads and circulation : 18 - 20%

Total site area : 100%

The industrial plots include the areas that can be allotted to industries for the purpose of industrial or commercial activity. The common infrastructure zones include areas for basic infrastructure (excluding roads, transportation), environmental infrastructure, social infrastructure and relevant technical infrastructure. The roads and transportation areas include roads, railway, parking areas, pedestrian pathways, bicycle tracks, etc.

4.3 Industrial Zones/Plots

The industrial zones should be earmarked based on homogeneity of function of the industrial activity and their inter-relationship to get the best use of land. The examples of such zones are:

- General engineering zone
- Chemical industry zone
- Micro, medium, and small enterprises (MSME) zone
- Green industry zone
- Women entrepreneurs industry zone

Each zone should be divided into blocks of appropriate size, which can be subdivided into plots. Depending on demand for size of the plot, smaller plots could be clubbed together. Also, in the future, without changing infrastructure, the plots could be combined or sub-divided as per demands persisting then.
The minimum plot size for layout & sub division of land for industrial uses shall be decided after stakeholder consultation with member/potential industries. Accordingly, ratio of length and width should also be decided.

4.4 Provisioning of Basic Infrastructure

a) Road network:

At city level, the road network includes hierarchies of roads as per site size and requirements. The suggestive road hierarchies\textsuperscript{17} are:

<table>
<thead>
<tr>
<th>Table no. 4.1: Hierarchy of Roads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arterial Roads</strong>&lt;br&gt;ROW of 50-80 m</td>
</tr>
<tr>
<td><strong>Sub Arterial Roads</strong>&lt;br&gt;ROW of 30-50 m</td>
</tr>
<tr>
<td><strong>Distributor/Collector Roads</strong>&lt;br&gt;ROW of 20-30 m</td>
</tr>
<tr>
<td><strong>Access Streets</strong>&lt;br&gt;ROW of 15-30 m</td>
</tr>
<tr>
<td><strong>Local Street</strong>&lt;br&gt;ROW of 10-20 m</td>
</tr>
</tbody>
</table>

It is necessary to accommodate utility services along and across the roads. The design of utilities has to be done to ease maintenance and operations but keep in mind that it will affect the traffic flow and conflict with other services. Location should be taken up so that minor or no adjustments are required with road works taken up later. These utility services include the following:

- Sewers
- Storm water drains, drainage
- Water supply lines
- Electricity cables
- Telecommunication cables
- Gas pipelines
- Cross conduit ducts
- Lighting
- Drainage

\textsuperscript{17} Code of Practice (part 1) Cross Section, Institute of Urban transport (India) and Ministry of Urban Development, GoI
□ Optical fibre cables

The road cross sections should also provide for:

□ Green belts - Tree belt should have a minimum width of 0.7 m and a desirable width of 1.5 m or more.
□ Traffic control devices
□ Public toilets integrated suitably
□ Shaded pedestrian pathways - The minimum width should be 1.2 m in order to accommodate wheelchair users. Comfortable minimum width is 1.8 m.
□ Spaces of benches, street light poles, service providers (e.g. kiosks)

![Typical road cross section with typical service inlay](source: Code of Practice, 2011)

Cross section of the road should accommodate a storm water drain of adequate size, shape and cross section. Footpaths should be of flexible/replaceable material of construction.

b) Entry/exit provisions:

The entry/exit gates could have signature architecture to reflect the unique identity of the Industrial Park as well as integrate local architectural elements. The infrastructure to be provided with entry/exit includes:

□ Security cabin.
□ Information centre.
□ Map of the industrial park.
□ Parking facility - to provide for adequate parking/standing to avoid queuing at the entry/exit; to provide for parking for those who want to use bicycles or battery operated vehicles.
□ Bus parking for external transport.
□ Bus parking for internal transport.
□ Adequate front space (in front of gate) for landscaping and aesthetic treatment.
□ Public toilets.
□ Drinking water facility.

c) Mobility - eco efficient transportation

□ External linkages:
  – External road linkages to nearby settlements or housing areas where from the workers/employees will travel to the Industrial Park and to the railway station, bus station, etc. in a time bound manner.
- Bus stops and pedestrian access points near the entrance gates.
- Eco-friendly public transportation such as battery operated vehicles, CNG buses from the industrial park to the nearby settlement, housing areas, railway station, bus station etc.
- Bicycle and pedestrian network from surrounding settlements to the industrial park.

- **Internal mobility:**
  - Battery operated vehicles for internal transport.
  - Provisions for bus stops/shelters throughout the industrial park.
  - Bicycle tracks, spaces for bicycle stations and bicycle parking.
  - For private vehicles, adequate parking facilities to be provided at the entry/exit points, at central level and at zonal level in the industrial park.
  - Pedestrian network consisting of sidewalks along roads and pathways in the green belts to create a system of safe and convenient pedestrian movement.

- **Parking for trucks**

  Truck movements are an important factor in assuring functionality and minimizing pollution in industrial estates. Truck parking provisions, if not made at planning stage amount to lot of problems for industrial functioning at later stages. Guidelines for the specific design requirements and operational characteristics of those movements are very important to be considered while planning the parking and allied facilities. To make truck parking most efficient node of parking of idle vehicles, social amenities should be grouped with them such as rest houses, communication facilities, eating facility, accommodation, weigh-bridges, warehouses, and automobile spare part stores etc. The truck terminals need to develop into centralized zones for the transport operators to operate from.

  Truck parking at should be classified in following hierarchy:

  1. **Centralised truck parking**
     - For long halts
  2. **Zonal level truck Parking**
     - For trucks waiting to reach an individual plot within the zone
  3. **Plot level truck parking**
     - For loading/unloading activity within the park

  **Fig. 4.2: Hierarchy of truck parking**

  Based on function of each parking; the components of parking at park level facility for halting of trucks for long have been listed in the table below:

  **Table no. 4.2: Infrastructure provisions in centralized parking zones**

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Facility</th>
<th>Parameters for providing the facility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Idle parking space</td>
<td>Each truck will generally require about 80 ft$^2$ of idle parking area. The parking area should be well marked and numbered for better idle park management.</td>
</tr>
<tr>
<td>2</td>
<td>Dormitory</td>
<td>About 125 ft$^2$ per bed(including land required for other facilities that should be provided within the dormitory)</td>
</tr>
<tr>
<td>3</td>
<td>Sanitary facility</td>
<td>Toilets, bathrooms, washing and drinking water</td>
</tr>
<tr>
<td>4</td>
<td>Transport operators office</td>
<td>Creating a hub of transport operators within the truck terminal compound encourages consolidation. Also the building must be created uniformly by the truck terminal so that there is efficient usage of space and for enabling better management of the terminal</td>
</tr>
<tr>
<td>5</td>
<td>Restaurant and retail shop</td>
<td>To serve clean and hygienic food and provide basic articles of general use</td>
</tr>
<tr>
<td>6</td>
<td>Medical facility</td>
<td>A health care facility to care for general health of the truckers as well as to create awareness about diseases</td>
</tr>
</tbody>
</table>
7 Banking facility To help the transport operators to carry out financial operations within the truck terminal
8 Office for the maintenance staff Personnel involved in idle parking management and other activities related to maintenance of the terminal
9 Weigh bridge For weighing of the input/ output goods to be transported
10 Service station For maintenance of the trucks
11 Fuel pump For refueling of trucks


Based on the assumptions and planning standards, parking requirement of long halt trucks has been worked out for every zone and added up for central level facility. e.g.

- Only loaded trucks (with raw materials) and empty trucks (for finished goods) coming to the estate will be using the parking area. The average parking duration for the trucks is assumed to be 8 hrs.
- 30% of the total daily trucks are assumed to come in a particular 8 hours including the peak hour.
- Area required for a truck for parking including circulation were assumed as follows and the required parking areas are estimated.

To design the truck parking, it is pertinent to know about the space criteria related to average size of trucks, parking space standards, most efficient angles of parking etc. Please refer to the tables below:

**Table no. 4.3: Carrying capacity of trucks**

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Mode</th>
<th>Carrying capacity in tonne</th>
<th>Passenger car unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 Axle trucks</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3 Axle trucks</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Multi-axle vehicles</td>
<td>31</td>
<td>4.5</td>
</tr>
</tbody>
</table>

(Source: Notification for the specification of Maximum Gross vehicle weight and the minimum safe axle weight, Ministry of road transport and highways (MORTH), GOI)

**Table no. 4.4: Parking efficiency**

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parking angle (degrees)</th>
<th>Maximum Parking produced (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90</td>
<td>67</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>


e) Parking for cars/2 wheelers-

Parking provision for cars and 2 wheelers should be made as the plot level parking is often not adequate or possible due to its size which leads to congestion on roads. Hence, space has to be designated for parking at the visitors, employees, service people etc. Following tables can help in estimating parking requirements:

- At the industrial estate level, overall modal split of traffic must be calculated. A sample table is given below:
Table no. 4.5: Modal split of total traffic

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Modal split</th>
<th>Employees + Service + Visitors portion of traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4W</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>2W (Motorcycle)</td>
<td>20%</td>
</tr>
<tr>
<td>3</td>
<td>2W (Bicycle)</td>
<td>20%</td>
</tr>
<tr>
<td>4</td>
<td>Shared vehicle (4W/ 3W)</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>Bus</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

As per the modal split of the traffic load in the industrial estate, space should be calculated for providing parking at following suggested locations:

- Near entrance - for visitors of business facilities
- Near central and zonal facility centers
- Within zones/clusters

f) **Automobile Service Station** - service stations/workshops should be provided, particularly to cater to trucks.

g) **Signage** – appropriate signage should be provided. Hierarchy of signage includes:

- Directional signage along major roads, pedestrian ways and bicycle ways.
- Signage on landmarks, central facilities, zonal facilities etc.
- Signage pertaining to names of industries should be uniform.
- Information signage.
- Advertisement boards/hoardings.

h) **Weigh Bridges** – to be located at entry points or centralised parking zones.

i) **Safety & Security** – to provide for security measures, suggested provisions include:

- Centralised security office at the main entrance. In addition, security cabins at the exit and other strategic points.
- Close circuit (cc) cameras placed at all strategic locations in the industrial park.
- Fencing all around the industrial park made of environment-friendly materials.
- Provision for a fire station.
- Provision for a police post.
- Disaster management centre that will be run with pool of experts from industries.

j) **Utilities** – include power transmission lines and a sub-station; water conveyance, treatment, adequate storage and distribution network; and telephone lines, telecommunications network.

4.5 **Provisioning of Technical Infrastructure**

a) **Warehouses/raw material depots** – space for suitable numbers to be provided as per requirements.

b) **Renewable Energy/Energy Efficiency Provisions** - All buildings would have to be energy efficient as per the Energy Conservation Building Code (ECBC). (Process loads for industrial buildings excluded). At least 25% of the installed external lighting load should be solar powered. 100% of internal & external lighting fixtures should be BEE star rated. All common spaces, including street lights shall use “LED”.
c) Provisions for solar street lamps, solar panels (PVs) on roof tops of factory buildings (Green Factory Buildings) and insulated rooftops, solar energy generation in public/common area should be done.

d) Business Centre (One Stop Service Centre) – provisions for administrative building, information centre and product display centre.

e) Product/Material Testing Facility – provisions to be made to cater to the requirements of the industries in the industrial park.

f) Training Centre/Design Centre/Incubators - training centre to undertake training needs, including vocational training, entrepreneurship development etc.; design centre to provide AutoCAD services, drawing and design services; and incubators for entrepreneurship promotion.

g) Commercial Zone - provisions for commercial activities including warehouse, shopping complex, petrol pump, etc.

h) Green Factory Buildings – preferably, factory buildings should be a Green Factory Building in accordance with ratings of the Indian Green Building Council.

i) Soft targets for inclusion in the site master plan in figure below.
4.6 Provisioning of Environmental Infrastructure

a) Storm Water Management – to include:
   - Storm water drains all across the industrial park in accordance with terrain and drainage.
   - Decentralized storm water management system for cost effectiveness.
   - Collection and treatment of run-off of first rains at the rate of 1 hour peak rainfall and 80% run-off coefficient to avoid any contamination risks. (Refer to Rain water harvesting and conservation manual, Central public works department, New Delhi).
   - Rainwater harvesting facilities.
   - Ponding and integration into green landscapes.
   - Recycle/reuse provisions for industrial, horticulture/irrigation uses.

b) Wastewater Management – to include:
   - Provisions for wastewater conveyance system in accordance with slopes and zoning of industries.
   - Provisions for common effluent treatment plants, sewage treatment plants.
   - Provisions for storage of treated waste water (guard pond) and provisions for recycle/reuse.

c) Solid Waste Management – to include:
   - Provisions for collection, transportation, storage and disposal of wastes.
   - Recycling centre for e-waste, vermi-compost plant and handmade paper plant etc.
   - Waste management systems
   - Hazardous wastes collection and temporary storage facility.

d) Green/Open Spaces/ Landscapes – to include:
   - Central green – lungs s for the Industrial park
   - Green belts at the periphery- to act as buffer
   - Vertical and horizontal stretches of greens spreading across the industrial estate in the form of avenue plantation and greenways
   - Green areas at the plot level

e) Resource Efficiency – to include:
   - Provisions for rainwater harvesting, recycle/reuse of water.
   - Provisions for recycle/reuse of treated wastewater.
   - Provisions of renewable energy.
f) Provisions for micro-climate control - open spaces, landscaped and hierarchical green areas that are criss-crossing the industrial estate, integrated with water bodies (of treated rainwater and wastewater) provide for ventilation and micro climate control.

g) Environmental monitoring – to include provisions for online monitoring of air quality in the industrial park; data display inside the industrial park as well as at the entry/exit points and data display via internet.

h) Biodiversity protection or enhancement on site - existing plantation, water bodies and other natural features on site with ecosystem services to be conserved; extensive greenery and plantation to encourage local habitat.

4.7 Provisioning of Social Infrastructure

Several provisions are suggested as social infrastructure in industrial parks:

a) Education and training:
   - entrepreneurship development facilities
   - incubators
   - training centres

b) Health and sanitation:
   - dispensary/health centre
   - public toilets
   - water dispensers

c) Recreational facilities:
   - sports fields
   - amphitheatre/auditorium
   - landmark area with signature architecture
   - green/landscaped areas

d) Guest House for visitors and service engineers etc.

e) Special arrangements for truck drivers
   - dormitories for stay repair of their trucks, cooking, and wash & change
   - facilities for food and beverages – canteens, kiosks, tea/coffee shops

f) Transportation/mobility arrangements - parking facilities for vehicles, eco-friendly internal public transport, external transport to bus terminus & railway station, bicycle tracks, bicycle stations, bicycle parking areas, pedestrian pathways along roads, greenways along green landscaped areas.

g) Safety & security provisions
   - CCTV cameras,
   - fencing around the industrial park,
   - security office and security cabins,
   - police post.

h) Gender aspects: provisions for women employees, including
   - Play schools, Crèche for infant children of workers
   - Ladies room, accommodation for late working
   - Provisions for strengthening of safety and security
   - Provisions for internal and external transportation
   - Provisions for health centre, canteens/food outlets, kiosks, toilets, internal shuttle service (battery operated)

i) Other provisions - ATM, post office, bank, internet centre, shops for convenience goods, crèche, guest houses etc.
4.8 Provisioning for Administrative and Management Aspects

a) Administrative and management aspects:

□ Overall Structure

The pre-clearances, site selection, site master planning, and development of a new Green Industrial Park may be taken up by a Special Purpose Vehicle (SPV) to be set up for this purpose by the public bodies such as the state industrial development corporations or state industrial infrastructure development corporations, or private agencies. The key functions of SPV, amongst others, may include:

- Site Master Planning of the industrial estate/park.
- Preparation of a strategy for development of the Green Industrial Park and an action plan for self-regulation, and approval by the Board of the SPV.
- Selection of developer/co-developers for the development and maintenance of common infrastructure and services at the Green Industrial Park. SPV can take up the work of development on its own through various agencies/contractors or take up the development in partnership with a developer who shall be selected through a transparent process. Development can be in stages.
- Formulation of rules and procedures for development, operation, regulation and management of the Green Industrial Park and its enforcement.
- Obtaining prior environmental clearance under the provisions of EIA Notification 2006, as applicable.
- Working out an arrangement with the State Governments regarding revenue streams including levy of user or service charges, fees or rent for the use of infrastructure/properties in the Green Industrial Park and creation of specific mechanisms for specialised services.
- Promotion of investments into the Green Industrial Park.

□ Management

- Industrial Area Local Authority (IALA) may be constituted with elected representatives from industries to manage the Green Industrial Park. IALA will be functioning under the purview of SPV.
- An Environmental Sub-committee of the IALA will look into environmental matters.

□ Site development

- Site development would be undertaken by SPV.

□ Services

- Services such as waste management and wastewater management may be tendered out by SPV based on appropriate business models (BOOT etc.) following Green Procurement principles.
- Services such as manning entry/exits, security etc. could be outsourced by the SPV.
- Infrastructure such as weigh-bridge, warehouses, commercial areas, and parking areas could be leased out through tender process by the SPV.

□ Plot allotment

- Plot allotment will be undertaken by the SPV (industrial estate developer), in consultation with IALA. Only those industries that are suitable will be allowed in each industrial zone.
- While allotting plots, conditions should be clearly laid and agreements made with plot allottees on adherence to Green Building norms, rainwater harvesting etc. for which “plot allotment guidelines” should be prepared by the industrial park developer.
- Maximum plots should not be allotted to those industries that will not utilize the common infrastructure and services in the industrial park, as otherwise the common infrastructure and services will become unviable.
Costing

The costs of development could be calculated based on essential infrastructure to be developed at the site by the industrial park developer, including roads, lighting, drainage, sewerage, greenery, entry/exit gates, buffer zones, rainwater harvesting, waste management etc. The allocable area can be calculated by dividing the total costs divided by the allocable area.

Costs towards common services would be payable by the allottees as per business case.

b) Provisioning in Site Master Plan

Provisions should be made in the Site Master Plan for:

- Office buildings for administration and management
- Office buildings for service providers
- Stores and materials for construction and maintenance

4.9 DGNB rating standards

The German Sustainable Building Council (DGNB) provides a certification system for industrial locations. It is based on international codes and standards making it easy to use in various countries while at the same time providing high quality and transparency. It is a first scheme available worldwide for the sustainability certification of industrial locations. It has a holistic approach with 36 certification criteria. In addition to building quality and resources required by the buildings, the scheme also considers outdoor spaces, infrastructure, and the local environment. It provides certification for existing, newly planned, or of a combination of both types of industrial locations. The parameters of the system are as below:

Fig. 4.3: Assessment criteria of DGNB rating system for industrial locations
[Source: DGNB GmbH]

The DGNB assesses buildings and urban districts which demonstrate an outstanding commitment to meeting sustainability objectives. The sustainability concept of the DGNB system is broadly based and goes beyond the well-known three-pillar model. The DGNB system covers all of the key aspects of sustainable building: environmental, economic, socio-cultural and functional aspects, technology, processes and site. The first four quality sections have equal weight in the assessment.

This means that the DGNB system is the only one that gives as much importance to the economic aspect of sustainable building as it does to the ecological criteria. The assessments are always based on the entire life cycle of a building. Of course the focus is always also on the wellbeing of the user. It is crucial that the DGNB does not assess individual measures but instead the overall performance of a building or urban district.

Table no. 4.6: Parameters of DNB rating system for industrial locations

<table>
<thead>
<tr>
<th>Environmental Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Life Cycle Assessment</td>
</tr>
<tr>
<td>- Building Pollutants</td>
</tr>
<tr>
<td>- Biodiversity</td>
</tr>
<tr>
<td>- Urban Climate</td>
</tr>
<tr>
<td>- Environmental Risks</td>
</tr>
<tr>
<td>- Safeguarding Water and Soil</td>
</tr>
<tr>
<td>- Life Cycle Assessment - Primary Energy</td>
</tr>
<tr>
<td>- Water Cycle</td>
</tr>
<tr>
<td>- Land Use</td>
</tr>
<tr>
<td>- Resource-Efficient Infrastructure,</td>
</tr>
<tr>
<td>- Earthworks Management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Life Cycle Costs</td>
</tr>
<tr>
<td>- Local Economic Impact</td>
</tr>
<tr>
<td>- Flexibility and Adaptability</td>
</tr>
<tr>
<td>- Efficient Land Use</td>
</tr>
<tr>
<td>- Value Stability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sociocultural and Functional Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Open Space</td>
</tr>
<tr>
<td>- Safety and Security</td>
</tr>
<tr>
<td>- Workplace Comfort</td>
</tr>
<tr>
<td>- Pollution</td>
</tr>
<tr>
<td>- Inclusive Access</td>
</tr>
<tr>
<td>- Urban Design</td>
</tr>
<tr>
<td>- Design Quality</td>
</tr>
<tr>
<td>- Social and Commercial Infrastructure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technical Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Maintenance, Servicing, Cleaning</td>
</tr>
<tr>
<td>- Energy Infrastructure</td>
</tr>
<tr>
<td>- Waste Infrastructure</td>
</tr>
<tr>
<td>- Rainwater Management</td>
</tr>
<tr>
<td>- Mobility Infrastructure</td>
</tr>
<tr>
<td>- Logistic Infrastructure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Process Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Integral Design</td>
</tr>
<tr>
<td>- Comprehensive Project Definition</td>
</tr>
<tr>
<td>- Participation</td>
</tr>
<tr>
<td>- Concepts Developed in Competitive Bids</td>
</tr>
<tr>
<td>- Construction Site, Construction Process</td>
</tr>
<tr>
<td>- Quality Assurance and Monitoring</td>
</tr>
<tr>
<td>- Controlling</td>
</tr>
</tbody>
</table>

[Source: DGNB GmbH]
Chapter 5: Case Examples

5.1 ALEAP Green Industrial Park (A-GRIP), Nandigama

The Association of Lady Entrepreneurs of Andhra Pradesh (ALEAP) was established in 1993. It is a state level organization with an objective of upliftment of women and empowerment through establishing small and medium enterprises. To promote women entrepreneurship, ALEAP is now developing 'ALEAP – Green Industrial Park' (A-GRIP) at Nandigama near Hyderabad in the newly formed State of Telangana.

A-GRIP at Nandigama is envisioned to provide an environment conducive for women entrepreneurs and employ state-of-the-art technologies, including clean technologies, renewable energy technologies, environmental technologies and cost-effective common infrastructure.

A-GRIP is located in Nandigama village, part of Patancheru Mandal in Medak District of Telangana. A-GRIP extends over 3,34,094 m² (82.54 acres) of land area outside the settlement area of Nandigama village. (Refer Picture 4.1).

[Picture 5-1: Location of site in Telangana


Overview

The following table gives a general overview about the A-GRIP case example.

Table 5.1: Overview of A-GRIP

<table>
<thead>
<tr>
<th>Industrial park</th>
<th>A-GRIP, Nandigama</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area of the site</td>
<td>82.54 acres≈ 0.33 km²</td>
</tr>
<tr>
<td>Expected number of enterprises</td>
<td>About 170</td>
</tr>
<tr>
<td>Expected number of service related entrepreneurs catering to A-GRIP</td>
<td>About 24</td>
</tr>
<tr>
<td>Project cost</td>
<td>Approx. INR 37.75 cr19≈ 6 million $ (including land cost, infrastructure and services; excluding factory buildings cost)</td>
</tr>
</tbody>
</table>

19 Cr stands for Crore. A Crore is a unit in the south Asian numbering system equal to ten million.
**Expected employment generation**

» 12,000 (direct employment)

**Targeted investments**

» INR 300 cr ≈ 48 million $

**Site master plan inputs by**

» Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
» Auroville Consulting
» Buro Happold Engineering, Germany
» German Sustainable Building Council (DGNB), Germany

**Site Master Plan finalization by**

» ALEAP
» Murty and Manyam Architects and Engineers Ltd.

*Note: The total area calculation may vary by +/- 5%*

### Land use

The proposed land use distribution of A-GRIP is as below:

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Land Use</th>
<th>Standard</th>
<th>Area (in m² &amp; %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Industrial</td>
<td>55%-60%</td>
<td>173,377 (51.89 %)</td>
</tr>
<tr>
<td>2</td>
<td>Recreational: Buffer zones, parks, sports field, etc.</td>
<td>10%-12%</td>
<td>38,535 (11.53 %)</td>
</tr>
<tr>
<td>3</td>
<td>Commercial: Shopping Centre, petrol pumps, guest house/ budget hotels, lodging and boarding, service and repair shops, communication / telephone exchange etc.</td>
<td>2%-3%</td>
<td>3,504 (1.05%)</td>
</tr>
<tr>
<td>4</td>
<td>Facilities: Public and semi- public- Fire Station/ fire post, police station / police post, hospital / dispensary, day care centre etc.</td>
<td></td>
<td>18,732</td>
</tr>
<tr>
<td></td>
<td>Utilities- Electricity sub-station, CETPs, pumping station, underground reservoir / firefighting tanks and other utilities etc.</td>
<td></td>
<td>26,891</td>
</tr>
<tr>
<td></td>
<td>Sub-total</td>
<td></td>
<td>45,623 (13.65%)</td>
</tr>
<tr>
<td>5</td>
<td>Transportation: Circulation, loading/unloading area, parking, idle truck parking, goods vehicle parking etc.</td>
<td>18-20%</td>
<td>73,055 (21.88%)</td>
</tr>
<tr>
<td></td>
<td>TOTAL AREA</td>
<td></td>
<td>334,094 (100%)</td>
</tr>
</tbody>
</table>

Zoning

The division of industrial zones in A-GRIP was done to cluster similar industries together and provide for their common infrastructure. Industries like pharmaceutical formulations, plastic products and general engineering were zoned towards the core of the industrial park and closest to the effluent treatment plant. Only non-polluting “green” industries were proposed for plot allocation in A-GRIP.

Plot sizing and orientation

The area requirement per plot was derived based on the requirements of women entrepreneurs of ALEAP. There were 3 plot sizes derived out of requirements expressed by women entrepreneurs. Most of the plots in the A-GRIP have orientation of 30° to the North for optimum climatic comfort.

Basic infrastructure

- **Road network** - A hierarchical and standardized road geometry was designed for A-GRIP. Various characteristics of roads are described below:

  Level 1: 24 m R-O-W
  (2+2 Motorized vehicle lanes, median, pedestrian path, street lights, bicycle track with underground utilities)

  Level 2: 18 m R-O-W
  (2+2 motorized vehicle lanes, median, pedestrian path, street lights, bicycle track with underground utilities)

  Level 3: 12 m R-O-W
  (1+1 Motorized vehicle lanes, median, pedestrian path, street lights with underground utilities)

- **Entry/exit provisions** - For effective safety and monitoring of A-GRIP and its workers, the main entrance was proposed with access control, security cabin and CCTV control room.

- **Eco-efficient transportation** - The transportation for A-GRIP was proposed to adapt walking, bicycling and use of green fuels.

- **Signage** - A-GRIP was proposed to have a system of signage to make it well-connected and easily maneuverable.

Technical infrastructure

- **Storm water management** - To prevent from contamination/pollution due to storm water runoff, A-GRIP was proposed with a storm water collection system the basis of 1 hour peak rainfall with 85% coefficient of runoff. The storm water will be collected in lined ponds, tested and treated if required, and then sent for recycle/reuse.

- **Wastewater management** - Provisions for wastewater conveyance system were done in accordance with slopes and zoning of industries. The treated water (after complying with the required standards) shall be recycled/reused.

- **Solid waste management** - Space was earmarked for waste recycling industries like handmade paper unit, vermicomposting etc.

Environmental infrastructure
Open spaces and landscaping- A hierarchy of interconnected green spaces was designed for A-GRIP with a huge central green spine to act as a lung space for the industrial park, green belts at the periphery will act as a buffer, vertical and horizontal stretches of greens spreading across the industrial park in the form of avenue plantations and green pathways and greens at the plot level.

Use of renewable energy- Solar street lighting installations with individual battery backup were proposed. A-GRIP was proposed with ‘green’ roof tops, combined with solar panels to reduce cooling needs as well as meet part of energy requirements through ‘green’ energy.

Energy efficiency provisions- All buildings in the A-GRIP were proposed to be energy efficient as per the Energy Conservation Building Code (ECBC). (Process loads for industrial buildings excluded)

Social infrastructure

Several services for women employees were included in the site master plan. These, for example include crèche, toilets, rest rooms for extended work, first aid, catering/canteens (centralised), kiosks, common toilets, internal shuttle service (battery operated), external connection to public transport, water dispensers, guest house, ladies room.

5.2 Green Industrial Park (INDUSTRIAL ESTATE), Jadcherla

The GIP site at Jadcherla was partly developed by the Telangana State Industrial Infrastructure Corporation (TSIIC). However, eventually TSIIC decided to re-plan the industrial park integrating “green” aspects. Accordingly, for re-planning, GIP at Jadcherla was envisioned to be a model “Green Industrial Park” with an environment-friendly site master plan reflecting the aspects of adequate infrastructure, resource efficiency, environmental monitoring, gender-friendliness and supporting infrastructure for the employees/workers.

![Location of site](Image)

**Pic. 5-2: Location of site**


Overview

The following table gives a general overview about the GIP Jadcherla case example.

**Table no. 5.3: Overview of GIP Jadcherla**

<table>
<thead>
<tr>
<th>Industrial park</th>
<th>GIP Jadcherla</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area of the site</td>
<td>956.58 acres* ≈ 3.87 km²</td>
</tr>
</tbody>
</table>
Expected number of enterprises | About 350 to 400
---|---
Expected number of service related entrepreneurs catering to A-GRIP | About 50
Project cost | Approx. INR 250 cr = 41 million $ (including land cost, infrastructure and services; excluding Factory buildings cost)
Expected employment generation | 20,000 (direct employment)
Targeted investments | INR 1,000 cr = 165 million $
Site master plan inputs by | Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
| Buro Happold Engineering, Berlin, Germany
| German Sustainable Building Council (DGNB), Germany
Site Master Plan finalization by | Advisory Group of TSIIC
| Working Team of TSIIC

*Note: The total area calculation may vary by +/- 5%

The previous layout of GIP was reviewed by GIZ (IGEP) and the international experts in consultation with TSIIC. The revised master plan was accomplished with multiple provisions as mentioned below.

### Zoning

The distinction of industrial zones in GIP was done in the light of the already allotted plots to various industrial units to provide for common infrastructure and facilities; the revised Site Master Plan was divided into the following zones:

- Zone 1: Special Economic Zone (SEZ)
- Zone 2: General Engineering Zone
- Zone 3: Micro, Medium and Small Enterprises (MSME) Zone
- Zone 4: Green Industry Zone
- Zone 5: Women Entrepreneurs Industry Zone
- Zone 6: Commercial Zone
- Zone 7: University Zone
- Zone 8: Rehabilitation Zone

### Basic infrastructure:

- **Road network** - Since most of the road network was already constructed on site, minimal changes within road cross sections were done to standardize them. After re-planning, following was the hierarchy of roads:
  
  Level 1: 45 m R-O-W  
  (3+3 Motorized vehicle lanes, median, pedestrian path, bicycle track, avenue plantation and utility including water supply, electrical lines zone)

  Level 2: 36 m R-O-W  
  (2+2 Motorized vehicle lanes, median, pedestrian path, bicycle track, avenue plantation and utility including water supply, electrical lines zone)

  Level 3: 24 m R-O-W  
  (1+1 Motorized vehicle lanes, sidewalk, avenue plantation, bicycle track and utility including water supply, electrical lines zone)
- **Entry/Exit provisions**- The main entry gate of GIP was proposed to have a signature architecture to reflect the unique identity of a “Green Industrial Park” and integrate local architectural elements.

- **Eco-efficient transportation**- Eco-efficient transportation included pedestrian pathways, bicycle ways, truck parking together with a service station, toilets, a rest house, cooking areas, and canteen for drivers.

- **Parking provision**- Planning for parking sites was been done based on hierarchy, purpose, safety accessibility and space standard. To avoid truck parking on-street in a haphazard manner, parking was required at: a) park level (overnight stay), b) zone/cluster level (temporary stay), and c) plot level (loading/unloading).

  For passenger cars and motorbikes, adequate parking areas were provided for: a) overnight stay (of cars and motorbikes), b) parking close to individual plots (cars and two wheelers of employees), and c) at individual plots (temporary parking for visitors). For the vehicles of workers, every zone will have a dedicated parking lot.

- **Signages**- Signage were integrated with road cross sections and landscaping features.

- **Security**- A centralized security office was proposed at the main entrance of the GIP. In addition, a security cabin was proposed at the entry and exit points.

### Technical infrastructure

- **Business infrastructure**- To strengthen the business opportunities, provisions for all necessary logistic and business facilities were made.

- **Building architecture**- All the factory buildings as well as administrative buildings in the Green Industrial Park Jadcherla were proposed to be green factory buildings as per IGBC rating system.

- **Renewable energy/ energy efficiency provisions**- All buildings in the Green Industrial Park Jadcherla have to be energy efficient as per the Energy Conservation Building Code (ECBC). Process loads for industrial buildings are excluded.

### Environmental infrastructure

- **Storm water management**- To prevent from contamination/pollution due to storm water runoff, seven locations were identified in GIP for storm water collection system on the basis of 1 hour peak rainfall with 85% coefficient of runoff.

- **Wastewater management**- Seven decentralized wastewater treatment plants were suggested for the site. They were located in the earmarked areas together with the storm water pond areas as these locations are catering to the industrial zones as well as aligned with the slopes/contours of the site.

- **Solid Waste Management**- For waste recycling industries, around 10,000 m² area was earmarked in the site master plan of industrial estate. In this area, facilities such as a vermicomposting plant for recycling compostable organic wastes, a handmade paper plant for recycling of waste paper, etc. would be encouraged through micro enterprises, which will help covert wastes to products as well as provide employment and means of income generation.

- **Open spaces and landscaping**- Existing mango plantations on the site were retained in the site master plan. Hierarchy of green spaces was also created. i.e.
  - Central green – lung space for the industrial park
  - Green belts at the periphery to act as a buffer
  - Vertical and horizontal stretches of greens spreading across the GIP in the form of avenue plantations and greenways
  - Greens at the plot level
Social infrastructure

- Education and training - A university campus was provided at the central location of the GIP. Provisions have been made for incubators, training facilities, product testing facilities, environmental monitoring facilities, etc.

- Gender specific - To cater to women employees, provisions for public toilets and dormitories were made within the Site Master Plan of the GIP.

- Health care - Two dispensaries were proposed for the GIP Jadcherla; one at the central facility zone and the other within the facilities for the rehabilitation zone.

- Worker specific amenities - Township to accommodate employees/workers housing – two housing areas (rehabilitation areas) were planned.

- Public toilets - Toilet facilities were suggested at the central facility zone, entrance/exit zone, individual zone level and at road side.

- Food facilities - Food services were proposed for the workers, visitors, and employees at the central parking level as well as at the zone level. These included:
  - canteens that provide meals;
  - restaurants / cafeterias attached to the business centre;
  - food kiosks for quick breaks and refreshments along green ways; and
  - food stations with natural shade near the zone level greens.

- Recreational and socio-cultural infrastructure - Provisions were made in public spaces for the benefit of employees/workers of GIP. These include sports fields, an amphitheater/auditorium, landmark area, green/landscaped area, etc.
Chapter 6: Recommendations

The key quality parameters that describe the sustainable industrial parks/estate are related to:

- Economic quality
- Technical quality
- Environmental quality
- Socio-functional quality
- Administrative & management quality

Details are given below.

Table no. 6.1: Economic quality parameters

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Land value development</td>
<td>• Development cost per unit area via-a-vis saleable cost of the industrial park.</td>
</tr>
<tr>
<td>2.</td>
<td>Efficient land use</td>
<td>• Land use break-up in accordance with applicable laws/rules/norms.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Site master plan and different thematic layers to be prepared in appropriate scales:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Site master plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Land use plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Transportation plan (e.g., roads, parking, service station, petrol pump, mobility plan, pedestrian pathways, bicycle tracks/stations etc.).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Storm water management plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Wastewater management plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Landscaping/green/buffer/open space plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Basic infrastructure plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Technical infrastructure plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Environmental infrastructure plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Social infrastructure plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Any other as may be required.</td>
</tr>
<tr>
<td>3.</td>
<td>Investments</td>
<td>• Value of total investments in the industrial park; number of enterprises/industries; number of support service businesses.</td>
</tr>
<tr>
<td>4.</td>
<td>Employment</td>
<td>• Total direct and indirect employment generation from the industrial park.</td>
</tr>
<tr>
<td>5.</td>
<td>Revenues</td>
<td>• Revenues generated from infrastructure and services in the industrial park.</td>
</tr>
</tbody>
</table>

  e.g., Revenues from access control at entry/exit gates; revenues from parking facilities; revenues from leasing of commercial spaces; revenues from plot allotment; revenues from allotment/outourcing of services; revenues from outsourcing social infrastructure, including kiosks, canteens, guesthouses, training centre, crèche etc.

Table no. 6.2: Technical quality parameters
<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1.   | Renewable energy and energy efficiency        | ● Total primary energy demand; solar and other renewable energy provisions; energy efficiency measures; provisions for heating and cooling; energy efficiency measures.  
   |                                               | » Solar street lamps and external lighting fixtures  
   |                                               | » Solar panels (PVs) on roof tops of factory buildings  
   |                                               | » Green Factory Buildings  
   |                                               | » Insulated rooftops  
   |                                               | » Solar energy generation in public/common areas  
   |                                               | » Renewable energy/energy efficiency fixtures (BEE star rated)  
| 2.   | Quality of transport infrastructure           | ● Presence of an overall transport system; quality of the traffic model and modal split; innovative and eco-efficient mobility offerings; quality of internal and external connectivity and their accessibility; public transport infrastructure; parking spaces; supporting infrastructure (service stations, weigh bridges; fuel stations etc.)  
   |                                               | » Hierarchy of roads and road cross sections as per standards.  
   |                                               | Integration of utility services [Sewers, storm water drains, drainage, water supply lines, electricity cables, lighting, telecommunication cables, optical fibre cables, gas pipelines, green belts, traffic control devices, public toilets integrated suitably, shaded pedestrian pathways, spaces for benches, street light poles, service providers (e.g., kiosks) etc.].  
   |                                               | » Entry and exit gates with access control [provisions at the entry/exit gates (security cabin, Information centre, map of the industrial park, parking facility, public toilets, drinking water facility etc.)].  
   |                                               | » Internal and external public transportation systems [internal transport from entry gates to discourage private vehicular movement, eco-friendly internal transport – battery operated vehicles, external transport – CNG buses, battery operated vehicles, automobile service stations, signage etc.].  
   |                                               | » Adequate parking facilities at entry/exist.  
   |                                               | » Centralised parking, zone level parking, plot level parking.  
   |                                               | » Weigh bridges; automobile service stations; shops/stores for materials, spare parts of vehicles etc.  
| 3.   | Quality of bicycle infrastructure            | ● Provisions for bicycling; safety and comfort; parking facilities; rental system; way finding systems.  
   |                                               | » Bicycle tracks  
   |                                               | » Bicycle stations for renting  
   |                                               | » Bicycle parking  
   |                                               | » Way finding systems  
| 4.   | Quality of pedestrian infrastructure         | ● Provisions for pedestrians; safety and comfort; street crossing aids; way finding systems.  
   |                                               | » Extensive safe pedestrian pathways  
   |                                               | » Pedestrian pathways along roads  
   |                                               | » Greenways along green belts and green landscapes |
7. Quality of overall logistics concept
   - Logistic support provisions for factories and employees.
     » Business centre, One-stop-services, Administrative building
     » Information centre
     » Warehouses/raw material depots
     » Training centre
     » Incubation centre
     » Design centre, product/material testing facility
     » Commercial zone

8. Resource-efficient infrastructure
   - Resource efficient infrastructure, viz. sustainable building materials, earthworks management; recycle and reuse of treated wastewater and rain water; recycle and reuse of wastes; recycle and reuse of chemicals and materials; reduced demands of fresh water use etc.
     » Green Factory Buildings and Green Buildings
     » Usage of eco-friendly building materials for roads, fencing, buildings etc.
     » Renewable energy, energy efficiency and resource efficiency fixtures/installations
     » Recycles/reuse of wastes, wastewater, rainwater and materials

9. Safety & security provisions
   - Provisions for safety and security of the industrial park and the employees.
     » Centralised security office at the main entrance. In addition, security cabins at the exit and other strategic points.
     » Close circuit (cc) cameras placed at al strategic locations in the industrial park.
     » Fencing all around the industrial park made of environment-friendly materials.
     » Provision for a fire station.
     » Provision for a police post.
     » Disaster management centre.

10. Utilities
    - Provisions for the required utilities the industrial park.
      » Power transmission lines
      » Power sub-station
      » Water conveyance, treatment, adequate storage and distribution network
      » Telecommunications network

Table no. 6.3: Environmental quality parameters

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Waste management</td>
<td>Adequacy of provisions for waste management, including compostable organic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wastes, hazardous wastes, plastic wastes, paper and other recyclable wastes,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>used containers and packaging materials etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Provisions for collection, transportation, storage and disposal of wastes.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Recycling centre for e-waste, vermi-compost plant and handmade paper plant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Recycling centre for recycling of wastes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Hazardous wastes collection and temporary storage facility.</td>
</tr>
</tbody>
</table>
2. **Rain water management**

- Adequacy of provisions for rain water management, including storm water drainage, collection, treatment, recycle/reuse for industrial production or cooling or for fire protection or irrigation of green spaces etc.
  - Storm water drainage network.
  - Collection of first rains @ 1hr peak rainfall and 80% run-off coefficient and treatment to prevent contamination risks.
  - Ponding of treated rainwater and integration into landscapes.
  - Recycle/reuse of treated rain water.
  - Rainwater harvesting facilities.

3. **Climate Change adaptation**

- Provisions for climate change adaptation due to increasing temperatures, increased flood, reduced water reserves etc.
  - Assessment of heat islands and provisions for appropriate land use in such areas;
  - Assessment of flooding areas and provisions of appropriate land use and drainage;
  - Landscaping and greenery provisions;
  - Appropriate internal and external transportation provisions;
  - Provisions for micro climate control.

4. **Biodiversity, greenery**

- Preservation and additional provisions for retaining and promoting biodiversity in the industrial park. Local habitat to be encouraged.
  - Preparation of habitat objectives, mapping of habitat functions and implementation of measures.
  - Conservation of existing plantation, water bodies and other natural features on site.
  - Provisions for greenery and buffer zones. Hierarchical greens - central greens, green belts at the periphery, vertical and horizontal stretches of greens across the industrial park, avenue plantation, plantation at plot level.

5. **Emissions and air pollution control**

- Provisions for control of atmospheric emissions and air pollution.
  - Restrictions on unsuitable air polluting industries.
  - Measures for reduction of emissions, viz. eco-efficient mobility with battery operated vehicles, CNG buses for internal/external transport, bicycling tacks, pedestrian pathways that do not cause pollution, usage of clean fuels, common steam and power plants.
  - Online air quality monitoring station and display boards.

6. **Waste water pollution control**

- Provisions for waste water pollution control.
  - Provisions for wastewater conveyance system in accordance with slopes and zoning of industries.
  - Provisions for common effluent treatment plants, sewage treatment plants.
  - Provisions for storage of treated waste water (guard pond)
  - Provisions for recycle/reuse.
  - Online monitoring systems to check water quality compliance with standards.
7. **Disaster risks**
   - Preparedness to natural disasters like earthquakes, storm, floods, landslides, soil subsidence.

8. **Effects on global and local environment**
   - Ensuring that there are no negative effects on global and local environment.
     - Life cycle assessment of emissions due to buildings, infrastructure, traffic and open spaces.
     - Control of pollution of air, water and soil.
     - Protection from hazards to ground water
     - Maintenance of physical, biological and chemical water quality in compliance with standards.
     - Control of any negative environmental impacts.

### Table no. 6.4: Administrative & management quality parameters

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Administrative &amp; management infrastructure</td>
<td>Provisioning of infrastructure for administration and management of the industrial park.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Administrative building</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» One stop service centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Product display/exhibition and marketing centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» IT based industrial park information system</td>
</tr>
<tr>
<td>2.</td>
<td>Service delivery</td>
<td>Elaboration of business and management models for common infrastructure and services.</td>
</tr>
<tr>
<td>3.</td>
<td>Organisational structures</td>
<td>Staff structures for development, operation and management of the industrial park and plot allotment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Formation of a Special Purpose Vehicle (SPV)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Industrial Area Local Authority (IALA) may be constituted with elected representatives from industries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>» Environmental Sub-committee under IALA</td>
</tr>
</tbody>
</table>

### Table no. 6.5: Socio-functional quality parameters

<table>
<thead>
<tr>
<th>S.no.</th>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Social quality and infrastructure</td>
<td>Provisioning of social infrastructure.</td>
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<td>» Training centre to cater to vocational training, education facility, incubator for entrepreneurship promotion</td>
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<td></td>
<td></td>
<td>» Health care facilities</td>
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<td></td>
<td></td>
<td>» Public toilets, drinking water facilities</td>
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<td></td>
<td></td>
<td>» ATM, post office/courier service, bank</td>
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<td></td>
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<td>» Information centre for customer services</td>
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<tr>
<td></td>
<td></td>
<td>» Guest house, dormitories for employees/workers/visitors</td>
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<td>» Food and beverages</td>
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<td>» Recreational facilities</td>
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<td>» Residential township in the vicinity</td>
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<td>» Special arrangements for truck drivers</td>
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<td>» Transportation/mobility arrangements</td>
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</tbody>
</table>
2. Gender considerations

- Special provisions for women employees.
  - Play schools and crèche for infant children of workers, ladies room and accommodation for late working
  - Safety and security, internal and external transportation
  - Health centre, canteens/food outlets, kiosks, toilets, internal shuttle service (battery operated)

3. Health, comfort and user satisfaction

- Provisions for health, comfort and user satisfaction in the industrial park.
  - Health centre.
  - Recreational areas, including sports fields, greenery, parks etc.
  - Safety provisions, including security at entry/exits, access control, fencing, CC cameras across the site, police post.
  - Landmark area at the centre with extensive landscaped area, amphitheatre etc. that provide ample opportunities for social interaction.
  - Elegantly designed green factory buildings and landscaped areas that provide visual identity and impact.

4. Functional and design quality

- High functional and design quality of the industrial park.
  - Signature architecture identity and visual impact
  - Mobility integrated with existing transport/mobility network
  - Master plan aligned with slopes/contours
  - Art in the design – traffic islands, landscaped areas at the entry/exist gates etc.
Further Readings

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