

Biodiversity Assessment & Biodiversity Enhancement Programme for the core and buffer zone of the Apollo Tyres Plant at Oragadam, Tamil Nadu

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Glossary of terms¹:

Alien/foreign species/invasive: a species occurring in an area outside of its historically known natural range as a result of intentional or accidental dispersal by human activities.

Biodiversity: the Convention on Biological Diversity defines biodiversity as the variability among living organisms from all sources including terrestrial (land), marine (sea), and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. In simpler terms, biodiversity is all the living creatures, plants and animals, on and in the earth, water and air in a particular place. Biodiversity also describes the interaction between these living creatures and the area (ecosystem) in which they live.

Biodiversity process: ecological processes and functions that sustain biodiversity

Buffer zones: areas of land in which development is strictly controlled.

Connectivity: connectivity refers to the ability of connective corridors to sustain ecosystem processes common to linked patches.

Conservation: the management of human use of the biosphere so that it may yield the greatest sustainable benefit to current generations while maintaining its potential to meet the needs and aspirations of future generations: Thus conservation is positive, embracing preservation, maintenance, sustainable utilisation, restoration, and enhancement of the natural environment.

Conservation action - includes but is not limited to the establishment or expansion of protected areas. Conservation action should include engaging with all major landowners and land-users across a

range of socio-economic sectors, to increase awareness of priority areas for meeting conservation targets and to ensure that land management and land-uses in these priority areas support biodiversity conservation.

Conservation assessment: the development of spatial data layers and the spatial analysis undertaken to identify options for meeting conservation targets. Conservation assessments should include the interpretation of this analysis for a wide range of stakeholders.

Corridors: habitat, ecosystems or undeveloped areas that physically connect habitat patches. Smaller, intervening patches of surviving habitat that link fragmented ecosystems by ensuring that certain ecological processes are maintained within and between groups of habitat fragments.

Degradation: the lowering of the quality of the environment through human activities, e.g. river degradation, soil degradation.

Ecological processes: ecosystems work because they are kept alive by ecological processes such as pollination, nutrient cycling, disturbance (e.g. Fire), migration of species or soil maintenance. Ecological processes typically only function well where natural vegetation remains, and in particular where the remaining vegetation is well connected with other nearby patches of natural vegetation. Loss and fragmentation of natural habitat severely threatens the integrity of ecological processes.

Ecosystem: the totality of factors of all kinds, living and non-living, which make up a particular environment; the complex of a biotic community and its abiotic, physical environment, functioning as an ecological unit in nature. Ecosystems provide direct and indirect benefits to humans, e.g. flood amelioration by naturally functioning wetlands, the oceans' regulation of the chemical composition of the atmosphere, and providing habitat for commercially exploited species.

Ecosystem status: ecosystem status of terrestrial ecosystems is based on the degree of habitat loss that has occurred in each ecosystem, relative to two thresholds: one for maintaining healthy ecosystem functioning, and one for conserving the majority of species associated with the ecosystem. As natural habitat is lost in an ecosystem, its functioning is increasingly compromised, leading eventually to the collapse of the ecosystem and to loss of species associated with that ecosystem.

Environmental Impact Assessment (EIA): the process of collecting, organising, analysing, interpreting and communicating information about the likely impacts of a proposed policy, plan or activity on the environment.

Habitat: the home of a plant or animal species. Generally those features of an area inhabited by animal or plant which are essential to its survival.

Habitat fragmentation - ecosystems and the species therein, need a certain amount of inter-connectivity for processes to continue. If a specific natural area is broken up into smaller pieces, eventually species disappear and certain functions are lost.

IUCN Red Data Book: contains data on the threat to and rarity of plant and animals species. For each species, data is provided on rarity status, (i.e. endangered, vulnerable, rare, out-of-danger, and indeterminate), geographical distribution, population size, habitat, breeding rate and any conservation measures taken to protect the species.

Restoration: the return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions.

Wetlands: a collective term used to describe lands that are sometimes or always covered by shallow water or have saturated soils. Collectively, wetlands and their associated vegetation are highly diverse and productive ecosystems and despite their invaluable social and environmental roles, wetlands have been identified as being among most threatened and neglected habitats.

Acronyms:

ATF.....Apollo Tyres Foundation
ATL.....Apollo Tyres Limited
IUCN.....International Union for the Conservation of Nature
KF.....Keystone Foundation
SIPCOT.....State Industries Promotion Corporation of Tamil Nadu

¹ www.sanbi.bgis.org as quoted in Altron_National_Biodiversity_Asesment_2012

1. Introduction

1.1. Background:

ATF engaged the services KF to design and conduct biodiversity assessment study at the Chennai manufacturing facility of ATL located at the SIPCOT complex at Oragadam in Tamil Nadu. The area was demarcated as the 'core' and 'buffer' zone, the former being the manufacturing facility and the latter an area of 5km² around the manufacturing facility. The overall objective of the project is to formulate a Biodiversity Enhancement Programme for the core and buffer zone. The current report focuses on the assessment of the biodiversity present in the core and buffer zone; identifying potential impacts and threats to the biodiversity and providing recommendations through the a Biodiversity Enhancement Programme.

1.2. Objectives:

The objectives of the project are as given below:

- To make a status report of the current biodiversity of the area (Company site and surrounding 5 km. radius)
- To identify species of conservation significance
- To assess the impact on the biodiversity by the company so far, in relation to a historical survey, scoring impact consequence etc.
- To find out the avenues of restoration and biodiversity enhancement and preparation of a proposal for Biodiversity Enhancement Programme in the project area

In addition to the above, according to the Global Reporting Initiative, corporates are required to report on sustainability, and in relation to biodiversity impacts, in the case of the ATL at Oragadam the following two indicators apply:

- **EN11 - Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas.**
- **EN12 - Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas.**

1.3. Description of the study site:

1.3.1. Core Zone:

The ATL manufacturing facility/campus (core zone) is located within the SIPCOT complex Oragadam Village, Sriperumbudur Taluk, Kanchipuram District, Tamil Nadu State. The site is located in the south-east of Chennai district (12°51'28.42"N/ 79°56'41.54"E). The extent of the facility is ~126 acres consisting of manufacturing facilities, a thermal captive power plant and associated support units. The green cover within the campus comprises of native and exotic species and formed roughly ~25% of the total area of the core zone at the time of the initial assessments in November 2014, however this was reduced considerably during the course of the assessments due to expansion activities within the core zone (details given in the report). The core zone is surrounded by other industries, water bodies and interspersed reserve forests that are of the scrub and deciduous type (Champion and Seth, 1968), and is referred to as the buffer zone.

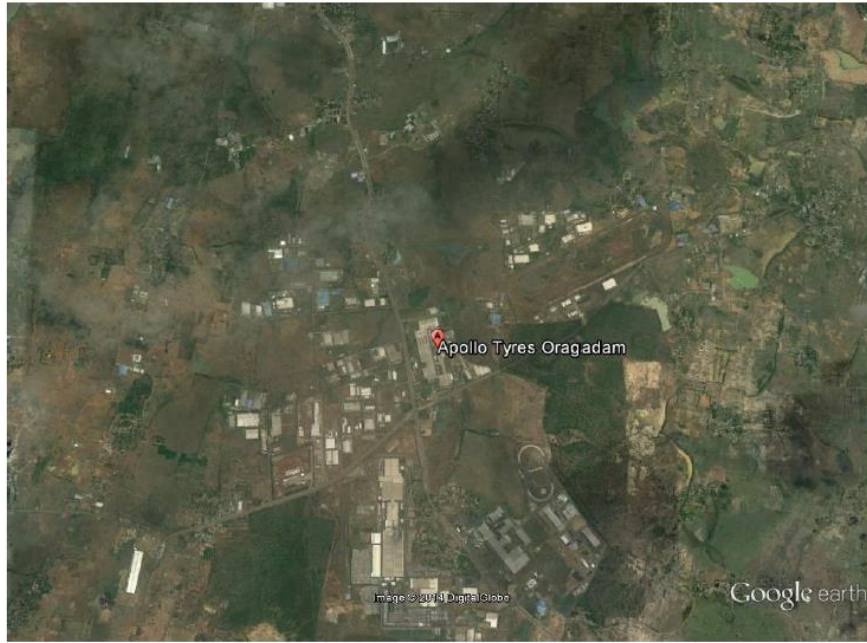


Fig. 1. Location and overview map of the core zone



Fig.2. View of the ATL manufacturing facility



Fig 3. Elevation profile of the core zone

1.3.2. Buffer Zone:

The buffer zone of the study is a part of the SIPCOT industrial complex located in the Kanchipuram District. The landscape is interspersed with farmlands, wetlands, large water bodies, patches of dry scrub and tropical dry evergreen forest. The patches of forests are under the reserved forest category and have plantations of Eucalyptus in certain sections of the landscape (details attached as Annexure H). A large number of human settlements and industries are found as well in the buffer zone.

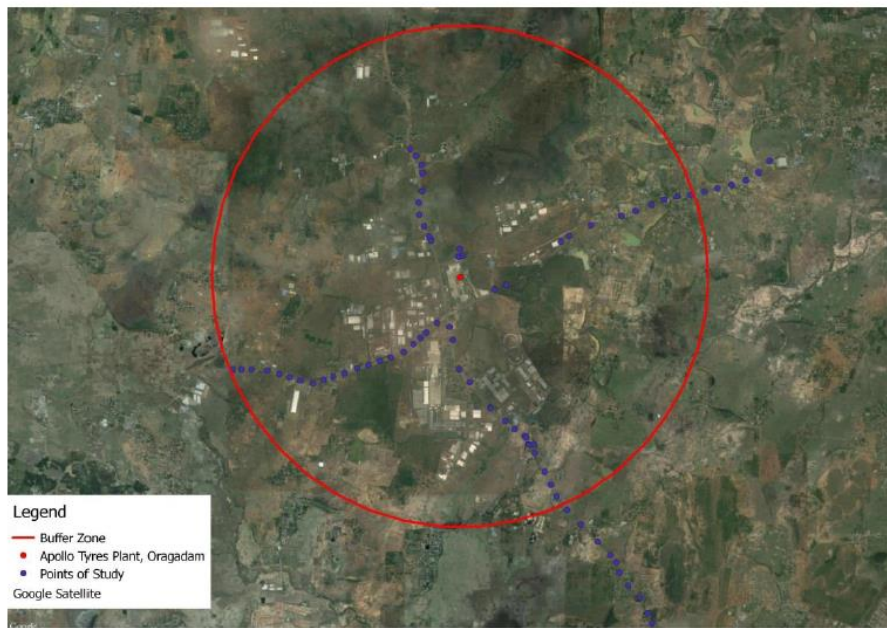


Fig.4. Overview of the buffer zone

A large number of human settlements and industries are found as well in the buffer zone. The buffer area identified were sample areas selected within a 5 Km² radius around the plant. Eraiyur,

Mettupalayam, Mathur, Vaipur, Chinnakuppam and Aapoor. The landscape was mostly similar in terrain across most sites, with the inclusion and exclusion of agricultural fields in certain areas. All selected study sites were situated around water bodies in the locality, ranging from small pools, to large irrigation tanks. There was a wide range of flora and fauna to be observed in the buffer zone.



Fig. 5. Images from the buffer zone

2. Methodology

The biodiversity assessments were done across four seasons viz. post-monsoon (November 2014 and January 2015), summer (April 2015), post-summer (July 2015) and pre-monsoon (October 2015) to capture the seasonal variations in the core and buffer zone. The diversity assessments followed by standard diversity index measurements (Magurran, A. E. 1988.) were carried out for groups such as – plants, butterflies, amphibians, reptiles, invertebrates and birds. The diversity indices were used as it provides more information than simply the number of species present (i.e., they account for some species being rare and others being common), they serve as valuable tools that help quantify diversity in a community.

The methodologies for the buffer zone are similar to the methodologies adopted for the surveys done in the core zone with minor modifications. Comparative analysis for the biodiversity presents within the core zone and the buffer zone and does factor seasonal variations and other impact factors. Visits to the community were done; semi-structured interviews and open-ended discussions were held with representatives.

2.1. Data collection:

The data collection for the vegetation, lepidopteron and avian inventories were done through field surveys within core zone. Systematic searches and survey techniques were used. The main areas of focus were the locations with green cover (planted up area, rain water harvesting pond, thermal power

plant and the areas covered with grasses). For the buffer zone, the main areas of focus were the reserve forest (restricted entry) areas, farmlands and water bodies. Secondary data collection was done through literature reviews and other online resources, however substantial information was not obtained and the results of the surveys done are highly dependent on the primary data that was collected.

2.2. Field assessment:

The following methods were used for the field assessments within the buffer zone

2.2.1. Flora assessment:

Plots were laid at 200 m interval along transects to quantify vegetation (Mueller-Dombois and Ellenberg 1967 and Kershaw 1973). Plot sizes of 15 m radius plots for trees, 8 m radius for shrubs, climbers and recruitment (gbh < 20 cm and height >50 cm) class of tree species, and five plots of 1 m x 1 m for herbs, grass and regeneration class of tree and shrub (< 50 cm height) species, with smaller plots nested within the larger plot. For all trees (>20 cm gbh at 1.3 m height) girth and phenology at the time of sampling were recorded. The numbers were being documented for the recruitment and regeneration class. The mentioned methodology was followed for the core zone with minor modifications to suit the layout of the core zone. For the buffer zone, the species encountered were enumerated and seasonal variations were calculated along with other factors that would indicate that a species is of conservation significance.

2.2.2. Avi-fauna assessment:

Birds (avi-fauna) being good biological indicators of human environment reflect the health of natural ecosystem and gives early warning of harmful changes. They are useful tools for conservation and environmental impact assessment of sites. Avi-fauna enumeration followed the area search method (Dieni and Jones 2002) within the core and buffer zones. Bird counts were made using line transects (Manuwal and Carey 1991, Bibby et al. 1992) spanning different microhabitats and contrasting disturbance parameters. Information on nesting habitats or breeding sites will also be recorded as and when encountered. The surveys were done on land and around water bodies present in the core and buffer zone.

2.2.3. Reptile and amphibian assessment:

The assessments for reptiles and amphibians were done through random searches for species within the buffer zone. Anecdotal information was collected through interactions with the staff at the core zone and the community at the buffer zone.

2.2.4. Invertebrate assessment:

i. Opportunistic survey: Invertebrates being very vast a group of animals, the methodology for the baseline inventory was restricted to opportunistic sampling of the diversity.

ii. Pitfall trapping of soil/litter fauna: Soil fauna include various groups of invertebrates that are too minute to be sampled through opportunistic survey. Also, soil fauna are essential to the floral and indirectly to the faunal health of any ecosystem. Their roles in nature include decomposition of

organic matter (indispensable for recycling of nutrients and the availability of the same to plants) among others such as predation.

Pitfall traps consisted of plastic cups with a funnel over them, buried into the earth such that the funnel mouths were in level with the ground. This set up facilitate or trick little ground dwelling organisms to stumble into the trap as they forage along the ground. The narrow end of the funnel worked to keeping the insects trapped until the traps were retrieved two days later.

No killing agent or preservative was used in the traps, so as to keep the trapping non-destructive. Hence during the inspection of the traps, the trapped organisms were photographed and let free.

2.2.5. Interactions with the community:

Semi-structured and open-ended discussions were done in the villages found within the buffer zone, elected representatives and other relevant stakeholders.

2.3. Desktop assessment:

The desktop assessments were done based on the data collected from the field assessments. The species recorded across various taxa were cross-referenced with the IUCN Red Data Book, secondary literature and other online sources for their conservation status category. The broad classifications are Extinct (EX); Extinct in the Wild (EW), Threatened (Critically Endangered (CR); Endangered (EN); Vulnerable (VU) and Lower Risk (Near Threatened (NT), Conservation Dependant and Least Concern (LC)). The classification is crucial to assess the overall threat matrix for the species and to identify the factors in the buffer zone that affect the species. It was also determined whether the species was native to the landscape or was introduced at some stage of the development that had occurred in the region. Google Earth was used to create boundary maps and to make land cover calculations.

2.4. Limitations:

The limitation for the study around the buffer zone was access to reserve forests and other areas that are out of limits such as other manufacturing complexes. The assessment team is of the opinion that the methodology and the data obtained during the assessments was sufficient to establish the baseline inventory for the buffer zone. The interactions with the community yielded some results and are indicative of actions that need to be taken in the region for a Biodiversity Enhancement Programme. Unwillingness of the community to interact was a limitation that had to be factored in.

Expansion activities that began in the core zone during the period of our assessment, restricting our access to one side of the core zone. Another consequence of this is was the inability to assess how much biodiversity has been affected during the process of expansion and construction. Significant development activities were observed in the buffer zone, which affected the assessments in a significant manner. Regardless of the limitations that were encountered, the assessments managed to capture the biodiversity and its seasonal variations in the core and buffer zone.

2.5. Baseline data available prior to assessment:

Data and information regarding the biodiversity of the region was acquired from ATL's Environmental Impact Assessment Report. The data was limited in terms of biodiversity present in the region; hence this was treated as a guiding document and not as a reference document. Extract attached as Annexure A.

3. Results from the assessment

3.1. Floristic diversity in the core and buffer zone:

A total of 221 species were identified from the core zone and 127 species from the buffer zone. The species represented the following families: Acanthaceae, Agaricaceae, Aizoaceae, Amaranthaceae, Amaranthaceae, Amaryllidaceae, Anacardiaceae, Apiaceae, Apocynaceae, Arecaceae, Asclepiadaceae, Asteraceae, Bignoniaceae, Boraginaceae, Caesalpinaceae, Cannaceae, Cassythaceae, Caryophyllaceae, Casurinaceae, Cactaceae, Capparaceae, Clausiaceae, Celeastraceae, Commelinaceae, Cordiaceae, Cucurbitaceae, Cycadaceae, Convolvulaceae, Combretaceae, Ebenaceae, Euphorbiaceae, Fabaceae, Gentianaceae, Hydrocharitaceae, Lamiaceae, Lythraceae, Malvaceae, Marsileaceae, Moraceae, Meliaceae, Mimosaceae, Molluginaceae, Myrtaceae, Nyctaginaceae, Onagraceae, Passifloraceae, Pedaliaceae, Potamogetanaceae, Poaceae, Proteaceae, Rubiaceae, Rhamnaceae, Sapindaceae, Scrophulariaceae, Sterculiaceae, Tiliaceae, Verbenaceae, Vitaceae and Violaceae.

The number of species varied during the assessment period and ranged from 56 (core):89 (buffer) species (post-summer assessment, July 2015) to 142 (core): 125 (buffer) (pre-monsoon assessment October 2015). Trees species were found throughout the sampling period. Aquatic plants showed seasonal variations. The consolidated list of species is attached as Annexure B and C.

- *Post- monsoon:* A total of 123 plant species were observed during the assessment in the core zone. More than 53 % of the species found at the facility were native and about 33% of the species were introduced. It was observed that the core zone had a well maintained lawn and also planted avenue/ ornamental trees species for the green cover. *Hoppea dictoma*, an endemic species was observed during the post monsoon 115 plant species were observed in the buffer zone during the assessment.

More than 90 % of the species found in the buffer zone were native and about 10% of the species were introduced. A large proportion of the introduced vegetation was herbs and was considered as weeds, followed by trees and shrubs. **Four endemic species were recorded. *Fuirena trilobites*, *Lepidagathis cristata*, *Secamone emetica* are endemic to Peninsular India and *Phoenix pusilla*, endemic to Coramandel Coast.** Based on the observations made in the buffer zone, it is assumed that the vegetation is of the scrub and tropical dry evergreen forest type, with interspersed water bodies such as wetlands.

- *Summer:* Due to the construction activities within the core zone, minor modifications were made to the methodology used for the assessment of flora. The species were enumerated through walk was done in all for directions of the core zone. The flora that was observed were recorded and later identified. The summer assessment records only 60 species, which

accounts to 49% reduction in the floral diversity within the core zone. Most of the species found in the core zone were native (58%) and about 42% of the species were introduced. The reason could be the time of the year and more important factor could be the elimination of the green cover for the expansion of the manufacturing facility. *Hoppea dictoma*, an endemic species reported during the post monsoon was not found during assessment done during the summer season. A total of 98 species was recorded in the buffer zone during the assessment for the summer season. The assessment during the post monsoon season had recorded 115 species. It is observed that there is a 13% reduction in the diversity of species found in the buffer zone.

- *Post-summer*: A total of 56 plant species were observed during the post-summer assessment in the core zone. A total of 89 species was recorded in the buffer zone.
- *Pre-monsoon*: A total of 142 plant species were observed during the in the core zone. It was observed that the grasses and herbs in the core zone were abundant in the lawns surrounding the kitchen, fabrication unit and rain water harvest pond. It was noticed that the lawn was not mowed but would happen in the coming weeks. Garden maintenance was minimal as expansion work is under process.

The plants that were relocated from the west side to the rain water harvest pond on the east side seemed to have survived as it looked healthy. An increase in the number of species (142) was observed during pre-monsoon assessment and a total of 125 species was recorded in the buffer zone. A general observation of the buffer zone was the increase in the water level of all water bodies due to the rains. Water in all tanks and ponds had increased. Due to the water level in the ponds aquatic plants were abundant. The forest patch did not appear different except at the edges on the roadsides. Lot of constructions work, levelling of soil was observed during this visit. The seasonal variations and detailed descriptions are a part of the activity report submitted during the course of the assessment. *Hoppea dictoma*, an endemic species reported during the post monsoon was not found during any of the subsequent assessment done in the core area. It has been categorised as Least Concern (LC) by IUCN Redlist. As the species is found growing along the sides of ditches, roadsides and riverbanks, moist exposed places along river banks, at the edges of pools and tanks and in rice fields. *Fuirena trilobites* (LC), *Lepidagathis cristata*, *Phoenix pusilla* were the endemic species found in the buffer zone. The developmental changes in the landscape might lead to habitat destruction and also pose a threat to the survival of these species.



Fig 6: Hedgerows on the eastern side within the core zone



Fig 7. Tree cover near rainwater harvesting pond



Fig 8. Construction activities at the core zone



Fig.9. Rainwater harvesting pond at the core zone

3.2. Faunal assessment of the core and buffer zone:

3.2.1. Avi-fauna diversity in the core zone:

The core zone presented a high diversity with respect to avifauna. 51 species (of which nine species were observed in the immediate vicinity of the core zone) were recorded during the first assessment of the core area. Considering this a baseline for what might be expected in the core area further observations were made and analysed. Some of the most avifauna encountered during our assessment was Paddyfield pipit, Indian pond heron, Cattle egret, Common pigeon, Indian cormorant, Pied kingfisher, White-browed wagtail, Indian roller, Black drongo, Shikra and Common myna. The consolidated list of species is attached as Annexure D and E.

- The summer observations of 17 species indicated a very low representation of avifaunal species from the core zone. A low number of wetland and grassland species could indicate that the core zone was not suitable for habitation during that time.

- The post-summer assessment indicated a slight increase in the number of avifaunal species recorded with 23 species. Although there was low representation of grassland and wetland species in the core zone, as similar to the summer observations.
- The pre-monsoon assessment showed an increase in the number of avifaunal species, with 29 species recorded. An increase in the wetland species observed around there could indicate preference for environments inside the premises; although the low number of grassland species could indicate that the habitat is still not currently suitable.
- Overall 58 species were recorded from the core zone.

One of the contributing factors to the decrease in number of species found could also be the large scale construction and expansion activities occurring within the premises of the plant. The harsh weather conditions also might have contributed to this, adding to the changing locations of tree cover during our observation period, the habitat might not have been preferred by birds. The seasonal variations and detailed descriptions are a part of the activity report submitted during the course of the assessment.

The buffer zone presented a high number of species as compared to the core area. 70 species were recorded in the first buffer zone assessment which could be considered a baseline to base further observations and analysis on. High number of wetland and widespread species were observed during this observation period, with low numbers of grassland birds. This could be attributed partially, at least, to diminishing cover and habitat preferred by these birds. Considering avi-fauna as an indicator, we could consider the water bodies in the buffer areas supporting a diversity of life.

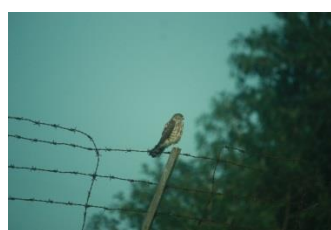
- During the summer assessment only 25 species were recorded. This decline could be attributed to the harsh weather and also probably towards lack of preferred habitats around the study sites. Significant reductions were noticed among wetland and grassland species. This could also be partially attributed to the reduction in water levels, and in some cases, drying up of the water bodies.
- The post summer assessment indicated an increase in the number of avifauna species recorded. 43 species were recorded during this observation period. A large number of the increase is attributed to widespread and wetland species.
- The pre monsoon assessment showed a further increase in the number of species recorded. 49 species were observed and recorded during this observation period with an increase in wetland, widespread and grassland species around our observation sites.
- The decrease in the number of species observed from the baseline to the last assessment could be a seasonal variation that occurs in this region, or it might be affected by various human activities that are occurring in the region.
- Overall 87 species were observed in the buffer zone



Black drongo



Paddyfield pipit



Shikra

Fig 10. Avifauna within the core zone

3.2.2. Reptilian diversity:

Across all seasons, very similar reptilian species were observed in the core zone. Oriental garden lizard was the most encountered species through all seasons, and in all parts of the ATL premises. On most occasions, an aquatic snake (*Checkered keelback*) was also observed. A few observations of Rat snake were also recorded from within the core zone. The mostly aquatic snake was the only habitat specific species spotted from within the premises; all other species can be considered widespread.

The buffer zone had a greater representation of reptiles as to the core zone. Skinks, agamas, and snakes were observed. 2 venomous snake species (Russell’s viper and Spectacled Cobra) were also observed to inhabit different areas in the buffer zone. The frequency of sightings and the habitats in which they were observed was more varied in the buffer as compared to the core zone. No unusual observations were made or recorded of any reptilian species or behaviour during this time. The consolidated list of species is attached as Annexure F.



Calotes vericolor (female)



Calotes vericolor

Fig. 11. Reptilian diversity in the core zone

3.2.3. Invertebrate diversity:

During the yearlong survey at four seasons viz., post-monsoon, pre-summer, post-summer and pre-monsoon, opportunistic visual sightings have helped document the following information for the core and buffer zones combined. Overall, a total of 137 species of insects; 7 species of molluscs; 8 species of spiders; 2 species of fungi were recorded. List attached as Annexure G.

Core zone: Varied forms of invertebrate fauna were observed in the core areas. The number of species reduced over the periods of our observation. While the harsh climatic conditions could be a contributing factor, the consulting entomologist attributed part of the reason to the disturbance of the landscape and habitat.

Only 6 groups of invertebrates were observed during our second assessment within the core zone. The summer season might have been a contributing factor towards this. Through later assessments also, number of groups recorded remains roughly the same, but the number of species could vary.

Buffer zone: 8 groups of invertebrates were recorded during our first assessment of the buffer zone. This would be considered the baseline on which to further analyse and interpret information. While the number of groups observed remain the same, there is a difference in the number of species recorded from each area. Changes in the landscape, in terms of usage, as well as presence of natural resources would affect the population and density of the existing invertebrate fauna in the region.

The following graph illustrates the major insect taxa that were recorded.

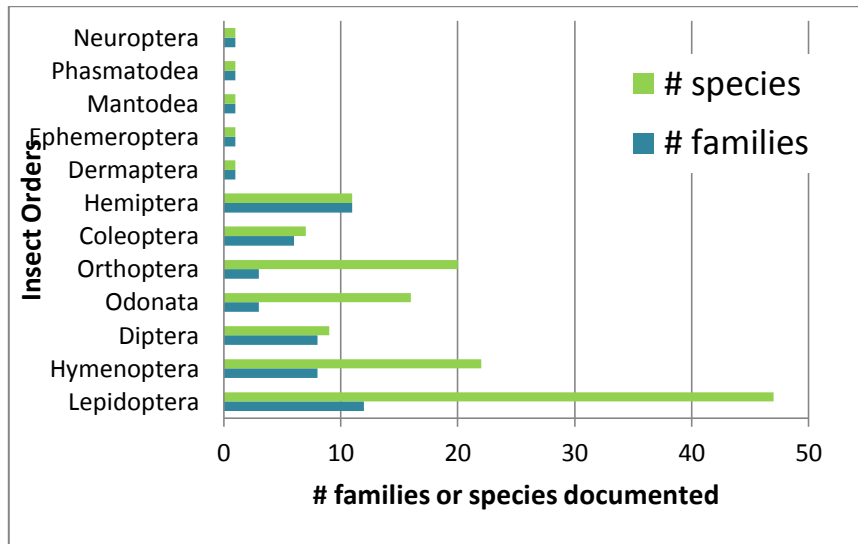


Fig 12. Number of invertebrate species/families documented

Table 1: List of Orders and their families with the number of species recorded

Order	# families	# species
Lepidoptera	12	47
Hymenoptera	8	22
Diptera	8	9
Odonata	3	16
Orthoptera	3	20
Coleoptera	6	7
Hemiptera	11	11
Dermaptera	1	1
Ephemeroptera	1	1
Mantodea	1	1
Phasmatodea	1	1
Neuroptera	1	1

Order	Family	# Species
Lepidoptera	Nymphalidae	13
	Papilionidae	6
	Pieridae	10
	Lycaenidae	7
	Hesperiidae	2
	Psychidae	1
	Geometridae	2
	Sphingidae	2
	Erebidae/Arctiidae	1
	Erebidae/Lymantridae (formerly in)	1
	Tineidae	1
	Amatidae	1
	Hymenoptera	Apidae
Halictidae		1
Megachilidae		1
Formicidae		4
Chrysididae		1
Scoliidae		1
Vespidae		5
Sphecidae		1
Diptera	Syrphidae	2
	Dolichopodidae	1
	Bombyliidae	1
	Asilidae	1
	Calliphoridae	1
	Ephydriidae	1
	Tabanidae	1
	Muscidae	1
	Odonata	Coenagrionidae
Libellulidae		10
Gomphidae		1
Orthoptera	Acrididae	18
	Tetrigidae	1
	Tettigoniidae	1
Coleoptera	Coccinellidae	2
	Scarabaeidae	1
	Meloidae	1
	Staphylinidae	1
	Hydrophilidae or Dytiscidae	1
	Scarabaeidae	1
Hemiptera	Membracidae	1
	Cicadellidae	1
	Cercopidae	1

	Aphidae	1
	Gerridae	1
	Vellidae	1
	Pseudococcidae	1
	Lygaeidae	1
	Scutelleridae	1
	Pyrrhocoridae or Lygaeidae	1
	Notonectidae	1
Dermaptera		1
Ephemeroptera		1
Mantodea		1
Phasmatodea		1
Neuroptera	Myrmeleontidae	1

Table 2. A list of the taxa documented with the number of species found

Arthropod group	No. of species		
	Core area	Buffer area	Common
Odonata - dragonflies	7	6	3
Odonata - damselflies	4	1	1
Orthoptera - grasshoppers	5	2	0
Hemiptera – true bugs	2	6	2
Coleoptera - beetles	3	1	0
Lepidoptera – butterflies and moths	26	10	7
Hymenoptera – bees, wasps, ants	13	8	6
Diptera – true flies	4	1	0
Neuroptera – antlions, lacewings	0	1	0
Arachnida - spiders	2	3	1
Crustacea – crabs, shrimps	0	1	0
Diplopoda – millipedes, centipedes	1	0	0

3.2.4. Other observations made during the course of the assessment:

3.2.4.1. Expansion of the manufacturing facility within the core zone:

Considering the expansion project undertaken from early 2015 within the core zone, a large portion of the gardens and green cover along the west road has been used up for the expansion. This section had a majority of the tree cover of the plant which has been lost. Another area affected by the extension is the north east corner of the plant close to the existing rain water harvesting pond has also been excavated to build another reservoir.

The north east corner displayed the greatest diversity of flora and fauna in the core zone, which was observed during our first visit to the core zone. The two major zones of expansion have definitely affected the presence and distribution of biodiversity inside the core zone. The temporal longevity of

the impact on biodiversity is unknown, and there may be a possibility of regaining the original diversity with careful planning and implementation of restoration of flora throughout the core zone.

The green cover of the core zone was ~25% (~31 acres) of the total area of ~126 acres during our first assessment. The image given below shows the areas in which the green cover has been affected. An approximate area of 15.11 acres of green cover has been lost in the expansion process, bringing down the area under green cover to 13% (~16 acres) . The largest tract of green cover lost was approximately 3.61 acres and the smallest tract was approximately 0.26 acres. Most expansion, and simultaneously loss of green cover has been along the west road, with 2 small sites (~2.47 acres) along the east road.

However, at the time of the final assessment, there seemed to be significant increase in biodiversity within the core zone when compared to the period when the expansion activities had begun as indicated in earlier sections of this report.



Fig.13. Construction/expansion activities indicated in 'red'



Fig 14. Construction activities within the core zone

Few other observation within the core zone include:

- The water flowing along the channels inside the core zone, all of which lead to the tanks at the North-East end, is not clear along certain stretches where one can find algal bloom occurring during summer.
- Along the South side, in a stretch the water seems to be favourable to brine flies, found in hundreds. These flies are known to frequent sewage and septic waters thereby indicating the state of the water along the channel.

- In the water tanks at the NE end of the premises, there are still quite a few dead fish floating on the water, and there are other fish that are found in decent numbers in the same waters.
- Towards the farther end of the East road, there seems to be a mixing of three kinds of waters in the channel that is almost that the spot where all the waters enter the tanks to the right. (1. Flowing from the left that is overridden by algae (probably a case of bio magnifications resulting from substances present in the effluent water discharged from the plant. 2. Flowing in from the right that is cream in colour (possibly from the construction work)



Fig 15. Water bodies within the core zone

3.2.4.2. General observations in the buffer zone:

The area immediately surrounding the plant gives us an impression that the area might be built up on a larger and contiguous wetland. There are a high number of water bodies that are present in the buffer zone. Evidence suggests that some of these water bodies might be linked to each other through seasonal water channels. We also observed major water bodies to have screw draw gates fitted into the bund forming the perimeter of the water body, along the slope. These gates are being used to regulate the flow of water into nearby agricultural areas.

The notified Reserve Forests around the area seem to be primarily eucalyptus plantations, and many of them occur along the road sides (possibly, roads might be running through the reserve forests). Around the water bodies in the buffer zone, we also noticed extensive fishing and hunting activities. We observed multiple instances of hunting along the southern side of the buffer, with many water birds being hunted and cooked. We also found 8 Indian Flap shell Turtles which were lying along the bank of the Perinjambakam Lake, immediately behind the ATL manufacturing facility (core zone).

Apart from the fishing and hunting, we also observed water bodies in the buffer zones being used in unsanitary ways, with open defecation being one of major issues. The local residents in the buffer zone attribute this problem to the increasing number of migrant workers who reside in the area and possibly live in conditions which do not offer them required infrastructure.

Quarrying of stone and sand was also observed in different parts of the buffer zone. Agriculture still appears to be a major activity in the buffer, but the increasing number of construction sites that are blossoming through the region, might soon cause changes which may affect biodiversity in unforeseen ways.

We also observed accumulation and stagnation of waste around wetlands, water bodies. Soil and rock from construction sites were also being disposed of in dried up regions of water bodies or in wetlands. This unregulated disposal of soil could potentially alter the landscape seriously, and may cause existing diversity to adapt or move away from the region (transition from perennial wetland to dry land).



Fig 16. Illegal activities in the buffer zone

3.3. Water bodies in the buffer zone:

Table 3. Description of water bodies in the buffer zone

Water body/Pond/Tank	Description/Issues	Image
<i>Pudhu Kulam</i>	<p>Main problems affected this water body at the Oragadam junction are garbage disposal, and open defecation and unplanned and unregulated flow of waste water and sewage into this water body. Considering this water body is situated in close proximity of large guest house complexes for migrant workers and required supporting infrastructure (hotels, tea shops, et al), it is at high risk of environmental degradation. Another issue noted in this region was the dumping of soil from construction sites along the road side as well as on dried up parts of the lake bed. This could potentially alter the existing geography of the place permanently</p>	

Vella Kulam

This water body faces risk from environmental damage owing to indiscriminate dumping of domestic waste as well as sewage. Due to road expansion being undertaken in this zone, the soil being excavated was being dumped in the water body.



Katteri Kulam

The water body seems to be in fairly good health. The work undertaken in terms of construction of bunds seems to be well done. Soil from road excavations happening nearby is being dumped around the periphery of the water body.

Image not available

Koil Kulam

There are 2 water bodies observed around the temple in Mathur Village. The smaller tank was being used for bathing and washing purposes. The bigger tank was filled with lotus and lily pads. The bigger tank, which is further away from the temple, seems to be connected to the Perinjambakam tank through a water channel which was flowing during summer. The water seemed fresh and had no distinct odour or smell.

The water in the smaller tank seemed quite clean, although there were no entry points for water from outside the tank to flow into it. The water channel flowing towards both these tanks flows through agricultural areas adjacent to the channel. There was also evidence of the water being diverted to agricultural fields.



Pond neighbouring the core zone

The pond seems to be seasonal in nature, with a seasonal connection to the adjoining Perinjambakam tank. There appears to have been dumping of soil excavated from construction sites randomly around this tank. A lot of the aquatic avian biodiversity was noticed shuffling between the core zone



and the tank adjacent to it as well as the Perinjambakam tank. We also observed this area was being treated as an open toilet by migrant workers, truck drivers and locals.



Mathur

The tank at Mathur seemed to be in good health. The water channels coming from the irrigation tank behind the Apollo plant (core zone), had fast flowing clear water running through. The tank in front of the temple was still being used for cleaning purposes. The adjacent isolated tank was covered in lily pads and many species of birds were spotted there. The barren fields in the area were observed being waterlogged based on seasonal availability of water in the region. Periods were observed where the channels were noted to be nearly/completely dry.



Irrigation Tank

The water level in the tank rises based on rainfall and inflow from other water bodies in the region. A few major channels meant to direct water into neighbouring agriculture fields were observed. During monsoon, or just after the monsoon, water levels were noticed to be high enough to cover most parts of the banks. During the dry season, the receded water level enabled us to



approach the centre of the lake more easily. Major human activities around the lake were fishing, garbage disposal, and agriculture..

Eraiyr Tank

There was not a noticeable difference in the health of the tank due to the monsoon and afterwards. Although the surrounding pools had higher water levels. Many water birds were observed in the vicinity, and no litter or garbage issues were noted around the vicinity. We also observed the irrigation channels to be flowing with water.



Vaipur Tank

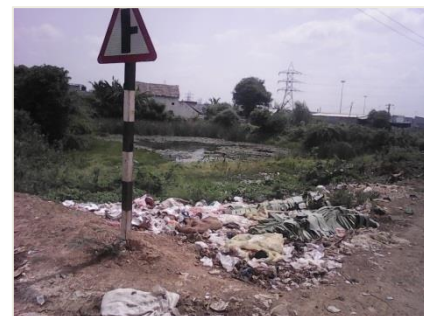
Due to its seasonal nature, water levels had risen due to the monsoon. As a result, there was a noticeable increase in the density and quantity of reeds present in the wetland. Many bird calls were also heard from the reed covered area, but they could not be observed. Smaller stagnant pools of water were also observed rich with amphibian and insect diversity. The connecting pieces of land between stretches of wetland were also observed to be waterlogged.



Sinnakuppam Tank

Water levels here, also, were noticed to be higher. There was an increase in the amount of vegetation present around the tank. Many species of birds, amphibians, reptiles and insects were observed. The adjoining reserve forest patches were also seen noticeably greener. We also noticed water being pumped out from tank into adjoining areas and /or vehicles. The waterlogged area in the vicinity of the tank stretched to a large distance.

Excavations along the periphery of the pond were observed. Large



quantities of litter were observed being dumped in and around the periphery of the tank. The water appeared mucky and green in colour and had a noticeable odour to it.

Mettupalayam Tank

Many physical alterations to the existing tank were observable. Most noticeable being a path created through the middle of the water, with dumped soil, effectively creating two disconnected sides to the tank. Many vehicles were seen plying on these roads. The waterlogged area around this tank also stretched to a considerable distance around the vicinity. Quarrying inside private fenced of lands was also observed, adjoining the periphery of the tank. This tank is still being used as an open toilet by residents of the region.



Perinjambakkam Lake

The Perinjambakkam tank (behind ATL plant) has also begun to play host to a small landfill that has been in use for a while. Domestic waste and some other kinds of waste were also noticed being dumped there. This could potentially be an environmentally degrading activity, as the number of toxins being released into the water could potentially go up.





3.4. Interactions with the community:

The interactions with the community in the buffer zone helped us identify certain key issues pertaining to each of the villages and the area overall. In-depth interactions were possible only at a few villages; however one-one interactions with people at random locations enabled us to understand the issues at large within the buffer zone.

Oragadam:

- During our conversation, she mentioned that 10 years ago the landscape surrounding the village was a wetland and dry land. *Nellu* (Paddy), *Kollu* (Horsegram), *Yellu* (Sesame), *Khel veragu* (Millet) and *Kadali* (groundnut) were cultivated. The agricultural fields were categorised as `Nanjai` and `Punjai`. Nanjai, is the water logged field where paddy was cultivated. Punjai, were the drier land where rain-fed and irrigated crops were cultivated. The water used for domestic and irrigation purposes was drawn from the wetland. Presently the village has been provided with water supply from the panchayat. Most income for villagers is sourced through housekeeping and gardening based opportunities provided on a contract basis to women by surrounding companies/industries. The younger generation, though educated, have not been able to secure employment locally, resulting in migration. According to the interviewees, local residents have not been offered skill based employment opportunities by any company situated in the automobile corridor.
- After the companies were set up, the villagers were not offered any employment opportunities in any of the companies, as promised during the acquisition of land by the government. Most affected are educated individuals, residing in these areas. The labour workforce are mostly immigrants from others states in India. He was also of the opinion that immigrant labour is considered to be less problematic to the companies since they work for minimum wages and only take time off once annually for a month.
- Another scenario that is prevalent in these villages is that the men and youth who are unemployed have become prone to alcoholism and drug addiction. Youth, according to him, get into the habit of drinking at the age of 15.
- Due to the construction of roads and compound wall by the companies, which has altered the natural landscape, drainage of water has been affected in the surrounding villages. The natural connectivity between the entire spread of the land and its perennial/seasonal water bodies have been tampered thus. The resulting stagnation of water is a cause of **water borne diseases**. Mosquito numbers have also increased dramatically in the area over the past decade as a result of stagnation.
- The lack of a regular and planned waste management system in this area has resulted in disposal of garbage near water bodies and in and around the village.
- Activities requested by the people:
 1. *Waste management*
 2. *Sanitation and sewage treatment plant*
 3. *Water /pond cleaning and restoration*

Eraiyr:

- During our conversations with local residents, they mentioned that 10 years before the landscape of the village was a scrub/thorny land. *Kambu*(Millet), *Cholam* and *Kadalai* (groundnut) were cultivated. Currently, gardening and housekeeping opportunities offered to the women on a contract basis, is the major source of income for most families in the village; while a minority continues to practice agriculture.
- Due to an increase in immigrant population, sanitation and waste management has become a serious concern. The lake near the village is choked with garbage. The water is being used by the villagers for domestic purposes (excluding activities requiring potable water). Another result is a shortage of labour to work in agricultural lands, due to high migration rate. The farmers find it difficult to continue practising agriculture as they do not have sufficient capital/subsidy/support from the government to invest in their lands. The farmers also attribute part of their difficulty to the restrictions placed on them in terms of water use from the lake, as well as bore wells or pump wells.
- Activities requested by the people:
 1. Aid/support for farming
 2. Construction of toilets, especially for women
 3. Waste management
 4. Cleaning of the lake (April-May)
-

Mathur:

- The interviewees stated that 10 years ago the village was situated in a wetland landscape. Paddy was mainly cultivated in two seasons during the month of Aadi and Thai. The younger generation is educated but due to the lack of employment opportunities, the level of migration is quite high. The source of income for the villagers is through housekeeping and gardening opportunities given to women on contract basis. The men go for labour work and as watchmen.
- Alcoholism has become an issue in the village. The villagers earn money and on weekend they spend it on alcohol. The lakes seem to be polluted and as a result there are no fishes to be seen now. The residents believe the polluted water is linked to the health issues that have become common over the recent past. As people migrate there are no people to work in agricultural fields. Hence, the land owners who have land are not practice agriculture.
- Activities requested by the people:
 1. Aid/support in farming
 2. Waste management
- *Key points:*
 - *Waste/garbage management needs to be addressed in all villages*
 - *Construction of toilets is a need for the women*
 - *Water /pond/lake cleaning*

Farmers from Mathur and Eraiyur village are interested in farming; support to them will be helpful. There are both landowners as well as people willing to work the fields – the only problem is the apparent lack of communication between the two sections of people. There is good potential for the revival of agriculture in the lands that are still available if the people come together positively for this purpose. This could address some of the unemployment needs locally as well. Alcoholism among youth is also a serious concern.



Fig 17. Interactions with the community

4. Impact related to affecting biodiversity in the vicinity

Based on the results from the biodiversity assessments, the following can be inferred:

4.1. Apollo Tyres Limited, Oragadam:

The impacts of the operations of ATL are:

- **LOW - The facility has a low risk of affecting the biodiversity and the areas with important ecological services needed to maintain biodiversity.**

Hence,

- **LOW- There is a low probability that the facility imposes risk on biodiversity**

Since the ATF is a zero-discharge facility (pers.comm) and no extraction activities are conducted within the core zone, no direct impacts to the biodiversity in the neighbouring areas or the buffer zone was observed during the course of the assessment. Indirect impacts could not be assessed during the course of the assessment, hence indirect consequences on the environment/ ecosystem processes cannot be accurately predicted.

The above statement holds true for the buffer zone, the development activities within the ATF (core zone) has led to visible reduction in the green cover presence in the core zone. The biodiversity found within the core zone was relatively high prior to the expansion activities, significant fluctuations in the biodiversity was observed, which could be attributed to the overall climatic conditions, but the impact of expansion activities cannot be ruled out.

There is scope for enhancing the biodiversity within the core zone, if appropriate measures are taken. (to be discussed in the Biodiversity Enhancement Programme)

4.2. Buffer zone:

The impacts of the other activities in the buffer zone other than those of ATL are:

- **HIGH - The activities in the buffer zone has high risk of affecting the biodiversity and the areas with important ecological services needed to maintain biodiversity**

Hence,

- **HIGH - There are potentially high impacts associated with activities on the biodiversity within close proximity**

Quarrying, hunting, fishing, garbage and sewage disposal, road widening, open defecation and dumping of construction waste in the lakes were some of the activities observed. These activities have a combined effect on the landscape and thereby affecting the biodiversity of the region. Effective measures need to be taken to mitigate certain impacts on biodiversity (to be discussed in the Biodiversity Enhancement Programme)

4.3. Scoring of Impact consequence:

The consequences on various environmental receptors have been ranked into 5 levels consequence and are given in the following table. This table covers flora fauna impacts only focusing on the study being undertaken by the Keystone team.

*Based on the observations and analysis conducted by the Keystone team, the consequence assessment score for ATL was determined as **C5-Moderate Consequence** (Site specific loss (removal) of some common well grown tree/trees species. Site specific loss of nesting/ breeding habitat of common/ generalist species of flora-fauna but will not result in permanent loss of habitat. Short term or long term impacts are likely to adversely affect the habitat character or functioning of ecosystem. Impact on surrounding agro-ecosystem/ agriculture), for both **Core and Buffer zones**. Environmental Impact categorization has only been done for negative impacts. The scoring is based on the descriptions mentioned in the report and follows the 'Scoring Impact Consequence' matrix provided by ATL and is attached as Annexure H.*

Table 4. Impact Consequence scoring: Core Zone

Sl. No.	Category	Score	Assessment
1	Site specific loss (removal) of some common well grown tree/trees species	4	Less severe
2	Site specific loss of nesting/ breeding habitat of common/ generalist species of flora-fauna but will not result in permanent loss of habitat	15	Very severe
3	Short term or long term impacts are likely to adversely affect the habitat character or functioning of ecosystem	16	Very severe
4	Impact on surrounding agro-ecosystem/ agriculture	1	Negligible

Table 5. Impact consequence scoring: Buffer Zone

Sl. No.	Category	Score	Assessment
1	Site specific loss (removal) of some common well grown tree/trees species	4	Less severe
2	Site specific loss of nesting/ breeding habitat of common/ generalist species of flora-fauna but will not result in permanent loss of habitat	20	Very severe
3	Short term or long term impacts are likely to adversely affect the habitat character or functioning of ecosystem	20	Very severe
4	Impact on surrounding agro-ecosystem/ agriculture	4	Less severe

5. Biodiversity Enhancement Programme:

The section on Biodiversity Enhancement Programme is categorised as core and buffer zone. The existing state of biodiversity and the environment is described, relevant areas for interventions have been identified and appropriate biodiversity enhancement measures have been enumerated.

5.1. Current state of biodiversity and the environment in the core zone:

A few major sites where efforts need to be undertaken have been identified through the course of our assessments. The rainwater harvesting areas displayed the most biodiversity within the premises of the core zone. Due to recent construction activities in the region, there has been a noticeable disturbance in the landscape which might have influenced the various faunal species living in these regions as well. The rain water harvesting ponds displayed (during one visit), a lot of dead fish floating on the water surface as well as all along the periphery, where the bunds made contact with the water body. The possibility of an accidental release of a chemical into the water which might have caused the death of all aquatic fauna cannot be ruled out. The sudden burst of algal growth in some of the water drains as well as prominent water channels could also be an indicator of the presence of a chemical in the water.

Most plantations within the campus premises were observed to be monotype plantations, which could be spread out more to increase the area available under shade throughout the plant premises. Due to construction activities, the entire landscape on one side of the plant has been cleared of most vegetation, making it an important site to work towards restoration of green cover, once construction has been completed.

The area behind the main canteen is also another place where green cover could potentially be increased. The open space available could host a variety of plant species, including fruiting or flowering species which in turn could host a wide variety of biodiversity.

The lawn structures along the sides of the plant have also been considerably disturbed by the expansion activities, and are vital that these habitats be restored as soon as expansion activities are completed. These areas housed a large number of grassland species of flora and fauna.

The table given below provides information on the areas (habitats) identified for intervention, current management practices and recommendations.



5.1.1. Biodiversity enhancement measures for the core zone:

5.1.1.1. Grasslands (Lawn):

Grassland/lawns in the core zones have intensive management and regularly mowing in the lawns, playing fields and planted flower beds. It can be found in the south direction near the main entrance gate and on the eastern side. The expansion on the western and north direction has restricted a variety of flora and fauna.

Current Management Practices	Recommended practices	Description of recommended practices
<ul style="list-style-type: none"> Grass is cut/mowed at periodic intervals Periodic watering is observed 	Bark mulch, mowed grasses can be used as raw material for composting	
	Pruning especially during flowering season can be avoided	
	Native flowering species can be double planted. (Plants flowering during April/May and September/October)	
	Less intensive management of the margin grassland can be followed at the fabrication unit and rain water harvesting pond	A less rigorous mowing regime should be adapted to create a buffer strip to improve the biodiversity value that enabling plants to flower and seed. These areas should be cut annually at the end of the flowering season.
	Recreation of wildflower rich areas.	Grassland can be enhanced by growing flowering species which can provide cover for invertebrates and source of nectar for insects. The following species are suitable seedling or sowing into the grassland/lawns and was found in few numbers within the core zone: <i>Anisomeles indiva</i> (Malabar-catmint) <i>Astercantha longifolia</i> (Long leaves barleria) <i>Boerhavia diffusa</i> (Hog weed) <i>Croton sparsiflorus</i> (Garden croton) <i>Fluggea leucopyrus</i> (Dehiscent berry)

Heliotropium indicum (Indian heliotrope)
Justicia simplex
Leucas aspera
Lippia nodiflora
Mimosa pudica (Touch me not)
Oldenlandia corymbosa (Flattop mille grains)
Abrus precatorius
Cardiospermum halicacabum

5.1.1.2. Buildings and built-up structures:

The core zone has significant number of buildings. The two main ways in which the buildings can support biodiversity is through installation of bird boxes and creation of green roofs and walls. In the future the potential for biodiversity enhancement should be considered right from the design and planning process for new development. However, the issue of Foreign Particulate Matter (FPM) entering is unfavourable for the production process within the core zone, in which case the production structures could be avoided and common spaces found along the Eastern side and the areas near the sewage and effluent treatment plants of the core zone could be considered.

Current Management Practices	Recommended practices	Description of recommended practices
<ul style="list-style-type: none"> Avenue trees (non-flowering) have been planted and species chosen on recommendations from the Tamil Nadu Pollution Control Board and the Forest Department. Rain water harvesting ponds have been created The avenue trees and rainwater harvesting ponds provide support to a limited amount of biodiversity 	Installation of bird boxes	A number of birds rely on the availability of suitable nesting substrates within buildings which modern building do not have. Bird boxes provides additional nesting space and can be fitted onto buildings, trees, walls etc.
	Green roofs for structures	Green roofs can enhance the biodiversity value of built-up area through replacing some of the habitat lost at ground level through the presence of vegetation on the roof. The y can be installed on most roof types provided the building is able to

	<p>support the weight of a green roof. It could potentially provide a habitat for ground nesting birds.</p> <p>www.greeningupthecity.com</p> <p>Species to consider for green roof: <i>Abrus precatorius</i> (Coral bead plant) <i>Capparis zeylanica</i> (Indian caper) <i>Cardiospermum halicacabum</i> (Balloon wine) <i>Clitoria ternatea</i> (Blue pea) <i>Gloriosa superba</i> (Flame lily) <i>Hugonia mystax</i> (Climbing flax)</p>
Creation of green walls	<p>Green walls are the walls with vegetation growing on them. These walls mimic natural rock faces providing habitat for several species of birds, reptiles and invertebrates. A green wall can be created by growing climbers against a section of the wall.</p> <p>Species to consider for green walls: <i>Ficus repens</i> (Creeping fig) <i>Hedera sp.</i> (Ivy)</p>
Construction of artificial habitats	<p>Creation of habitats provides home for invertebrates, pollinators and reptiles. The most suitable place would be under the tree or beside a wall. Artificial habitats can be made by piling up of wood planks. The gaps between the wooden planks can be filled with stones, twigs and tiles. The top layer can be covered by moss and dry leaves.</p>
Construct wood piles	<p>Dead and decaying wood is a haven for insects, fungi, mosses and lichens and also provides a food source for birds. A large pieces of wood or log can be used which can be placed on the ground on a shaded area.</p>

5.1.1.3. Tree cover:

26 species of trees were found in the core zone ranging from native and non-native trees. The trees are planted in all four directions of the core zone mainly concentrated in the North West and North East side. Due to expansion the planted trees from the North West and north east side was transplanted to the areas near the rain water harvest pond and to the neighbouring sister concern. Palms were planted along the walk ways. Most plantations within the campus premises were observed to be monotype plantations, which could be spread out more to increase the area available under shade throughout the plant premises. Due to construction activities, the entire landscape on one side of the plant has been cleared of most vegetation, making it in an important site to work towards restoration of green cover, once construction has been completed.

The area behind the main canteen is also another place where green cover could potentially be increased. The open space available could host a variety of plant species, including fruiting or flowering species which in turn could host a wide assortment of biodiversity.

Current Management Practices	Recommended practices	Description of recommended practices
<ul style="list-style-type: none"> The campus has landscape horticulturist and many gardeners who inspects and implement pruning and replacement planting. A well-established nursery is in place Drip irrigation is observed. 	Planting of native trees	<p>Trees can be grown in hedgerows, shoreline of water bodies (rain water harvesting pond) and along the boundary. Trees provide a natural habitat for birds and animals and also as source of food. These trees also provide aesthetic value.</p> <p>Species to consider for planting:</p> <p><i>Azadirachta indica</i> <i>Cassia fistula</i> <i>Enterolobium saman</i> <i>Mangifera indica</i> <i>Madhuca latifolia</i> <i>Memecylon umbellatum</i> <i>Mimusops elengi</i> <i>Murraya paniculata</i> <i>Ixorra parviflora</i> <i>Ochna squarrosa</i> <i>Pavetta indica</i> <i>Syzygium cumini</i> <i>Sapindus emarginatus</i></p>
	Planting of pollution control trees	Filtering of pollutants is most effective when

plants are close to the source of pollution. They are also effectiveness in alleviating noise pollution. The following species are likely potential for pollution control. The species that are currently performing the function of pollution control within the core zone are *Ficus macrocarpa* and *Ficus benjamii*. In addition to the above mentioned species, the following could be considered:
Acaica nilotica (Babul)
Dyospyros sp.
Polyathia lotigifolia (Asoka)
Tamraindus indica (Indian date)
Zizypus jujuba (jujuba)

5.1.1.4. Wetlands (water bodies):

Wetland include all standing water such as lakes ponds, pools and al running water, such as rivers and streams. The core zone has a rain water harvesting pond on the Eastern side. Water running in canals is observed in all four directions of the core zone.

Current Management Practices	Recommended practices	Description of recommended practices
<ul style="list-style-type: none"> • Ponds and water course are cleaned. During our recent visits we observed that the fishes in the rain water harvesting pond were dead and the water looked oily and polluted. • The water running in the canals were clear during our initial visits. Lately the water had algal growths, turbid with foul smell. • Periodical monitoring of water quality 	<p>Every 3 to 5 years the water can be drained or lowered to prevent build-up of rotting material</p>	<p>Pumps and fountains can be used to agitate ponds, introducing oxygen to sustain pond life and reduce the build-up of weed and algal growth</p>

Algal growth can be removed manually		
Creating a corridor between wetland areas		Increasing the width and diversity of the marginal vegetation strips along the edges of ponds and waterways will help to create corridors for wetland species. These corridors can be created by establishing a one metre buffer strip around the perimeter of a wetland area, which can then be linked to other such areas in order to create a network of safe routes for wetland species to move between.
Reduce excessive woodland shading on the banks of wetland areas		Excessive shading from woodland on the bank of a wetland area can result in limited marginal vegetation development. Increased light levels would enhance marginal floral species and in turn increase the connectivity or flow of water to the nearby water body. The marginal habitats should be managed on a rotational basis with no more than 30% of the total surface area of the water body.
Improve the fish stock in the ponds		The rain water harvest pond is a man-made brick and with cement concrete and is home to non-native fishes such as <i>Tilapia sp.</i> . Native fish stock can be introduced in to the pond. The fish stocked ponds often reduce the biodiversity value compared to other ponds because the fish tend to cause silt disturbance resulting in reduced light levels, excessive algae growth takes place due to the additional nutrients added from fish excrement, and the fish can eat submerged water plants and smaller animals. An area could be segregated from the fish using netting.
Connecting with nearby water bodies		Wetlands contribute to the biodiversity by providing corridors and potential habitat for birds, butterflies, insects and reptiles. The area near the rain water harvest pond has been identified as area

where habitat creation would enhance the biodiversity by linking the existing wetlands/small ponds immediately north of the campus (pond adjacent to Apollo, via Classic Industry). Planting of native trees and shrubs at these locations would enhance the overall biodiversity and movement of animals.

Species to consider for creating corridors:

Acorus calamus

Juncus sp.

Typha angustata

Cypres rotundus

Cypres kyllingia



5.2. Current state of biodiversity and the environment in the buffer zone:

The buffer area presented varied landscape complexes ranging from scrub to dry evergreen to wetland. Agricultural practice, housing, constructions, expansion of road, laying of cable along forest borders and dumping of garbage along roadsides and water bodies were the various observation made in the buffer zone. A major issue in the buffer zone is the seasonal availability of water, as well as land use patterns that go hand in hand with water.

The biodiversity enhancement recommendation was prioritised across four categories for different habitats for the core zone. As the buffer zone has many stakeholders and the management plan needs to be in partnership. Hence, the recommendation is not habitat wise, but listed as priority sites for intervention. It was observed that there an increasing amount of anthropogenic pressure on the environment. As the available space was used for garbage dumping and as open toilets. It was felt that if the issues of waste management and sanitation were addressed. The pressure on the environment would decrease.

- **Priority 1: Wetlands and water bodies**

Current Management Practices/ Status	Recommended practices	Description of recommended practices	Stakeholders
<ul style="list-style-type: none"> • The lakes/water bodies are under panchayath tenure. • Grazing, fishing, hunting is observed • The water bodies are interconnected • Garbage and sewage disposal • Landfills for construction waste • Water used for irrigation, drinking, bathing, washing and other domestic/private purposes • Other forms of encroachment 	Mark and strengthen the boundary of the lake/water body (Full tank level)	Marking of boundaries is essential because as the water receded during summer, the dried up areas are used as landfills for construction waste, garbage disposal and other encroachments.	Panchayath, communities, migrant workers, other industries
	Every 3 to 5 years the water can be drained or lowered to prevent build-up of rotting material.	As mentioned in the biodiversity enhancement recommendations for core zone	
	Pumps and fountains can be used to	As mentioned in the biodiversity	

agitate ponds, introducing oxygen to sustain pond life and reduce the build-up of weed and algae problems.	enhancement recommendations for core zone
Creating a corridor between wetland areas.	As mentioned in the biodiversity enhancement recommendations for core zone
Reduce excessive shading on the banks of wetland areas.	As mentioned in the biodiversity enhancement recommendations for core zone
Information board for all water bodies and lakes	Information boards stating the importance of wetlands and the flora and fauna associated with the ecosystem can be put up.
Wetland eco-park	Parks can be developed around wetlands which is open to public and for nature education activities. This could prevent illegal activities at the lake/water body
Connecting with existing natural ecosystems	As mentioned in the biodiversity enhancement recommendations for core zone; wetlands)

- **Priority 2: Efficient waste management system:**

ATL has initiated waste management works at Sennakuppam village. ATL has a staff working with the composting yard and have developed a small kitchen garden. The work needs technical inputs and strategic planning from the collection of waste, segregation and composting, along with efficient ways of managing sewage and improving sanitation. Keystone suggests that the work could be done in collaboration with Gramalaya, an NGO based at Trichy with expertise on waste management and sanitation. <http://www.gramalaya.in/>. As part of CSR activity, ATF can contribute to Swachh Bharat Mission, which can take up work of sanitation in selected villages, in partnership with the local government. The details can be looked at http://sbm.gov.in/cfd/Document/Guidelines_CSR_SBM.pdf.

The underlying premise to the above recommendation is that engagement with the relevant stakeholders, including the migrant worker community in waste management systems and sanitation would directly contribute to the well-being of the ecosystem, thereby ensuring increase in biodiversity. Ecological

systems may not require direct interventions, but addressing the factors affecting them is pertinent to ensure the proper functioning and longevity of these systems.



Fig.18. Waste management at Sennakuppam by ATL

Priority 3: Awareness creation among the community and local administration:

Awareness among the community and local administration is an important aspect to be considered for better quality of environment. The recent Chennai floods was due to lack of enforcement of planning rules that resulted in rampant building violations, such as encroaching roads and pavements, illegal connections of sewerage lines to storm water drains and construction on ponds, lakes, marshes and other natural catchment areas. Oragadam with development underway, such a scenario could be avoided happening in the future.

Socio economic assessment of the community would help to understand the changes in demographics, employment and income level which would help in knowing the skills of people and creation of jobs.

The interactions with the people of Sennakuppam, Eraiyur and Mathur. According to the interviewee of Eraiyur it was known that the local residents have not been offered skill based employment opportunities by any company situated in the automobile corridor. The farmers find it difficult to continue practising agriculture as they do not have sufficient capital/subsidy/support from the government to invest in their lands. There is good potential for the revival of agriculture in the lands that are still available if the people come together positively for this purpose. This could address some of the unemployment needs locally as well. Alcoholism among youth is also a serious concern. They had also requested waste management, construction of toilets, sewage treatment and water /pond cleaning and restoration to improve the quality of the environment. As the survey was a random sampling, the information may was not sufficient it would be better if an in depth socio economic assessment is done in this regard.

The socio-economic assessment would provide further insights into the social systems that exist in the buffer zone, which in turn could assist in further interactions with the community. It would provide an avenue to engage with the community in managing the ecological systems of the buffer zone.

Annexure A_List of Plants in the core zone

S.No.	Species name	Habit	Family	Introduced/Native	Redlist
1	<i>Abrus precatorius</i>	Climber	Fabaceae	Native	NA
2	<i>Abutilon indicum</i>	Shrub	Malvaceae	Native	NA
3	<i>Acacia nilotica</i>	Tree	Mimosaceae	Native	NA
4	<i>Acalypha amentacea</i>	Shrub	Euphorbiaceae	Introduced	NA
5	<i>Acanthospermum hispidum</i>	Herb	Asteraceae	Introduced	NA
6	<i>Achyranthes aspera</i>	Herb	Amaranthaceae	Native	NA
7	<i>Aeschynomene aspera</i>	Herb	Fabaceae	Native	LC
8	<i>Agapanthus africanus</i>	Shrub	Amarylidaceae	Introduced	NA
9	<i>Agaricus sp.</i>	Fungi	Agaricaceae	Native	NA
10	<i>Agaricus urinascens</i>	Fungi	Agaricaceae	Native	NA
11	<i>Allmania nudiflora</i>	Herb	Amaranthaceae	Native	NA
12	<i>Alstonia scholaris</i>	Tree	Apocynaceae	Native	LC
13	<i>Alternanthera dentata</i>	Herb	Amaranthaceae	Introduced	NA
14	<i>Alternanthera sessilis</i>	Herb	Amaranthaceae	Native	NA
15	<i>Alysicarpus monilifer</i>	Herb	Fabaceae	Native	NA
16	<i>Alysicarpus sp.</i>	Herb	Fabaceae	Native	NA
17	<i>Amaranthus</i>	Herb	Amaranthaceae	Native	NA
18	<i>Ammania baccifera</i>	Herb	Lythraceae	Native	NA
19	<i>Andrographis paniculata</i>	Herb	Acanthaceae	Native	NA
20	<i>Anisomeles indica</i>	Herb	Lamiaceae	Native	NA
21	<i>Anisomeles malabarica</i>	Herb	Lamiaceae	Native	NA
22	<i>Apluda mutica</i>	Grass	Poaceae	Native	NA
23	<i>Aristida setacea</i>	Grass	Poaceae	Native	NA
24	<i>Astercantha longifolia</i>	Subshrub	Acanthaceae	Native	NA
25	<i>Asystasia gangetica</i>	Herb	Acanthaceae	Native	NA
26	<i>Azadirachta indica</i>	Tree	Meliaceae	Native	NA
27	<i>Bacopa monnieri</i>	Herb	Aizoaceae	Native	NA
28	<i>Bamboo</i>	Grass	Poaceae	Native	NA
29	<i>Bambusa vulgaris</i>	Grass	Poaceae	Native	NA
30	<i>Baptisia</i>	Herb	Fabaceae	Introduced	NA
31	<i>Baugainvillea spectabilis</i>	Liana	Nyctaginaceae	Introduced	NA
32	<i>Bauhinia variegata</i>	Tree	Fabaceae	Native	NA
33	<i>Blepharis integrifolia</i>	Herb	Acanthaceae	Native	NA
34	<i>Blepharis maderaspatensis</i>	Herb	Acanthaceae	Native	NA
35	<i>Boerhavia diffusa</i>	Herb	Nyctaginaceae	Native	NA
36	<i>Boerhavia erecta</i>	Herb	Nyctaginaceae	Native	NA
37	<i>Borassus flabellifer</i>	Palm	Palmaceae	Native	NA
38	<i>Bulbostylis densa</i>	Grass	Poaceae	Native	LC
39	<i>Caesalpinia pulcherrima</i>	Shrub	Caesalpinaceae	Introduced	NA
40	<i>Calatropis gigantea</i>	Shrub	Asclepiadaceae	Native	NA
41	<i>Callistemon sp</i>	Shrub	Myrtaceae	Introduced	NA

Annexure A_List of Plants in the core zone

42	<i>Calocera</i> sp.	Fungi		Native	NA
43	<i>Calophyllum inophyllum</i>	Tree	Clausiaceae	Native	LC
44	<i>Calotropis gigantea</i>	Shrub	Asclepiadaceae	Native	NA
45	<i>Canna indica</i>	Herb	Cannaceae	Introduced	NA
46	<i>Canscora heteroclita</i>	Herb	Gentianaceae	Native	NA
47	<i>Cardiospermum halicacabum</i>	Creeper	Sapindaceae	Native	NA
48	<i>Carissa spinarum</i>	Shrub	Apocynaceae	Native	NA
49	<i>Carmona retusa</i>	Shrub	Boraginaceae	Native	NA
50	<i>Cassia auriculata</i>	Shrub	Caesalpiniaceae	Native	NA
51	<i>Cassia fistula</i>	Tree	Caesalpiniaceae	Native	NA
52	<i>Cassia tora</i>	Shrub	Caesalpiniaceae	Native	NA
53	<i>Cassytha filiformis</i>	Climber	Lauraceae	Native	NA
54	<i>Cassytha</i> sp.	Climber	Cassythaceae	Native	NA
55	<i>Casurina equisetifolia</i>	Tree	Casurinaceae	Introduced	NA
56	<i>Centella asiatica</i>	Spreading herb	Apiaceae	Native	NA
57	<i>Chloris barbata</i>	Grass	Poaceae	Native	NA
58	<i>Chrysopogon aciculatus</i>	Grass	Poaceae	Native	NA
59	<i>Cissus quadrangulris</i>	Climber	Vitaceae	Native	NA
60	<i>Cleome viscosa</i>	Herb	Capparaceae	Native	NA
61	<i>Clerodendrum inerme</i>	Shrub	Verbenaceae	Native	NA
62	<i>Clitoria ternata</i>	Climber	Fabaceae	Native	NA
63	<i>Coccinia grandis</i>	Climber	Cucurbitaceae	Native	NA
64	<i>Cocos nucifera</i>	Tree	Arecaceae	Native	NA
65	<i>Commelina benghalensis</i>	Herb	Commelinaceae	Native	LC
66	<i>Cordia obliqua</i>	Tree	Boraginaceae	Native	NA
67	<i>Cordia sesbania</i>	Tree	Cordiaceae	Introduced	NA
68	<i>Croton bonplandianum</i>	Herb	Euphorbiaceae	Introduced	NA
69	<i>Cucumis trigonus</i>	Climber	Cucurbitaceae	Native	NA
70	<i>Cucurbitaceae</i>	Climber	Cucurbitaceae	Native	NA
71	<i>Cuphea hyssopifolia</i>	Herb	Lythraceae	Introduced	NA
72	<i>Cycas revoluta</i>	Tree	Cycadaceae	Introduced	NA
73	<i>Cymbopogon flexuosus</i>	Grass	Poaceae	Native	NA
74	<i>Cynodon dactylon</i>	Grass	Poaceae	Native	NA
75	<i>Cyperus compressus</i>	Sedge	Cyperaceae	Native	NA
76	<i>Cyperus rotundus</i>	Sedge	Cyperaceae	Native	NA
77	<i>Cyprepis kyllinga</i>	Sedge	Cyperaceae	Native	NA
78	<i>Dactyloctenium aegyptium</i>	Grass	Poaceae	Introduced	NA
79	<i>Desmodium triflorum</i>	Herb	Fabaceae	Introduced	NA
80	<i>Digera arvense</i>	Herb	Amaranthaceae	Native	NA
81	<i>Dodonaea angustifolia</i>	Shrub	Sapindaceae	Native	NA
82	<i>Dopatrium junceum</i>	Herb	scrophulariaceae	Native	LC

Annexure A_List of Plants in the core zone

83	<i>Duranta erecta</i>	Shrub	Verbenaceae	Introduced	NA
84	<i>Echinochloa sp.</i>	Grass	Poaceae	Native	NA
85	<i>Echinochloa sp1.</i>	Grass	Poaceae	Native	NA
86	<i>Echinochloa sp2.</i>	Grass	Poaceae	Native	NA
87	<i>Eclipta alba</i>	Herb	Asteraceae	Native	NA
88	<i>Elicpta prostrata</i>	Herb	Asteraceae	Native	NA
89	<i>Emilia sonchifolia</i>	Herb	Asteraceae	Native	NA
90	<i>Enicostemma littorale</i>	Herb	Gentianaceae	Native	NA
91	<i>Eragostatis</i>	Grass	Poaceae	Native	NA
92	<i>Eragrostiella bifaria</i>	Grass	Poaceae	Native	NA
93	<i>Eriocaulon sp.</i>	Herb	Eriocaulaceae	Native	NA
94	<i>Eucalyptus tereticornis</i>	Tree	Myrtaceae	Introduced	NA
95	<i>Euphorbia heterophylla</i>	Herb	Euphorbiaceae	Native	NA
96	<i>Euphorbia hirta</i>	Herb	Euphorbiaceae	Native	NA
97	<i>Euphorbia hycericifolia</i>	Herb	Euphorbiaceae	Introduced	NA
98	<i>Euphorbia thymifolia</i>	Herb	Eriocaulaceae	Native	NA
99	<i>Evolvulus alsinoides</i>	Spreading herb	Convolvulaceae	Native	NA
100	<i>Felicium decipiens</i>	Tree	Sapindaceae	Native	NA
101	<i>Ficus benjamina</i>	Tree	Moraceae	Native	NA
102	<i>Ficus macrocarpa</i>	Tree	Moraceae	Native	NA
103	<i>Fimbristylus dicotoma</i>	Sedge	Cyperaceae	Native	NA
104	<i>Fleuggea</i>	Shrub	Euphorbiaceae	Native	NA
105	<i>Frimbristylis sp.</i>	Sedge	Cyperaceae	Native	NA
106	<i>Fuirena trilobites</i>	Sedge	Cyperaceae	Endemic to peninsular india	NA
107	<i>Gmelina asiatica</i>	Shrub	Verbenaceae	Native	NA
108	<i>Gomphrena decumbens</i>	Herb	Amaranthaceae	Introduced	NA
109	<i>Goniogyna hirta</i>	Herb	Fabaceae	Native	NA
110	<i>Grevillea robusta</i>	Tree	Proteaceae	Introduced	NA
111	<i>Grewia sp.</i>	Tree	Tiliaceae	Native	NA
112	<i>Hemidesmus indicus</i>	Climber	Asclepiadaceae	Native	NA
113	<i>Heteropogon contortus</i>	Grass	Poaceae	Native	NA
114	<i>Hoppea dichotoma</i>	Herb	Gentianaceae	Native	LC
115	<i>Hybanthus ennaespermus</i>	Herb	Violaceae	Native	NA
116	<i>Hyptis suaueolens</i>	Herb	Lamiaceae	Introduced	NA
117	<i>Indigofera enneaphylla</i>	Creeper	Fabaceae	Native	NA
118	<i>Indigofera linnae</i>	Herb	Fabaceae	Native	NA
119	<i>Ipomoea biloba</i>	Spreading herb	Convolvulaceae	Native	NA
120	<i>Ipomoea carnea</i>	Shrub	Convolvulaceae	Native	NA
121	<i>Ixora singaporensis</i>	Shrub	Rubiaceae	Introduced	NA
122	<i>Juncus sp.</i>	Sedge	Cyperaceae	Native	NA
123	<i>Justicia simplex</i>	Herb	Acanthaceae	Native	NA

Annexure A_List of Plants in the core zone

124	<i>Kyllinga triceps</i>	Sedge	Cyperaceae	Native	NA
125	<i>Lagerstroemia reginae</i>	Tree	Lythraceae	Native	NA
126	<i>Lantana camara</i> <i>var.hybrida</i>	Shrub	Verbenaceae	Introduced	NA
127	<i>lemna sp.</i>	Aquatic herb	Lemnaceae	Native	NA
128	<i>Lepidagathis cristata</i>	Herb	Acanthaceae	Endemic to peninsular india	NA
129	<i>Leucas aspera</i>	Herb	Lamiaceae	Native	NA
130	<i>Leucophloea</i> <i>leucocephala</i>	Tree	Mimosaceae	Introduced	NA
131	<i>Lippia nodiflora</i>	Herb	Verbenaceae	Introduced	NA
132	<i>Ludwigia adscendens</i>	Herb	Onagraceae	Native	NA
133	<i>Luffa cylindrica</i>	Climber	Cucurbitaceae	Native	NA
134	<i>Maba buxifolia</i>	Tree	Ebenaceae	Native	NA
135	<i>Mangifera indica</i>	Tree	Anacardiaceae	Native	NA
136	<i>Marsilea minuta</i>	Herb	Marsileaceae	Native	NA
137	<i>Martynia annua</i>	Herb	Pedaliaceae	Native	NA
138	<i>Maytenus emarginata</i>	Shrub	Celastraceae	Native	NA
139	<i>Melia dubia</i>	Tree	Meliaceae	Native	NA
140	<i>Mellittia pinnata</i>	Tree	Fabaceae	Native	NA
141	<i>Memecylon umbellatum</i>	Tree	Melastomataceae	Native	NA
142	<i>Merremia tridentata</i>	Climber	Convolvulaceae	Native	NA
143	<i>Mimosa pudica</i>	Herb	Mimosaceae	Introduced	NA
144	<i>Morinda sp.</i>	Tree	Rubiaceae	Native	NA
145	<i>Mukia maderaspatana</i>	Climber	Cucurbitaceae	Native	NA
146	<i>Muntingia calabura</i>	Tree	Malvaceae	Introduced	NA
147	<i>Murraya paniculata</i>	Shrub	Rutaceae	Native	NA
148	<i>Najas minor</i>	Aquatic herb	Najadaceae	Native	NA
149	<i>Obtimum compositus</i>	Grass	Poaceae	Native	NA
150	<i>Oldenlandia umbellata</i>	Herb	Rubiaceae	Native	NA
151	<i>Opuntia stricta</i>	Shrub	Cactaceae	Introduced	NA
152	<i>Osbeckia zeylanica</i>	Herb	Melastomaceae	Native	NA
153	<i>Oxystelma esculentum</i>	Creeper	Asclepiadaceae	Native	LC
154	<i>Parthenium</i> <i>hysterophorus</i>	Herb	Asteraceae	Introduced	NA
155	<i>Paspalidium flavidum</i>	Sedge	Cyperaceae	Native	LC
156	<i>Passiflora foetida</i>	Climber	Passifloraceae	Native	NA
157	<i>Pennisetum sp.</i>	Grass	Poaceae	Native	NA
158	<i>Pergularia daemia</i>	Climber	Apocynaceae	Native	NA
159	<i>Perotis indica</i>	Grass	Poaceae	Native	NA
160	<i>Phaseolus trilobus</i>	Herb	Fabaceae	Native	NA
161	<i>Phoenix sylvestris</i>	Shrub	Arecaceae	Native	NA
162	<i>Phoenix pusilla</i>	Tree	Arecaceae	Endemic to coramental coast	NA
163	<i>Phyllanthus amarus</i>	Herb	Euphorbiaceae	Native	NA

Annexure A_List of Plants in the core zone

164	<i>Phyllanthus debilis</i>	Herb	Euphorbiaceae	Native	NA
165	<i>Phyllanthus maderaspatensis</i>	Herb	Euphorbiaceae	Native	NA
166	<i>Phyllanthus niruri</i>	Herb	Euphorbiaceae	Introduced	NA
167	<i>Phyllanthus simplex</i>	Herb	Euphorbiaceae	Native	NA
168	<i>Physalis minima</i>	Herb	Solanaceae	Native	NA
169	<i>Pistia stratiotes</i>	Aquatic herb	Araceae	Introduced	NA
170	<i>Plecosperrum sp.</i>	Tree	Moraceae	Native	NA
171	<i>Plumeria alba</i>	Shrub	Apocynaceae	Introduced	NA
172	<i>Plumeria pudica</i>	Shrub	Apocynaceae	Introduced	NA
173	<i>Polyalthia longifolia</i>	Shrub	Mimosaceae	Native	NA
174	<i>Polycarpeae corymbosa</i>	Herb	Caryophyllaceae	Native	NA
175	<i>Portulaca oleracea</i>	Herb	Portulacaceae	Native	NA
176	<i>Potamogeton sp.</i>	Herb	Potamogetanaceae	Native	NA
177	<i>Prosopis juliflora</i>	Tree	Fabaceae	Introduced	NA
178	<i>Pseuderanthemum carruthersii</i>	Shrub	Acanthaceae	Introduced	NA
179	<i>Pseuderanthemum reticulatum</i>	Shrub	Acanthaceae	Introduced	NA
180	<i>Psidium guajava</i>	Tree	Myrtaceae	Introduced	NA
181	<i>Randia dumetorum</i>	Tree	Rubiaceae	Native	NA
182	<i>Rhynchosia minima</i>	Herb	Fabaceae	Native	LC
183	<i>Ricinus communis</i>	Shrub	Euphorbiaceae	Native	NA
184	<i>Rivea hypocrateriformis</i>	Climber	Convolvulaceae	Native	NA
185	<i>Sarcostemma acidum</i>	Climber	Asclepiadaceae	Native	NA
186	<i>Scoparia dulcis</i>	Herb	Scrophulariaceae	Introduced	NA
187	<i>Secamone emitica</i>	Climber	Apocynaceae	Native	NA
188	<i>Securenega leucopyrus</i>	Shrub	Euphorbiaceae	Native	NA
189	<i>Sida acuta</i>	Herb	Malvaceae	Introduced	NA
190	<i>Sida cordifolia</i>	Herb	Malvaceae	Native	NA
191	<i>Spathodea campanulata</i>	Tree	Bignoniaceae	Introduced	NA
192	<i>Spermacoce ocymoides</i>	Herb	Rubiaceae	Native	NA
193	<i>Spermacoce hispida</i>	Herb	Rubiaceae	Native	NA
194	<i>Stachytarpeta jamaicensis</i>	Herb	Verbenaceae	Introduced	NA
195	<i>Stemodia viscosa</i>	Herb	Scrophulariaceae	Native	NA
196	<i>Sterculia foetida</i>	Tree	Sterculiaceae	Introduced	NA
197	<i>Striga asiatica</i>	Herb	Scrophulariaceae	Native	NA
198	<i>Stylosanthes hamatus</i>	Herb	Fabaceae	Introduced	NA
199	<i>Syzygium cumini</i>	Tree	Myrtaceae	Native	NA
200	<i>Tabernaemontana divaricatata</i>	Shrub	Apocynaceae	Native	NA
201	<i>Tarenna asiatica</i>	Shrub	Rubiaceae	Native	NA
202	<i>Tecomaria capensis</i>	Liana	Bignoniaceae	Introduced	NA
203	<i>Tectona grandis</i>	Tree	Lamiaceae	Native	NA
204	<i>Tephrosia purpurea</i>	Herb	Fabaceae	Native	NA

Annexure A_List of Plants in the core zone

205	<i>Terminalia arjuna</i>	Tree	Combretaceae	Native	NA
206	<i>Terminalia catappa</i>	Tree	Combretaceae	Native	NA
207	<i>Tilia sp.</i>	Herb	Sterculiaceae	Native	NA
208	<i>Tradescantiasp.</i>	Herb	Commelinaceae	Introduced	NA
209	<i>Tragia involucrata</i>	Climber	Euphorbiaceae	Native	NA
210	<i>Trichodesma sp.</i>	Herb	Boraginaceae	Native	NA
211	<i>Tridax procumbens</i>	Herb	Asteraceae	Introduced	NA
212	<i>Turnera subulata</i>	Herb	Passifloraceae	Introduced	NA
213	<i>Typha angustata</i>	Grass	Poaceae	Native	NA
214	<i>Vernonia cinerea</i>	Herb	Asteraceae	Native	NA
215	<i>Waltheria indica</i>	Subshrub	Sterculiaceae	Native	NA
216	<i>Wasingtonia filifera</i>	Palm	Areaceae	Introduced	LC/near threatened
217	<i>Wattakaka volubilis</i>	Climber	Asclepiadaceae	Native	NA
218	<i>Wedelia urticifolia</i>	Herb	Asteraceae	Native	NA
219	<i>Xanthium indicum</i>	Shrub	Asteraceae	Native	NA
220	<i>Ziziphus mauritiana</i>	Tree	Rhamnaceae	Native	NA
221	<i>Ziziphus oenoplia</i>	Shrub	Rhamnaceae	Native	NA

Annexure B_List of plants in the buffer zone and water bodies (lakes/ponds)

Sl.No	Species	Habit	Family	Native/Introduced	IUCN category
1	<i>Abrus precatorius</i>	Climber	Fabaceae	Native	NA
2	<i>Abutilon indicum</i>	Shrub	Malvaceae	Native	NA
3	<i>Acacia nilotica</i>	Tree	Mimosaceae	Native	NA
4	<i>Achyranthes aspera</i>	Herb	Amaranthaceae	Native	NA
5	<i>Allmania nudiflora</i>	Herb	Amaranthaceae	Native	NA
6	<i>Alternanthera sessilis</i>	Herb	Amaranthaceae	Native	NA
7	<i>Ammania baccifera</i>	Herb	Lythraceae	Native	LC
8	<i>Anisomeles indica</i>	Herb	Lamiaceae	Native	NA
9	<i>Anisomeles malabarica</i>	Herb	Lamiaceae	Native	NA
10	<i>Apluda mutica</i>	Grass	Poaceae	Native	NA
11	<i>Aristida setacea</i>	Grass	Poaceae	Native	NA
12	<i>Astercantha longifolia</i>	Subshrub	Acanthaceae	Native	NA
13	<i>Azadirachta indica</i>	Tree	Meliaceae	Native	NA
14	<i>Benkara malabarica</i>	Tree	Rubiaceae	Native	NA
15	<i>Blepharis integrifolia</i>	Herb	Acanthaceae	Native	NA
16	<i>Blepharis maderaspatensis</i>	Herb	Acanthaceae	Native	NA
17	<i>Borassus flabellifer</i>	Palm	Palmaceae	Introduced	NA
18	<i>Bulbostylis densa</i>	Sedge	Cyperaceae	Native	NA
19	<i>Calatropis gigantea</i>	Shrub	Asclepiadaceae	Native	NA
20	<i>Canscora heteroclita</i>	Herb	Gentianaceae	Native	NA
21	<i>Cardiospermum halicacabum</i>	Climber	Sapindaceae	Native	NA
22	<i>Carissa spinarum</i>	Shrub	Apocynaceae	Native	NA
23	<i>Carmona retusa</i>	shrub	Boraginaceae	Native	NA
24	<i>Cassia auriculata</i>	Shrub	Caesalpiaceae	Native	NA
25	<i>Cassia tora</i>	Shrub	Caesalpiaceae	Native	NA
26	<i>Cassytha filiformis</i>	Climber	Lauraceae	Native	NA
27	<i>Chloris barbata</i>	Grass	Poaceae	Native	NA
28	<i>Chrysopogon aciculatus</i>	Grass	Poaceae	Native	NA
29	<i>Cissus quadrangulris</i>	Climber	Vitaceae	Native	NA
30	<i>Coccinia grandis</i>	Climber	Cucurbitaceae	Native	NA
31	<i>Cocos nucifera</i>	Tree	Arecaceae	Native	NA
32	<i>Coldenia procumbens</i>	Herb	Boraginaceae	Native	NA
33	<i>Commelina benghalensis</i>	Herb	Commelinaceae	Native	NA
34	<i>Cordia obliqua</i>	Tree	Boraginaceae	Native	NA
35	<i>Croton bonplandianus</i>	subshrub	Euphorbiaceae	Native	NA
36	<i>Ctenolepis garcini</i>	Climber	Curcurbitaceae	Native	NA
37	<i>Cyanotis axillaris</i>	Herb	Commelinaceae	Native	NA
38	<i>Cymbopogon flexuosus</i>	Grass	Poaceae	Native	NA
39	<i>Cynodon dactylon</i>	Grass	Poaceae	Native	NA
40	<i>Cyperus compressus</i>	Sedge	Cyperaceae	Native	NA

Annexure B_List of plants in the buffer zone and water bodies (lakes/ponds)

41	<i>Dactyloctenium aegyptium</i>	Grass	Poaceae	Native	NA
42	<i>Desmodium triflorum</i>	Herb	Fabaceae	Native	NA
43	<i>Dodonaea angustifolia</i>	Shrub	Sapindaceae	Native	NA
44	<i>Dopatrium junceum</i>	Herb	Scrophulariaceae	Native	LC
45	<i>Elicpta prostrata</i>	Herb	Asteraceae	Native	NA
46	<i>Enicostemma littorale</i>	Herb	Gentianaceae	Native	NA
47	<i>Eragrostiella bifaria</i>	Grass	Poaceae	Native	NA
48	<i>Eriocaulon sp.</i>	Herb	Eriocaulaceae	Native	NA
49	<i>Eucalyptus tereticornis</i>	Tree	Myrtaceae	Introduced	NA
50	<i>Euphorbia heterophylla</i>	Herb	Euphorbiaceae	Introduced	NA
51	<i>Euphorbia hirta</i>	Herb	Euphorbiaceae	Introduced	NA
52	<i>Euphorbia thymifolia</i>	Herb	Eriocaulaceae	Native	NA
53	<i>Evolvulus alsinoides</i>	Herb	Convolvulaceae	Native	NA
54	<i>Evolvulus nummularius</i>	Herb	Convolvulaceae	Native	NA
55	<i>Fuirena trilobites</i>	Sedge	Cyperaceae	Endemic to peninsular india	LC
56	<i>Gmelina asiatica</i>	Shrub	Verbenaceae	Native	NA
57	<i>Gomphrena decumbens</i>	Herb	Amaranthaceae	Introduced	NA
58	<i>Goniogyna hirta</i>	Herb	Fabaceae	Native	NA
59	<i>Grewia sp.</i>	Tree	Tiliaceae	Native	NA
60	<i>Hemidesmus indicus</i>	Climber	Asclepiadaceae	Native	NA
61	<i>Heteropogon contortus</i>	Grass	Poaceae	Native	NA
62	<i>Indigofera linnaei</i>	Herb	Fabaceae	Native	NA
63	<i>Ipomoea carnea</i>	shrub	Convolvulaceae	Native	NA
64	<i>Ipomoea carnea</i>	Climber	Convolvulaceae	Introduced	NA
65	<i>Juncus sp.</i>	Sedge	Cyperaceae	Native	NA
66	<i>Justicia simplex</i>	Herb	Acanthaceae	Native	NA
67	<i>Kyllinga triceps</i>	Sedge	Cyperaceae	Native	NA
68	<i>Lemna gibba</i>	Aquatic herb	Lemnaceae	Introduced	LC
69	<i>Lepidagathis cristata</i>	Herb	Acanthaceae	Endemic to peninsular india	NA
70	<i>Leucas aspera</i>	Herb	Lamiaceae	Native	NA
71	<i>Lippia nodiflora</i>	Herb	Verbenaceae	Native	NA
72	<i>Ludwigia adscendens</i>	Aquatic herb	Onagraceae	Native	NA
73	<i>Luffa cylindrica</i>	Climber	Cucurbitaceae	Native	NA
74	<i>Maba buxifolia</i>	Tree	Ebenaceae	Native	NA
75	<i>Marsilea minuta</i>	Aquatic herb	Marsileaceae	Native	NA

Annexure B_List of plants in the buffer zone and water bodies (lakes/ponds)

76	<i>Martynia annua</i>	Herb	Pedaliaceae	Native	NA
77	<i>Maytenus emarginata</i>	shrub	Celastraceae	Native	NA
78	<i>Memecylon umbellatum</i>	Tree	Melastomataceae	Native	NA
79	<i>Merremia tridentata</i>	Creeper	Convolvulaceae	Native	NA
80	<i>Mimosa pudica</i>	Herb	Mimosaceae	Native	NA
81	<i>Monochoria vaginalis</i>	Aquatic herb	Pontederiaceae	Native	NA
82	<i>Morinda sp.</i>	Tree	Rubiaceae	Native	NA
83	<i>Mukia maderaspatana</i>	Climber	Cucurbitaceae	Native	NA
84	<i>Mullugo pentaphylla</i>	Herb	Molluginaceae	Native	NA
85	<i>Najas sp.</i>	Aquatic herb	Hydrocharitaceae	Native	NA
86	<i>Opuntia stricta</i>	Shrub	Cactaceae	Introduced	NA
87	<i>Osbeckia stricta</i>	Herb	Melastomaceae	Native	NA
88	<i>Osbeckia zeylanica</i>	Herb	Melastomaceae	Native	NA
89	<i>Oxystelma esculentum</i>	Herb	Asclepiadaceae	Native	LC
90	<i>Parthenium hysterophorus</i>	Herb	Asteraceae	Introduced	NA
91	<i>Passiflora foetida</i>	Climber	Passifloraceae	Native	NA
92	<i>Pavonia odorata</i>	Herb	Malvaceae	Native	NA
93	<i>Pergularia extensa</i>	Climber	Asclepiadaceae	Native	NA
94	<i>Perotis indica</i>	Grass	Poaceae	Native	NA
95	<i>Phoenix pusilla</i>	Tree	Arecaceae	Endemic to coramantal coast	NA
96	<i>Phyllanthus debilis</i>	Herb	Euphorbiaceae	Native	NA
97	<i>Phyllanthus maderaspatensis</i>	Herb	Euphorbiaceae	Native	NA
98	<i>Phyllanthus niruri</i>	Herb	Euphorbiaceae	Introduced	NA
99	<i>Phyllanthus simplex</i>	Herb	Euphorbiaceae	Native	NA
100	<i>Pistia stratiotes</i>	Aquatic herb	Araceae	Introduced	NA
101	<i>Plecosperrum sp.</i>	Tree	Moraceae	Native	NA
102	<i>Polycarpeae corymbosa</i>	Herb	Caryophyllaceae	Native	NA
103	<i>Potamogeton sp.</i>	Aquatic herb	Potamogetanaceae	Native	NA
104	<i>Prosopis chilensis</i>	Tree	Mimosaceae	Introduced	NA
105	<i>Randia dumetorum</i>	Tree	Rubiaceae	Native	NA
106	<i>Ricinus communis</i>	Shrub	Euphorbiaceae	Introduced	NA
107	<i>Rivea hypocrateriformis</i>	Climber	Convolvulaceae	Native	NA
108	<i>Sarcostemma acidum</i>	Climber	Asclepiadaceae	Native	NA

Annexure B_List of plants in the buffer zone and water bodies (lakes/ponds)

109	<i>Secamone emetica</i>	Climber	Apocynaceae	Endemic to Peninsular india	NA
110	<i>Securenega leucopyrus</i>	Shrub	Euphorbiaceae	Native	NA
111	<i>Sida acuta</i>	Herb	Malvaceae	Native	NA
112	<i>Spermacoce hispida</i>	Herb	Rubiaceae	Native	NA
113	<i>Spermacoce ocymoides</i>	Herb	Rubiaceae	Native	NA
114	<i>Stachytarpheta jamaicensis</i>	Herb	Verbenaceae	Native	NA
115	<i>Striga asiatica</i>	Herb	Scrophulariaceae	Native	NA
116	<i>Stylosanthes hamatus</i>	Herb	Fabaceae	Introduced	NA
117	<i>Syzygium cumini</i>	Tree	Myrtaceae	Native	NA
118	<i>Tarenna asiatica</i>	Shrub	Rubiaceae	Native	NA
119	<i>Tephrosia purpurea</i>	Climber	Fabaceae	Native	NA
120	<i>Toddalia asiatica</i>	Shrub	Rubiaceae	Native	NA
121	<i>Tragia involucrata</i>	Twiner	Euphorbiaceae	Native	NA
122	<i>Tridax procumbens</i>	Herb	Asteraceae	Introduced	NA
123	<i>Typha angustata</i>	Herb	Poaceae	Native	LC
124	<i>Vernonia cinerea</i>	Herb	Asteraceae	Native	NA
125	<i>Waltheria indica</i>	subshrub	Sterculiaceae	Native	NA
126	<i>Ziziphus mauritiana</i>	Tree	Rhamnaceae	Native	NA
127	<i>Ziziphus oenoplia</i>	shrub	Rhamnaceae	Native	NA

Pond	Landmark	Species
Pond 1	Apollo Neighbouring	<i>Typha angusta</i>
Pond 2	Perinjabakam lake	<i>Juncus sp.</i>
		<i>Nymphaea alba</i>
		<i>Ipomoea aquatica</i>
		<i>Nymphoides hydrophylla</i>
		<i>Potamogetonsp.</i>
Pond 3	Pond near Mathur, on the highway side,	<i>Pistia stratiotes</i>
Pond 4	Koil kulam, Mathur inside village	<i>Nelumbo nucifera</i>
		<i>Pistia stratiotes</i>
		<i>Ludwigia adscendens</i>
		<i>Juncus sp.</i>
Pond 5	Koil kulam -temple main pond	<i>Juncus sp.</i>
		<i>Azadirachta indica</i>
Pond 6	Near vaipur, Tambaram road	<i>Typha angustata</i>
		<i>Euphlyctis sp.</i>
		<i>Nymphaea alba</i>
Pond 7	Eraiyyur	<i>Nymphaea alba</i>

Annexure B_List of plants in the buffer zone and water bodies (lakes/ponds)

		<i>Sagittaria montevidens</i>
		<i>Potamogeton</i>
		<i>Juncus sp.</i>
		<i>Najas graminea</i>
		<i>Nymphoides hydrophylla</i>
		<i>Ludwigia adscendens</i>
		<i>Nelumbo nucifera</i>
Pond 8	Katteri kulam	<i>Nelumbo nucifera</i>
		<i>Nymphaea alba</i>
		<i>Typha angustata</i>
Pond 9	Nalla thanni kulam	<i>Pistia stratiotes</i>
		<i>Nymphaea alba</i>

Annexure C_List of birds in the core zone

Sl.No.	Common Name	Scientific Name	IUCN Status	Resident/Migrant	Habitat
1	Ashy drongo	<i>Dicrurus leucophaeus</i>	Least concern	Resident	Grassland
2	Ashy prinia	<i>Prinia socialis</i>	Least concern	Resident	Widespread
3	Asian koel	<i>Eudynamis scolopaceus</i>	Least Concern	Resident	Widespread
4	Asian openbill	<i>Anastomus oscitans</i>	Least Concern	Resident	Wetland
5	Asian palm swift	<i>Cypsiurus balasiensis</i>	Least Concern	Resident	Widespread
6	Barn Swallow	<i>Hirundo rustica</i>	Least Concern	Resident	Widespread
7	Besra	<i>Accipiter virgatus</i>	Least Concern	Resident	Widespread
8	Black Drongo	<i>Dicrurus macrocercus</i>	Least Concern	Resident	Grassland
9	Black-capped kingfisher	<i>Halcyon pileata</i>	Least Concern	Resident	Widespread
10	Black-headed munia	<i>Lonchura atricapilla</i>	Least concern	Resident	Widespread
11	Black-winged kite	<i>Elanus caeruleus</i>	Least Concern	Resident	Widespread
12	Blue-tailed bee-eater	<i>Merops philippinus</i>	Least Concern	Migrant	Grassland/Wetland
13	Cattle egret	<i>Bubulcus ibis</i>	Least Concern	Resident/Migrant	Wetland
14	Common babbler	<i>Turdoides caudata</i>	Least Concern	Resident	Widespread
15	Common kingfisher	<i>Alcedo atthis</i>	Least Concern	Resident	Widespread
16	Common myna	<i>Acridotheres tristis</i>	Least Concern	Resident	Widespread
17	Common pigeon	<i>Columba livia</i>	Least Concern	Resident	Widespread
18	Common tailorbird	<i>Orthotomus sutorius</i>	Least Concern	Resident	Widespread
19	Common woodshrike	<i>Tephrodornis pondicerianus</i>	Least Concern	Resident	Widespread
20	Coppersmith barbet	<i>Psilopogon haemacephalus</i>	Least Concern	Resident	Widespread
21	Gray francolin	<i>Francolinus pondicerianus</i>	Least Concern	Resident	Grassland
22	Green bee-eater	<i>Merops orientalis</i>	Least Concern	Resident	Grassland

Annexure C_List of birds in the core zone

23	Gull billed tern	<i>Gelochelidon nilotica</i>	Least Concern	Resident	Wetland
24	House Crow	<i>Corvus splendens</i>	Least Concern	Resident	Widespread
25	Indian cormorant	<i>Phalacrocorax niger</i>	Least Concern	Resident/Migrant	Wetland
26	Jungle Crow	<i>Corvus macrorhynchos</i>	Least Concern	Resident	Widespread
27	Indian pond heron	<i>Ardeola grayii</i>	Least Concern	Resident	Wetland
28	Indian roller	<i>Coracias benghalensis</i>	Least Concern	Resident	Grassland
29	Indian silverbill	<i>Lonchura malabarica</i>	Least concern	Resident	Wetland
30	Intermediate egret	<i>Mesophoyx intermedia</i>	Least Concern	Resident	Wetland
31	Lesser coucal	<i>Centropus bengalensis</i>	Least Concern	Resident	Widespread
32	Little cormorant	<i>Microcarbo niger</i>	Least concern	Resident	Wetland
33	Little egret	<i>Egretta garzetta</i>	Least concern	Resident	Wetland
34	Long-tailed shrike	<i>Lanius schach</i>	Least Concern	Resident	Grassland
35	Oriental magpie-robin	<i>Copsychus saularis</i>	Least Concern	Resident	Widespread
36	Paddyfield pipit	<i>Anthus rufulus</i>	Least Concern	Resident	Grassland
37	Painted stork	<i>Mycteria leucocephala</i>	Near Threatened	Resident	Wetland
38	Pied bushchat	<i>Saxicola caprata</i>	Least Concern	Resident	Widespread
39	Pied kingfisher	<i>Ceryle rudis</i>	Least Concern	Resident	Wetland
40	Plain prinia	<i>Prinia inornata</i>	Least concern	Resident	Widespread
41	Purple heron	<i>Ardea purpurea</i>	Least Concern	Resident	Wetland
42	Purple sunbird	<i>Cinnyris asiaticus</i>	Least Concern	Resident	Widespread
43	Purple-rumped sunbird	<i>Leptocoma zeylonica</i>	Least concern	Resident	Widespread
44	Red-vented bulbul	<i>Pycnonotus cafer</i>	Least Concern	Resident	Widespread
45	Red-wattled lapwing	<i>Vanellus indicus</i>	Least Concern	Resident	Wetland
46	Rose-ringed parakeet	<i>Psittacula krameri</i>	Least Concern	Resident	Widespread
47	Rosy starling	<i>Pastor roseus</i>	Least Concern	Migratory	Widespread

Annexure C_List of birds in the core zone

48	Rufous treepie	<i>Dendrocitta vagabunda</i>	Least Concern	Resident	Widespread
49	Scaly-breasted munia	<i>Lonchura punctulata</i>	Least concern	Resident	Widespread
50	Shikra	<i>Accipiter badius</i>	Least Concern	Resident	Widespread
51	Small minivet	<i>Pericrocotus cinnamomeus malabaricus</i>	Least Concern	Resident	Widespread
52	Spotted dove	<i>Streptopelia chinensis</i>	Least Concern	Resident	Widespread
53	Spotted owl	<i>Athene brama</i>	Least concern	Resident	Widespread
54	Tricoloured munia	<i>Lonchura malacca</i>	Least Concern	Resident	Widespread
55	White-browed wagtail	<i>Motacilla maderaspatensis</i>	Least concern	Resident	Wetland
56	White-breasted Kingfisher	<i>Halcyon smyrnensis</i>	Least Concern	Resident	Widespread
57	Yellow-billed babbler	<i>Turdoides affinis</i>	Least concern	Resident	Widespread
58	Yellow-footed Pigeon	<i>Treron phoenicopterus</i>	Least Concern	Resident	Widespread

Annexure D_List of birds in the buffer zone

Sl. No.	Common Name	Scientific Name	Status	Resident/Migrant	Habitat
1	Ashy crowned sparrowlark	<i>Eremopterix griseus</i>	Least concern	Resident	Grassland
2	Ashy prinia	<i>Prinia socialis</i>	Least Concern	Resident	Widespread
3	Ashy woodswallow	<i>Artamus fuscus</i>	Least Concern	Resident	Widespread
4	Asian koel	<i>Eudynamys scolopaceus</i>	Least concern	Resident	Widespread
5	Asian open bill	<i>Anastomus oscitans</i>	Least concern	Resident	Widespread
6	Asian palm swift	<i>Cypsiurus balasiensis</i>	Least Concern	Resident	Widespread
7	Barn swallow	<i>Hirundo rustica</i>	Least Concern	Resident	Widespread
8	Baya weaver	<i>Ploceus philippinus</i>	Least concern	Resident	Widespread
9	Besra	<i>Accipiter virgatus</i>	Least Concern	Resident	Widespread
10	Black drongo	<i>Dicrurus macrocercus</i>	Least concern	Resident	Grassland
11	Black headed munia	<i>Lonchura atricapilla</i>	Least concern	Resident	Widespread
12	Blyth's reed warbler	<i>Acrocephalus dumetorum</i>	Least concern	Resident	Grassland
13	Brahminy starling	<i>Sturnia pagodarum</i>	Least concern	Resident	Widespread
14	Bronze-winged jacana	<i>Metopidius indicus</i>	Least concern	Resident	Wetland
15	Brown shrike	<i>Lanius cristatus</i>	Least Concern	Migrant	Widespread
16	Cattle egret	<i>Bubulcus ibis</i>	Least Concern	Resident/Migrant	Wetland
17	Chestnut-shouldered petronia	<i>Petronia xanthocollis</i>	Least concern	Resident	Widespread
18	Chestnut-tailed starling	<i>Sturnia malabarica</i>	Least Concern	Resident/Migrant	Widespread
19	Cinereous tit	<i>Parus cinereus</i>	Least Concern	Resident	Widespread
20	Common babbler	<i>Turdoides caudata</i>	Least concern	Resident	Widespread
21	Common coot	<i>Fulica atra</i>	Least Concern	Resident/Migrant	Wetland
22	Common hoopoe	<i>Upupa epops</i>	Least concern	Resident	Grassland
23	Common kingfisher	<i>Acridotheres tristis</i>	Least concern	Resident	Widespread
24	Common myna	<i>Acridotheres tristis</i>	Least concern	Resident	Widespread

Annexure D_List of birds in the buffer zone

25	Common pigeon	<i>Columba livia</i>	Least Concern	Resident	Widespread
26	Common sandpiper	<i>Actitis hypoleucos</i>	Least Concern	Resident/Migrant	Wetland
27	Common tailorbird	<i>Orthotomus sutorius</i>	Least Concern	Resident	Widespread
28	Common woodshrike	<i>Tephrodornis pondicerianus</i>	Least Concern	Resident	Widespread
29	Cotton-pygmy goose	<i>Nettapus coromandelianus</i>	Least Concern	Resident	Wetland
30	Darter	<i>Anhinga melanogaster</i>	Least Concern	Resident	Wetland
31	Eurasian coot	<i>Fulica atra</i>	Least Concern	Resident	Wetland
32	Eurasian wigeon	<i>Anas penelope</i>	Least Concern	Migrant	Wetland
33	Fulvous-whistling duck	<i>Dendrocygna bicolor</i>	Least Concern	Migrant	Wetland
34	Green bee-eater	<i>Merops orientalis</i>	Least concern	Resident	Grassland
35	Grey francolin	<i>Francolinus pondicerianus</i>	Least Concern	Resident	Grassland
36	Grey heron	<i>Ardea cinerea</i>	Least Concern	Resident/Migrant	Wetland
37	Grey-headed moorhen	<i>Porphyrio poliocephalus</i>	Least concern	Resident	Wetland
38	Gull-billed tern	<i>Gelochelidon nilotica</i>	Least concern	Resident	Wetland
39	House crow	<i>Corvus splendens</i>	Least concern	Resident	Widespread
40	Indian golden oriole	<i>Oriolus kundoo</i>	Least concern	Migrant	Grassland
41	Indian pond heron	<i>Ardeola grayii</i>	Least Concern	Resident	Wetland
42	Indian robin	<i>Saxicoloides fulicatus</i>	Least concern	Resident	Widespread
43	Indian roller	<i>Coracias benghalensis</i>	Least concern	Resident	Widespread
44	Indian spot-billed duck	<i>Anas poecilorhyncha</i>	Least Concern	Resident	Wetland
45	Indian thick-knee	<i>Burhinus indicus</i>	Least concern	Resident	Wetland
46	Intermediate egret	<i>Mesophoyx intermedia</i>	Least Concern	Resident/Migrant	Wetland
47	Laughing dove	<i>Spilopelia senegalensis</i>	Least Concern	Resident	Widespread
48	Lesser coucal	<i>Centropus sinensis</i>	Least concern	Resident	Widespread

Annexure D_List of birds in the buffer zone

49	Little cormorant	<i>Microcarbo niger</i>	Least concern	Resident/Migrant	Wetland
50	Little egret	<i>Hirundo rustica</i>	Least concern	Resident	Wetland
51	Little grebe	<i>Tachybaptus ruficollis</i>	Least concern	Resident	Wetland
52	Loten's sunbird	<i>Cinnyris lotenius</i>	Least Concern	Resident	Widespread
53	Northern pintail	<i>Anas acuta</i>	Least concern	Migrant	Wetland
54	Northern shoveler	<i>Anas clypeata</i>	Least Concern	Resident/Migrant	Wetland
55	Oriental skylark	<i>Alauda gulgula</i>	Least Concern	Resident	Grassland
56	Osprey	<i>Pandion haliaetus</i>	Least Concern	Resident	Wetland
57	Paddyfield pipit	<i>Anthus rufulus</i>	Least concern	Resident	Grassland
58	Painted Stork	<i>Mycteria leucocephala</i>	Near Threatened	Resident	Wetland
59	Pheasant-tailed jacana	<i>Hydrophasianus chirurgus</i>	Least concern	Resident	Wetland
60	Pied bushchat	<i>Saxicola caprata</i>	Least concern	Resident	Widespread
61	Pied kingfisher	<i>Ceryle rudis</i>	Least concern	Resident	Widespread
62	Pin-tailed snipe	<i>Gallinago stenura</i>	Least Concern	Migrant	Wetland
63	Plain prinia	<i>Prinia inornata</i>	Least concern	Resident	Widespread
64	Purple heron	<i>Ardea purpurea</i>	Least concern	Resident	Wetland
65	Purple sunbird	<i>Cinnyris asiaticus</i>	Least Concern	Resident	Widespread
66	Purple swamphen	<i>Porphyrio porphyrio</i>	Least Concern	Resident	Wetland
67	Purple-rumped sunbird	<i>Leptocoma zeylonica</i>	Least concern	Resident	Widespread
68	Red-vented bulbul	<i>Pycnonotus cafer</i>	Least concern	Resident	Widespread
69	Red-wattled lapwing	<i>Vanellus indicus</i>	Least concern	Resident	Wetland
70	Red-whiskered bulbul	<i>Pycnonotus jocosus</i>	Least Concern	Resident	Widespread
71	Rose-ringed parakeet	<i>Psittacula krameri</i>	Least concern	Resident	Widespread
72	Rosy starling	<i>Pastor roseus</i>	Least Concern	Resident	Widespread
73	Rufous tree-pie	<i>Dendrocitta vagabunda</i>	Least Concern	Resident	Widespread
74	Scaly-breasted munia	<i>Lonchura punctulata</i>	Least concern	Resident	Widespread

Annexure D_List of birds in the buffer zone

75	Shikra	<i>Accipiter badius</i>	Least Concern	Resident	Widespread
76	Spot-billed duck	<i>Anas poecilorhyncha</i>	Least concern	Migrant	Wetland
77	Spot-billed pelican	<i>Pelecanus philippensis</i>	Near Threatened	Resident/Migrant	Wetland
78	Spotted dove	<i>Spilopelia chinensis</i>	Least Concern	Resident	Widespread
79	Spotted owl	<i>Athene brama</i>	Least Concern	Resident	Widespread
80	White-breasted kingfisher	<i>Halcyon smyrnensis</i>	Least Concern	Resident	Widespread
81	White-breasted waterhen	<i>Amaurornis phoenicurus</i>	Least Concern	Resident	Wetland
82	White-browed wagtail	<i>Motacilla maderaspatensis</i>	Least Concern	Resident	Wetland
83	White-throated kingfisher	<i>Halcyon smyrnensis</i>	Least concern	Resident	Widespread
84	Wood sandpiper	<i>Tringa glareola</i>	Least Concern	Migrant	Wetland
85	Yellow-billed babbler	<i>Turdoides affinis</i>	Least Concern	Resident	Grassland
86	Yellow-wattled lapwing	<i>Vanellus malabaricus</i>	Least concern	Resident	Wetland
87	Zitting cisticola	<i>Cisticola juncidis</i>	Least Concern	Resident/Migrant	Grassland

Annexure E_ List of reptiles in the core and buffer zone

Sl.No.	Common Name	Scientific Name	Conservation Status
1	Checkered Keelback	<i>Xenochrophis piscator</i>	Least Concern
2	Oriental Garden Lizard	<i>Calotes versicolor</i>	Least Concern
3	Peninsular Rock Agama	<i>Psammophilus dorsalis</i>	Least Concern
4	Spectacled Cobra	<i>Naja naja</i>	Least Concern
5	Saw-scaled Viper	<i>Echi carinatus</i>	Least Concern
6	Common Skink	<i>Mabuya carinata</i>	Least Concern
7	Russell's Viper	<i>Daboia russelii</i>	Least Concern

Annexure F_List of invertebrates in the core and buffer zone

Appendix 1: Complete List of all recorded invertebrates

BUFFER	Class	Order	Family	Common name	Species
	Insecta	Lepidoptera	Nymphalidae	Common crow	<i>Euploea core core</i> , Cramer 1790
Perinjapakkam Eraiyyur Vaipur Hirco	Insecta	Lepidoptera	Nymphalidae	Plain tiger	<i>Danaus chrysippus</i>
Mettupalayam Mathur Perinjapakkam Hirco	Insecta	Lepidoptera	Nymphalidae	Tawny coster	<i>Acraea violae</i>
	Insecta	Lepidoptera	Nymphalidae	Danaid Eggfly	<i>Hypolimnas misippus</i>
Mathur Eraiyyur	Insecta	Lepidoptera	Nymphalidae	Peacock Pansy	<i>Junonia almana</i> (Linnaeus)
Hirco	Insecta	Lepidoptera	Nymphalidae	Blue Pansy	<i>Junonia orithiya</i>
	Insecta	Lepidoptera	Nymphalidae	Castor	<i>Ariadne sp</i>
Mathur	Insecta	Lepidoptera	Nymphalidae	Blue tiger	<i>Tirumala limniace</i>
	Insecta	Lepidoptera	Papilionidae	Tailed Jay	<i>Graphium agamemnon</i>
	Insecta	Lepidoptera	Papilionidae	Common rose	<i>Atrophaneura aristolochiae</i>
Perinjapakkam	Insecta	Lepidoptera	Papilionidae	Lime butterfly	<i>Papilio demoleus</i>
Eraiyyur	Insecta	Lepidoptera	Papilionidae	Common Mormon - male	<i>Papilio polytes</i>
Mathur	Insecta	Lepidoptera	Pieridae	Common Emigrant	<i>Catopsilia pomona</i>
	Insecta	Lepidoptera	Pieridae	Yellow Orange Tip	<i>Ixias pyrene sesia</i> Fabricius, 1777
Vaipur	Insecta	Lepidoptera	Pieridae	One spot Grass Yellow	<i>Eurema andersoni</i>
Mathur Hirco	Insecta	Lepidoptera	Lycaenidae	Lesser Grass Blue (LGB)	<i>Zizina otis</i>
	Insecta	Lepidoptera	Lycaenidae	A Cupid	<i>Chilades sp.</i>
	Insecta	Lepidoptera	Lycaenidae	Parrhasius Small Cupid	<i>Chilades parrhasius</i>
	Insecta	Lepidoptera	Lycaenidae	Plains Cupid	<i>Chilades pandava</i>
	Insecta	Lepidoptera	Lycaenidae	Oriental Grass Jewel (OGJ)	<i>Freyeria putli</i>
	Insecta	Lepidoptera	Hesperiidae	A skipper	Unidentified
	Insecta	Lepidoptera	Hesperiidae	Oriental Grass Dart	<i>Taractrocera maevius</i> (Fabricius)
	Insecta	Lepidoptera			Cocoon of Caterpillar sp.1
	Insecta	Lepidoptera			Cocoon of Caterpillar sp. 2
	Insecta	Lepidoptera	Sphingidae	Impatiens Hawk Moth	<i>Theretra oldenlandiae</i>
	Insecta	Lepidoptera	Pyralidae	Snout moth	unidentified
	Insecta	Lepidoptera	Geometridae	Geometer moth	unidentified
	Insecta	Lepidoptera	Psychidae	Case Moth Caterpillar in twig case	
	Insecta	Lepidoptera		Moth sp2 - small elongate grey moth with single black horizontal line	
	Insecta	Hymenoptera	Formicidae	Ant sp 4	unidentified
	Insecta	Hymenoptera	Formicidae	Ant sp 2 - with golden	

Annexure F_List of invertebrates in the core and buffer zone

		a		abdomen	
Mathur	Insecta	Hymenoptera	Formicidae	Ant sp 3	
Mathur	Insecta	Hymenoptera	Vespidae	Paper wasp	<i>Polistes sp.</i>
Mathur Eraiyyur	Insecta	Hymenoptera	Vespidae	Greater Banded Hornet	<i>Vespa tropica</i>
	Insecta	Hymenoptera	Vespidae	Potter wasp	unidentified
	Insecta	Hymenoptera	Sphecidae	thread-waisted wasp	unidentified
	Insecta	Hymenoptera	Apidae	Metallic Blue green bees	<i>Ceratina sp.</i>
Eraiyyur	Insecta	Hymenoptera	Apidae	Big Carpenter Bee	<i>Xylocopa sp.</i>
Mettupalayam	Insecta	Hymenoptera	Apidae	Big Carpenter Bee	<i>Xylocopa sp. 2</i>
Mettupalayam	Insecta	Hymenoptera	Apidae	Little honey bee	<i>Apis florea</i>
Hirco	Insecta	Hymenoptera	Apidae	Asian honey bee	<i>Apis cerana</i>
Mathur Behind Apollo	Insecta	Hymenoptera	Apidae	Blue Banded bee	<i>Amegilla sp.</i>
	Insecta	Hymenoptera	Halictidae	Sweat bee	unidentified
	Insecta	Hymenoptera	Megachilidae	Leaf cutter bee	Megachilid sp 1
	Insecta	Diptera	Syrphidae	Syrphid fly	<i>Unidentified sp.1</i>
	Insecta	Diptera	Syrphidae	Syrphid fly	<i>Unidentified sp.2</i>
Mathur	Insecta	Diptera	Asilidae	Robber fly	Unidentified
	Insecta	Diptera	Ephydriidae	Brine fly	Unidentified
	Insecta	Diptera	Tabanidae	Horse fly	
	Insecta	Coleoptera	Staphylinidae	Rove beetle	
Hirco	Insecta	Coleoptera	Meloidae	Banded blister beetle	<i>Mylabris pustulata</i>
	Insecta	Coleoptera	Hydrophilidae or Dytiscidae	Water scavenger beetle or dytiscid beetle	
	Insecta	Coleoptera		Aquatic beetle	Unidentified
Hirco	Insecta	Hemiptera	Pyrrhocoridae or Lygaeidae	stainer bug or seed bug	
Mathur Hirco	Insecta	Hemiptera	Scutelleridae	Shield-back bug	<i>Chrysocoris sp.</i>
Eraiyyur	Insecta	Hemiptera	Gerridae	Water Strider	Water Strider sp1
Eraiyyur	Insecta	Hemiptera	Vellidae	Broad shouldered water strider	BS water strider sp1
Hirco	Insecta	Hemiptera	Cercopidae	Spittle bugs	
Eraiyyur	Insecta	Hemiptera	Notonectidae	Back Swimmers	unidentified
	Insecta	Odonata - Anisoptera	Gomphidae	Common Clubtail	<i>Ictinogomphus rapax</i>
	Insecta	Odonata - Anisoptera	Libellulidae	Granite Ghost	<i>Bradinopyga geminata</i>
Mathur Perinjapakkam Vaipur	Insecta	Odonata - Anisoptera	Libellulidae	Ditch Jewel	<i>Brachythemis contaminata</i>

Annexure F_List of invertebrates in the core and buffer zone

Mettupalayam Eraiyyur	Insecta	Odonata - Anisoptera	Libellulidae	Common Picture Wing	<i>Rhyothemis variegata</i>
Perinjapakkam Vaipur	Insecta	Odonata - Anisoptera	Libellulidae	Ground skimmer	<i>Diplocodes trivialis</i>
Vaipur	Insecta	Odonata - Anisoptera	Libellulidae	Green Marsh Hawk	<i>Orthetrum sabina</i>
Mettupalayam Mathur Eraiyyur Vaipur	Insecta	Odonata - Anisoptera	Libellulidae	Ruddy Marsh Skimmer	<i>Crocothemis servilia</i>
	Insecta	Odonata - Anisoptera	Libellulidae	Blue Marsh Hawk	<i>Orthetrum glaucaum</i>
Mathur Eraiyyur	Insecta	Odonata - Anisoptera	Libellulidae	Crimson Marsh Glider	<i>Trithemis aurora</i>
	Insecta	Odonata - Zygoptera	Coenagrionidae	Golden Dartlet	<i>Ischnura aurora</i>
Mathur Eraiyyur	Insecta	Odonata - Zygoptera	Coenagrionidae	Coromandel Marsh Dart	<i>Ceriagrion coromandelianum</i>
	Insecta	Odonata - Zygoptera		a parrot green damselfly	unidentified
	Insecta	Odonata - Zygoptera	Coenagrionidae	Pigmy Dartlet	<i>Agriocnemis pygmaea</i>
	Insecta	Orthoptera	Acrididae	SHGH sp 7 - medium sized brown gh with yellow brown white grey n black	
	Insecta	Orthoptera	Acrididae	SHGH sp10 - small brown	
	Insecta	Orthoptera	Acrididae	SHGH sp15 - bold diagonal white line on base of wings, white line on lateral side of hindleg also	
	Insecta	Orthoptera	Acrididae	SHGH sp 16	
Mettupalayam	Insecta	Orthoptera	Acrididae	SHGH sp 17	all green gh
Mathur	Insecta	Orthoptera	Acrididae	SHGH sp 18	dead leaf like gh
	Insecta	Orthoptera	Tettigoniidae	Green Katydid	unidentified
Mettupalayam Hirco	Insecta	Neuroptera	Myrmeleontida e	Antlion	Unidentified
Mathur	Diplopoda	Polydesmida	Paradoxosomati dae	Millipede	<i>Orthomorpha coarctata</i>
	Arachnida	Araneae	Oxyopidae	Lynx spider	Lynx spider sp1
Mettupalayam Hirco	Arachnida				Spider sp7 - web spread on grass
Mathur	Arachnida			Social spiders	unidentified
Mathur	Arachnida		Araenidae	Signature spider/Speckled band four-leg	<i>Argiope anasuja?</i>
Mathur	Crustacea			Land Crab	
Hirco	Gastropod a				Gastropod sp3

Annexure F_List of invertebrates in the core and buffer zone

Hirco	Gastropoda				larger one - find in july photos
Mathur	Gastropoda				large snail

List of Fungi recorded

		S						Fungi	unidentified
		S						Fungi	unidentified
			Perinjapakkam					Fungi	unidentified
			Eraiyr					Fungi	unidentified

List of Vertebrates recorded

	E		Mettupalayam	Amphibia	Anura			Frog	Unidentified
			Vaipur	Amphibia	Anura			Frog 2	Unidentified
	E			Pisces				fish	unidentified
			Eraiyr Mathur					fish with silver spot on head	unidentified
			Eraiyr					fish with two silver spots on head	unidentified

Annexure F_List of invertebrates documented during the four-season survey

Appendix 2. List of all Invertebrates documented during the four-season survey

14-Nov	15-Jan	15-Apr		15-Jul		15-Oct		Class	Order	Family	Common name	Species
ATL		ATL	Buffer	ATL	Buffer	ATL	Buffer					
NOV ATL	JAN B					OCT ATL	OCT B	Insecta	Lepidoptera	Nymphalidae	Blue tiger	<i>Tirumala limniace</i>
NOV ATL	JAN B	APR ATL		JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Lepidoptera	Nymphalidae	Tawny coster	<i>Acraea violae</i>
NOV ATL	JAN B	APR ATL	APR B	JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Lepidoptera	Nymphalidae	Plain tiger	<i>Danaus chrysippus</i>
NOV ATL							OCT B	Insecta	Lepidoptera	Nymphalidae	Blue Pansy	<i>Junonia orithiya</i>
NOV ATL	JAN B			JUL ATL		OCT ATL	OCT B	Insecta	Lepidoptera	Nymphalidae	Peacock Pansy	<i>Junonia almana</i> (Linnaeus)
	JAN B				JUL B			Insecta	Lepidoptera	Nymphalidae	lemon pansy	<i>Junonia lemonias</i>
	JAN B		APR B					Insecta	Lepidoptera	Nymphalidae	grey pansy	<i>Junonia atlites</i>
NOV ATL	JAN B							Insecta	Lepidoptera	Nymphalidae	Striped Tiger - CONFIRM	<i>Danaus genutia</i>
NOV ATL					JUL B	OCT ATL		Insecta	Lepidoptera	Nymphalidae	Danaid Eggfly	<i>Hypolimnna misippus</i>
NOV ATL	JAN B	APR ATL				OCT ATL		Insecta	Lepidoptera	Nymphalidae	Common crow	<i>Euploea core core</i> Cramer 1790
NOV ATL	JAN B							Insecta	Lepidoptera	Nymphalidae	Common Leopard	<i>Phalanta phalantha</i> (Drury)
NOV ATL								Insecta	Lepidoptera	Nymphalidae	Common Evening Brown	<i>Melanitis leda</i> (Linnaeus)
NOV ATL	JAN B							Insecta	Lepidoptera	Nymphalidae	Angled Castor	<i>Ariadne ariadne</i>
NOV ATL		APR ATL			JUL B		OCT B	Insecta	Lepidoptera	Papilionidae	Common Mormon - male	<i>Papilio polytes</i>
NOV ATL				JUL ATL	JUL B	OCT ATL		Insecta	Lepidoptera	Papilionidae	Tailed Jay	<i>Graphium agamemnon</i>
		APR ATL						Insecta	Lepidoptera	Papilionidae	Common Jay	<i>Graphium doson</i>

Annexure F_List of invertebrates in the core and buffer zone

	JAN B			JUL ATL	JUL B			Insecta	Lepidoptera	Papilionidae	Crimson rose	<i>Atrophaneura hector</i>
					JUL B	OCT ATL		Insecta	Lepidoptera	Papilionidae	Common rose	<i>Atrophaneura aristolochiae</i>
							OCT B	Insecta	Lepidoptera	Papilionidae	Lime butterfly	<i>Papilio demoleus</i>
NOV ATL								Insecta	Lepidoptera	Pieridae	Pale clouded yellow	<i>Colias erate</i> (Esper)
NOV ATL					JUL B			Insecta	Lepidoptera	Pieridae	Mottled Emigrant	<i>Catopsilia pyranthe</i>
		APR ATL		JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Lepidoptera	Pieridae	Common Emigrant	<i>Catopsilia pomona</i>
NOV ATL								Insecta	Lepidoptera	Pieridae	Oriental Common Grass Yellow	<i>Eurema hecabe</i>
NOV ATL								Insecta	Lepidoptera	Pieridae	Common Albatross	<i>Appias albina</i> *
NOV ATL	JAN B							Insecta	Lepidoptera	Pieridae	Small Grass Yellow	<i>Eurema brigitta</i>
						OCT ATL	OCT B	Insecta	Lepidoptera	Pieridae	One Spot Grass yellow	<i>Eurema andersoni</i>
NOV ATL								Insecta	Lepidoptera	Pieridae	Common Gull	<i>Cepora nerissa</i> Fabricius
					JUL B			Insecta	Lepidoptera	Pieridae	Plain Orange Tip	<i>Colotis aurora</i>
						OCT ATL		Insecta	Lepidoptera	Pieridae	Yellow Orange Tip	<i>Ixias pyrene sesia</i> Fabricius, 1777
NOV ATL	JAN B			JUL ATL		OCT ATL	OCT B	Insecta	Lepidoptera	Lycaenidae	Lesser Grass Blue (LGB)	<i>Zizina otis</i>
NOV ATL	JAN B	APR ATL		JUL ATL		OCT ATL		Insecta	Lepidoptera	Lycaenidae	Oriental Grass Jewel (OGJ)	<i>Freyeria putli</i>
NOV ATL				JUL ATL		OCT ATL		Insecta	Lepidoptera	Lycaenidae	Plains Cupid	<i>Chilades pandava</i>
NOV ATL		APR ATL						Insecta	Lepidoptera	Lycaenidae	Oriental Gram Blue	<i>Euchrysops cnejus</i>
NOV ATL								Insecta	Lepidoptera	Lycaenidae	Zebra Blue	<i>Leptotes pilinius</i> Fabricius
	JAN B							Insecta	Lepidoptera	Lycaenidae	Common Pierrot	<i>Castalius rosimon</i>

Annexure F_List of invertebrates in the core and buffer zone

	JAN B							Insecta	Lepidoptera	Lycaenidae	lime blue	<i>Chilades lajus</i>
NOV ATL								Insecta	Lepidoptera	Hesperiidae	Indian Palm Bob	<i>Suastus gremius</i>
NOV ATL				JUL ATL		OCT ATL		Insecta	Lepidoptera	Hesperiidae	Oriental Grass Dart	<i>Taractrocera maevius</i> (Fabricius)
NOV ATL						OCT ATL		Insecta	Lepidoptera	Psychidae	Caterpillar in twig case	unidentified
NOV ATL						OCT ATL		Insecta	Lepidoptera	Geometridae	Moth sp3 - medium sized triangular moth with black v shaped lines on wings	unidentified
NOV ATL				JUL ATL				Insecta	Lepidoptera	Sphingidae	Hawk moth sp1	unidentified
						OCT ATL		Insecta	Lepidoptera	Sphingidae	Impatiens Hawk Moth	<i>Theretra oldenlandiae</i>
NOV ATL								Insecta	Lepidoptera	Erebidae/Arctiidae	Heliotrope moth	<i>Utetheisa</i> sp. (pulchelloides?)
NOV ATL								Insecta	Lepidoptera	Erebidae/Lymantri dae (formerly in)	Tussock moth cocoon	unidentified
NOV ATL								Insecta	Lepidoptera	Tineidae	plume moth	unidentified
NOV ATL								Insecta	Lepidoptera	Amatidae	Tiger moth	<i>Amata</i> sp.
						OCT ATL		Insecta	Lepidoptera	Geometridae	Geometer moth	unidentified
NOV ATL						OCT ATL		Insecta	Hymenoptera	Halictidae	sweat bee	unidentified
			APR B	JUL ATL				Insecta	Hymenoptera	Apidae	Giant Rock Bee	<i>Apis dorsata</i>
NOV ATL	JAN B	APR ATL				OCT ATL	OCT B	Insecta	Hymenoptera	Apidae	Little bee	<i>Apis florea</i>
NOV ATL	JAN B	APR ATL		JUL ATL		OCT ATL		Insecta	Hymenoptera	Apidae	Metallic Blue green bees	<i>Ceratina</i> sp.
		APR ATL						Insecta	Hymenoptera	Apidae		<i>Ceratina</i> sp2
NOV ATL	JAN		APR			OCT	OCT	Insecta	Hymenoptera	Apidae - Tribe	Blue banded bee	<i>Amegilla</i> sp.

Annexure F_List of invertebrates in the core and buffer zone

	B		B			ATL	B			Anthophorinae		
	JAN B	APR ATL				OCT ATL	OCT B	Insecta	Hymenoptera	Apidae	Asian honey bee	<i>Apis cerana</i>
	JAN B							Insecta	Hymenoptera	Apidae	Stingless bee	<i>Trigona</i> sp.
	JAN B		APR B			OCT ATL	OCT B	Insecta	Hymenoptera	Apidae	Big carpenter bee	<i>Xylocopa</i> sp.
						OCT ATL		Insecta	Hymenoptera	Megachilidae	Leaf cutter bee	Megachilid sp 1
NOV ATL						OCT ATL		Insecta	Hymenoptera	Formicidae	large black ant sp 1	unidentified
NOV ATL								Insecta	Hymenoptera	Formicidae	Ant sp 1 CONFIRM with aphids	unidentified
NOV ATL	JAN B					OCT ATL		Insecta	Hymenoptera	Formicidae	Ant sp 2 - with golden abdomen - carpenter ant?	
						OCT ATL	OCT B	Insecta	Hymenoptera	Formicidae	Ant sp3	unidentified
						OCT ATL		Insecta	Hymenoptera	Formicidae	Ant sp4	unidentified
NOV ATL								Insecta	Hymenoptera	Chrysididae	Cuckoo wasp	unidentified
NOV ATL								Insecta	Hymenoptera	Scoliidae	Flower Wasp	<i>Scolia</i> sp
NOV ATL								Insecta	Hymenoptera	Vespidae	Wasp sp 1 - unidentified small wasp	
NOV ATL								Insecta	Hymenoptera	Vespidae	Wasp sp2 - unidentified	
NOV ATL	JAN B	APR ATL	APR B			OCT ATL	OCT B	Insecta	Hymenoptera	Vespidae	Paper wasp	<i>Polistes</i> CONFIRM
NOV ATL							OCT B	Insecta	Hymenoptera	Vespidae	Greater Banded Hornet	<i>Vespa tropica</i>
NOV ATL						OCT ATL		Insecta	Hymenoptera	Vespidae	Potter wasp	<i>Delta pyriforme</i>
						OCT ATL		Insecta	Hymenoptera	Sphecidae	thread-waisted wasp	unidentified

Annexure F_List of invertebrates in the core and buffer zone

NOV ATL								Insecta	Diptera	Muscidae	House fly	
NOV ATL								Insecta	Diptera		Fly sp2 - small with black n white abdomen	
NOV ATL	JAN B					OCT ATL	OCT B	Insecta	Diptera	Syrphidae	Tiny cute hover fly sp 1	
NOV ATL								Insecta	Diptera		Fly sp3 - check with previous two - has orange colouration on base of wings	
	JAN B							Insecta	Diptera	Dolichopodidae	Long legged Fly	
	JAN B							Insecta	Diptera	Bombyliidae	Bee fly	
	JAN B						OCT B	Insecta	Diptera	Asilidae	Robber fly	
	JAN B							Insecta	Diptera	Calliphoridae	Blue Bottle Fly	
NOV ATL						OCT ATL		Insecta	Diptera	Ephydriidae	Brine fly	Unidentified
	JAN B					OCT ATL		Insecta	Diptera	Tabanidae	Horse fly	
NOV ATL		APR ATL		JUL ATL	JUL B	OCT ATL		Insecta	Odonata - Zygoptera	Coenagrionidae	Golden Dartlet - male	<i>Ischnura aurora</i>
NOV ATL		APR ATL						Insecta	Odonata - Zygoptera	Coenagrionidae	Senegal Golden Dartlet - male	<i>Ischnura senegalensis</i>
NOV ATL	JAN B					OCT ATL		Insecta	Odonata - Zygoptera	Coenagrionidae	Pigmy Dartlet	<i>Agriocnemis pygmaea</i>
NOV ATL					JUL B			Insecta	Odonata - Zygoptera	Coenagrionidae	Blue Grass Dartlet	<i>Pseudagrion microcephalum</i>
NOV ATL	JAN B			JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Odonata - Zygoptera	Coenagrionidae	Coromandel Marsh Dart	<i>Ceriagrion coromandelianum</i>
NOV ATL	JAN B	APR ATL		JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Ground Skimmer	<i>Diplacodes trivialis</i>
NOV ATL		APR ATL	APR B		JUL B		OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Common Picture Wing	<i>Rhyothemis variegata</i>

Annexure F_List of invertebrates in the core and buffer zone

NOV ATL	JAN B							Insecta	Odonata - Anisoptera	Libellulidae	Long legged Marsh Glider	<i>Trithemis pallidinervis</i>
NOV ATL	JAN B		APR B	JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Ditch Jewel	<i>Brachythemis contaminata</i>
NOV ATL	JAN B	APR ATL		JUL ATL		OCT ATL		Insecta	Odonata - Anisoptera	Libellulidae	Granite Ghost	<i>Bradinopyga geminata</i>
NOV ATL	JAN B	APR ATL		JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Green Marsh Hawk	<i>Orthetrum sabina</i>
NOV ATL	JAN B		APR B	JUL ATL	JUL B	OCT ATL	OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Ruddy Marsh Skimmer	<i>Crocothemis servilia</i>
	JAN B							Insecta	Odonata - Anisoptera	Libellulidae	Scarlet Marsh Hawk	<i>Aethriamanta brevipennis</i>
						OCT ATL		Insecta	Odonata - Anisoptera	Libellulidae	Blue Marsh Hawk	<i>Orthetrum glaucaum</i>
NOV ATL		APR ATL			JUL B		OCT B	Insecta	Odonata - Anisoptera	Libellulidae	Crimson Marsh Glider	<i>Trithemis aurora</i>
NOV ATL		APR ATL	APR B		JUL B	OCT ATL		Insecta	Odonata - Anisoptera	Gomphidae	Common Clubtail	<i>Ictinogomphus rapax</i>
NOV ATL								Insecta		?	Aquatic larva sp 1	?
NOV ATL								Insecta	Orthoptera	Acrididae	Short horned grasshopper sp 1 - green	<i>Acrida</i> sp. (<i>A.exaltata</i>)
NOV ATL								Insecta	Orthoptera	Acrididae	Short horned grasshopper sp 2 - brown	<i>Acrida</i> sp. (<i>A.cinerea</i>)
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp 3 - green with brown line along lateral sides	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp 4 - light brown with brown/white tiny spots	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp 5 - brown - resembling a piece of bark	

Annexure F_List of invertebrates in the core and buffer zone

NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp 6 - green with grey eyes and grey on wings	
NOV ATL						OCT ATL		Insecta	Orthoptera	Acrididae	SHGH sp 7 - medium sized brown gh with yellow brown white grey n black	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp 8 - small medium but resembling sp 4	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp9 - small green gh	
NOV ATL						OCT ATL		Insecta	Orthoptera	Acrididae	SHGH sp10 - small brown	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp11 - brown grasshopper with black bars on hindlegs and white diagonal bar on wing base	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp12 - dirty brown n yellow gh	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp13 - similar to sp7. find if they are the same or different species	
NOV ATL								Insecta	Orthoptera	Acrididae	SHGH sp14 - check if same as sp5	
NOV ATL					JUL B	OCT ATL		Insecta	Orthoptera	Acrididae	SHGH sp15 - bold diagonal white line on base of wings, white line on lateral side of hindleg also	
	JAN B				JUL B	OCT ATL		Insecta	Orthoptera	Acrididae	SHGH sp16	
							OCT B	Insecta	Orthoptera	Acrididae	SHGH sp 17	all green gh

Annexure F_List of invertebrates in the core and buffer zone

							OCT B	Insecta	Orthoptera	Acrididae	SHGH sp 18	dead leaf like gh
NOV ATL								Insecta	Orthoptera	Tetrigidae	brown pigmy gh sp1	
	JAN B				JUL B	OCT ATL		Insecta	Orthoptera	Tettigoniidae	green katydid sp 1	
NOV ATL								Insecta	Coleoptera		Beetle sp 1 - red with black spots - two on thorax, black patches on elytra, antennae comb like (pectinate)	
NOV ATL								Insecta	Coleoptera	Coccinellidae	Red beetle with black patterns - coccinellid sp1	
NOV ATL								Insecta	Coleoptera	Coccinellidae	lady beetle sp2 - light brown beetle with black patterns	
NOV ATL								Insecta	Coleoptera	Scarabaeidae	Rhinoceros beetle	<i>Oryctes rhinoceros</i>
	JAN B						OCT B	Insecta	Coleoptera	Meloidae	Banded blister beetle	<i>Mylabris pustulata</i>
	JAN B					OCT ATL		Insecta	Coleoptera	Staphylinidae	Rove beetle	
						OCT ATL		Insecta	Coleoptera	Hydrophilidae or Dytiscidae	Water scavenger beetle or dyticide beetle	
				JUL ATL				Insecta	Coleoptera	Scarabaeidae	Ground beetle	
NOV ATL	JAN B							Insecta	Hemiptera	Membracidae	treehopper sp1 - brown with dorsal thorny horn	
NOV ATL								Insecta	Hemiptera	Cicadellidae	tiny pale yellow white plant hoppers on grass	
NOV ATL	JAN B	APR ATL					OCT B	Insecta	Hemiptera	Cercopidae	Spittle bugs	
NOV ATL								Insecta	Hemiptera	Aphidae	Aphid sp 1 - black aphids on Tridax	

Annexure F_List of invertebrates in the core and buffer zone

											procumbens tended by ant sp1?	
NOV ATL					JUL B		OCT B	Insecta	Hemiptera	Gerridae	Water Strider sp1	
					JUL B		OCT B	Insecta	Hemiptera	Vellidae	Broad shouldered water strider	BS water strider sp1
	JAN B						OCT B	Insecta	Hemiptera	Pseudococcidae	Mealybugs	
	JAN B	APR ATL						Insecta	Hemiptera	Lygaeidae		
	JAN B		APR B			OCT ATL	OCT B	Insecta	Hemiptera	Scutelleridae	Jewel Bug	<i>Chrysocoris</i> sp.
NOV ATL						OCT ATL	OCT B	Insecta	Hemiptera	Pyrrhocoridae or Lygaeidae	stainer bug or seed bug	
							OCT B	Insecta	Hemiptera	Notonectidae	Back Swimmers	unidentified
NOV ATL	JAN B							Insecta	Dermoptera		Earwig sp1 - littleblack earwig with few white segments in its antennae	
NOV ATL								Insecta	Ephemeroptera		May fly sp1 - green	
	Jan B							Insecta	Mantodea		Mantis	Unidentified
								Insecta	Phasmatodea		Stick Insect	
			APR B				OCT B	Insecta	Neuroptera	Myrmeleontidae	Antlion	
NOV ATL								Mollusca - Gastropoda			Slug sp1	
NOV ATL								Mollusca -			Aquatic snail sp1	

Annexure F_List of invertebrates in the core and buffer zone

								Gastropoda				
NOV ATL								Annelida -			Earthworm sp1	
NOV ATL						OCT ATL	OCT B	Diplopoda	Polydesmida	Paradoxosomatidae	Millipede	<i>Orthomorpha coarctata</i>
NOV ATL											Pillbugs	
NOV ATL								Sub phylum Crustacea			Crab sp1	dead and alive
NOV ATL								Arachnida	Aranae		spider sp1	
NOV ATL								Arachnida			spider sp2 -1	
NOV ATL								Arachnida			spider sp3	
NOV ATL								Arachnida			spider sp4 - black	
NOV ATL								Arachnida			small orb weaver sp1 - light brown n yellow spider with thick center circular webbing	Argiope sp.
NOV ATL								Arachnida			small orb weaver sp2 - marking different from sp1 but confirm	
NOV ATL								Arachnida			a small pale coloured spider - is it a male of argiope or a species by itself?	
NOV ATL	JAN B					OCT ATL	OCT B	Arachnida		Araenidae	Signature spider/Speckled band four-leg	Argiope anasuja?
NOV ATL								Arachnida			Spider sp5 - on cycas revoluta	
NOV ATL								Arachnida			Spider sp6 - on cycas revoluta - is it same as	

Annexure F_List of invertebrates in the core and buffer zone

										sp5?	
NOV ATL								Arachnida			Spider sp7 - web spread on grass
NOV ATL								Arachnida		Salticidae	JS sp 1
NOV ATL								Arachnida		Salticidae	JS sp 2 - dark brown with creamy patterns on body
NOV ATL		APR ATL						Arachnida		Salticidae	JS sp 3 - brown and gold with pointed abdomen
NOV ATL								Arachnida		Salticidae	JS sp4 - brown with two white spots at the posterior end of abdomen and two cream white lines on the anterior part of abdomen
NOV ATL								Arachnida		Salticidae	JS sp5 - brown with cream, hairy
NOV ATL								Arachnida		Salticidae	JS sp6 - dirty brown cream sort with large hairy pedipalps
NOV ATL								Arachnida		Salticidae	JS sp 7 - confirm if it is not same as sp4
NOV ATL								Arachnida		Salticidae	JS sp8 - dark brown spider with three bold white lines
NOV ATL	JAN B							Arachnida		Salticidae	JS sp9 - small brown spider with cream and white bands on face - cute
NOV ATL								Arachnida		Lycosidae	wolf spider sp1
	JAN B						OCT B	Arachnida		Eresidae	social spiders
	JAN B						OCT ATL	Arachnida		Oxyopidae	

Annexure F_List of invertebrates in the core and buffer zone

Scoring the Impact Consequence

The consequences on various environmental receptors have been ranked into 5 levels consequence and are given in the following table 2.1. This table covers flora fauna impacts only focusing on the study being undertaken by the Keystone team.

Table 2-1: Impact Scoring System: Consequence Assessment

S. No	Environmental Component Impacted	Impact and Score ¹				
		Insignificant Consequence (+/-) 1 point	Minor Consequence (+/-) 2 points	Moderate Consequence (+/-) 3 points	Major Consequence (+/-) 4 points	Catastrophic Consequence (+/-) 5 points
C1	C2	C3	C4	C5	C6	C7
1.	Impacts on Flora/ Fauna Habitat/ Ecosystem	Site specific loss (removal) of common floral species (but not any tree or trees). Vegetation composition does not form a habitat character for any species of conservation significance. No short term or long term impacts are likely to adversely affect the	Site specific loss (removal) of some saplings of trees. Minor temporary impacts on ecosystem functioning or habitat ecology of common/generalist species. Minor short term/ long term impacts on surrounding/ immediate / adjacent habitats and are resilient to changes in	Site specific loss (removal) of some common well grown tree/trees species. Site specific loss of nesting/ breeding habitat of common/generalist species of flora-fauna but will not result in permanent loss of habitat. Short term or long term impacts are likely	Site specific impact on threatened species but impacted species is widely distributed outside the project site. Short term impacts may lead to loss of abundance or extent, but unlikely to cause local population extinction. Site specific habitat loss of fauna listed in IUCN,	Impact on threatened species listed in as a endemic / Schedule-I as per IWPA 1972, BSI, Red Data Book, ZSI, BSI or literature published by any State Govt. Institute, University and Collage etc. Loss of habitat of above said flora-fauna. Impact on genetic diversity Impact on

¹ In case none of the impacts are not applicable, then Not Applicable (NA) is written in the appropriate cell.

Annexure G_ Scoring Impact Consequence

S. No.	Environmental Component Impacted	Impact and Score ¹				
		Insignificant Consequence (+/-) 1 point	Minor Consequence (+/-) 2 points	Moderate Consequence (+/-) 3 points	Major Consequence (+/-) 4 points	Catastrophic Consequence (+/-) 5 points
C1	C2	C3	C4	C5	C6	C7
		<p>habitat/ecosystem. Site specific disturbance to common/generalist faunal species (e.g. movement pattern, temporary displacement etc.). No negative impacts on ecosystem functioning or habitat ecology.</p>	<p>habitat structure or condition.</p>	<p>to adversely affect the habitat character or functioning of ecosystem. Impact on surrounding agro-ecosystem/agriculture</p>	<p>WCMC, Birdlife International, or any other international literature - secondary information. Impacts on habitats / ecosystems of international importance.</p>	<p>threatened / endemic/ Schedule-I fauna. Impact on endemic fauna, species listed in ZSI or literature published by any State Govt. Institute, University and Collage etc. The project activity within 10 km of NP/WS/RF/ PF and other eco-sensitive area). Impact on NP /PF /WLS /ESZ /IBA / tiger reserve / elephant corridor / corridor Impact on ecosystem like river, forest etc.</p>

Quantifying the Probability of Occurrence of the Impact

After identifying the consequence severity as shown in the following table 2.2. The probability of occurrence also needs to be estimated to arrive at a complete picture of environmental impact. Table 2.3 provides probability/likelihood ratings on a scale of 1-5. These ratings are used for estimating the likelihood of each occurrence.

Table 2-2: Probability of Occurrence

Description	Environment/Health and Safety	Probability
Frequent	Continues or will happen every time	5
Often	Occur several times	4
Likely	Might occur at least once	3
Possible	Might occur	2
Rare	Very rarely encountered	1

Quantifying Environmental Impact

The level of environmental impact risk is calculated by multiplying the consequence score and the probability of occurrence together. Thus Significance of Impact=Consequence Score × Probability of Occurrence. The final score is in relative point score, rather than actual impact. The impact estimation is carried out assuming a well managed exploratory program with the use of standard safety measures. Table 2.4 assigns significance criteria, based on the scale of 1-25, used for prioritizing mitigation measures for reducing the environmental impact and thereafter, formulating and implementing Environmental Management Plans (EMP's).

To do this, environmental impact risk levels are first scored and identified as mentioned earlier and then evaluated on the evaluation scale that follows in

Table2-3: Environmental Impact Significance Criteria

Probability	Consequence				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Extensive (5)
Rare (1)	1	2	3	4	5
Possible (2)	2	4	6	8	10
Likely (3)	3	6	9	12	15
Often (4)	4	8	12	16	20
Certain (5)	5	10	15	20	25

Table 2-4: Environmental Impact Categorization

Scoring Negative Impacts (-)			Scoring Positive Impacts (+)	
Color Code and Score Range	Type of Risk	Inference	Colour Code and Score Range	Inference

Annexure G_ Scoring Impact Consequence

25	Extremely Severe	Activity should not proceed in current form	25	Activity has Extensive Positive Benefits
15-20	Very Severe	Activity should be modified to include remedial planning and actions and be subject to detailed ecological assessment	15-20	Activity has Major Benefits
8-12	Moderately Severe	Activity can operate subject to management and / or modification	8-12	Activity has Moderate Benefits
4-6	Less Severe	No action required unless escalation of risk is possible	4-6	Activity has Minor Benefits
1-3	Minor/Negligible	Negligible Risk of activity	1-3	Activity has mildly positive impacts

- **Reserve forests around Oragadam:**

The reserve forests within the buffer zone of ATL were determined using Google Earth Pro (GEP) satellite imagery. Three reserve forests viz. Mahanyam Reserve Forest, Vattakambam Reserve Forest and Vadakkapattu Reserve Forest. There were other forests of similar description beyond the buffer zone. Survey of India maps were not accessed given data usage restrictions; however the GEP imagery can be used as a point of reference. The descriptions of the forests are provided in the main report along with other activities in the vicinity of these reserve forests. The diversion of reserve forest land for development activities could not be verified given that the source of information was not reliable and could not be validated.

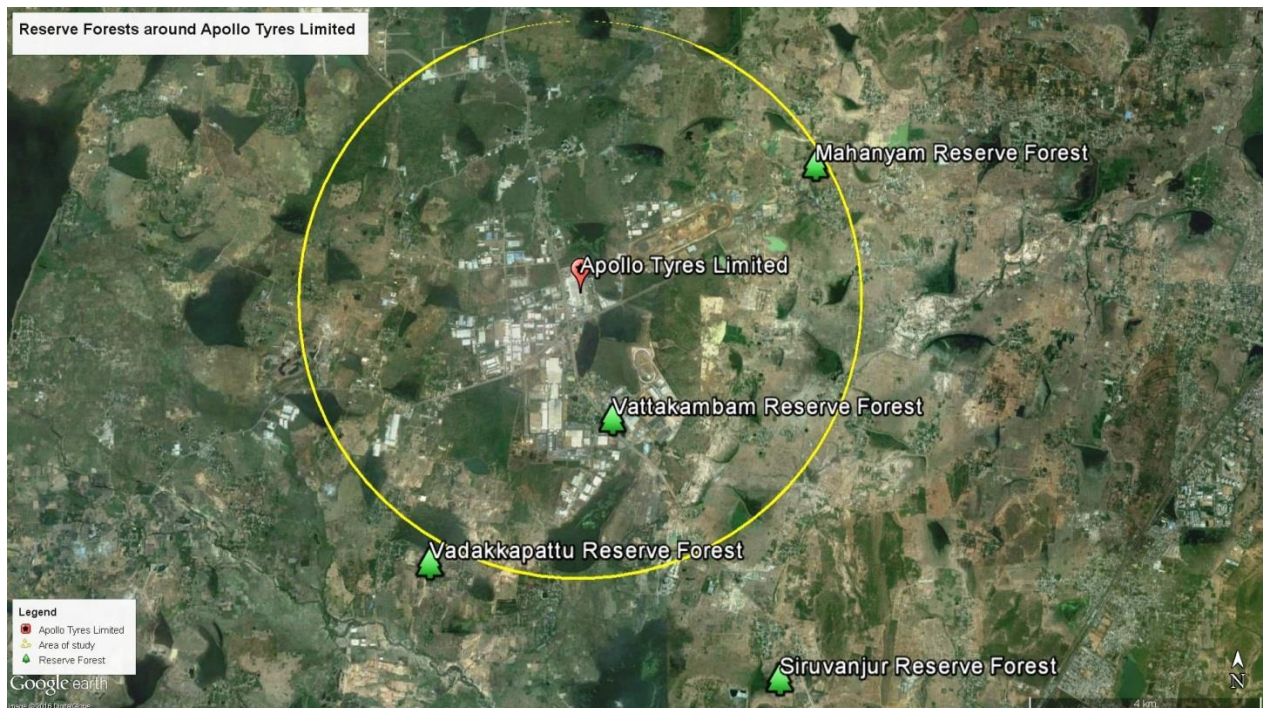


Image: GEP image of reserve forests within the buffer zone

- **Description and notification of Reserve Forests in India¹:**

Reserved Forest is an area mass of land duly notified under the provisions of India Forest Act or the State Forest Acts having full degree of protection. In Reserved Forests all activities are prohibited unless permitted. Reserved Forest is notified under section 20 of the Indian Forest Act, 1927 [Act 16 of 1927] or under the reservation provisions of the Forest acts of the State Governments of the Indian Union. The manner in which a Reserved Forest, shortly written as RF, has to be constituted is described in section 3 to 20 of the Act. It is within power of a State Government to issue a preliminary notification under section 4 of the Act declaring that it has been decided to constitute such land, as specified in a Schedule with details of its location, area and boundary description, into a Reserved Forest. Such a notification also appoints an officer of the State Government, normally the Deputy Commissioner of the concerned district, as Forest Settlement Officer. The Forest Settlement Officer

¹ https://en.wikipedia.org/wiki/Indian_Forest_Act,_1927

Annexure H_Reserve forests in Oragadam

fixes a period not less than three months, to hear the claims and objections of every person having or claiming any rights over the land which is so notified to be reserved. He conducts inquiries into the claims of rights, and may reject or accept the same. He is empowered even to acquire land over which right is claimed. For rights other than that of right of way, right of pasture, right to forest produce, or right to a water course, the Forest Settlement Officer may exclude such land in whole or in part, or come to an agreement with the owner for surrender of his rights, or proceed to acquire such land in the manner prescribed under the Land Acquisition Act, 1894 [Act 1 of 1894]. Once the Forest Settlement Officer settles all the rights either by admitting them or rejecting them, as per the provisions of the Act, and has heard appeals, if any, and settled the same, all the rights with the said piece land [boundaries of which might have been altered or modified during the settlement process] vest with the State Government. Thereafter, the State Government issues notification under section 20 of the Indian Forest Act, 1927 declaring that piece of land to be a Reserved Forest.

De-notification of protected areas:

<http://www.moef.nic.in/sites/default/files/np-sanc.pdf>

<http://www.moef.nic.in/division/draft-guidelines-diversion-denotification-forest-land-national-park-sanctuaries-non-forest->

<http://forestsclearance.nic.in/Guidelines.aspx>