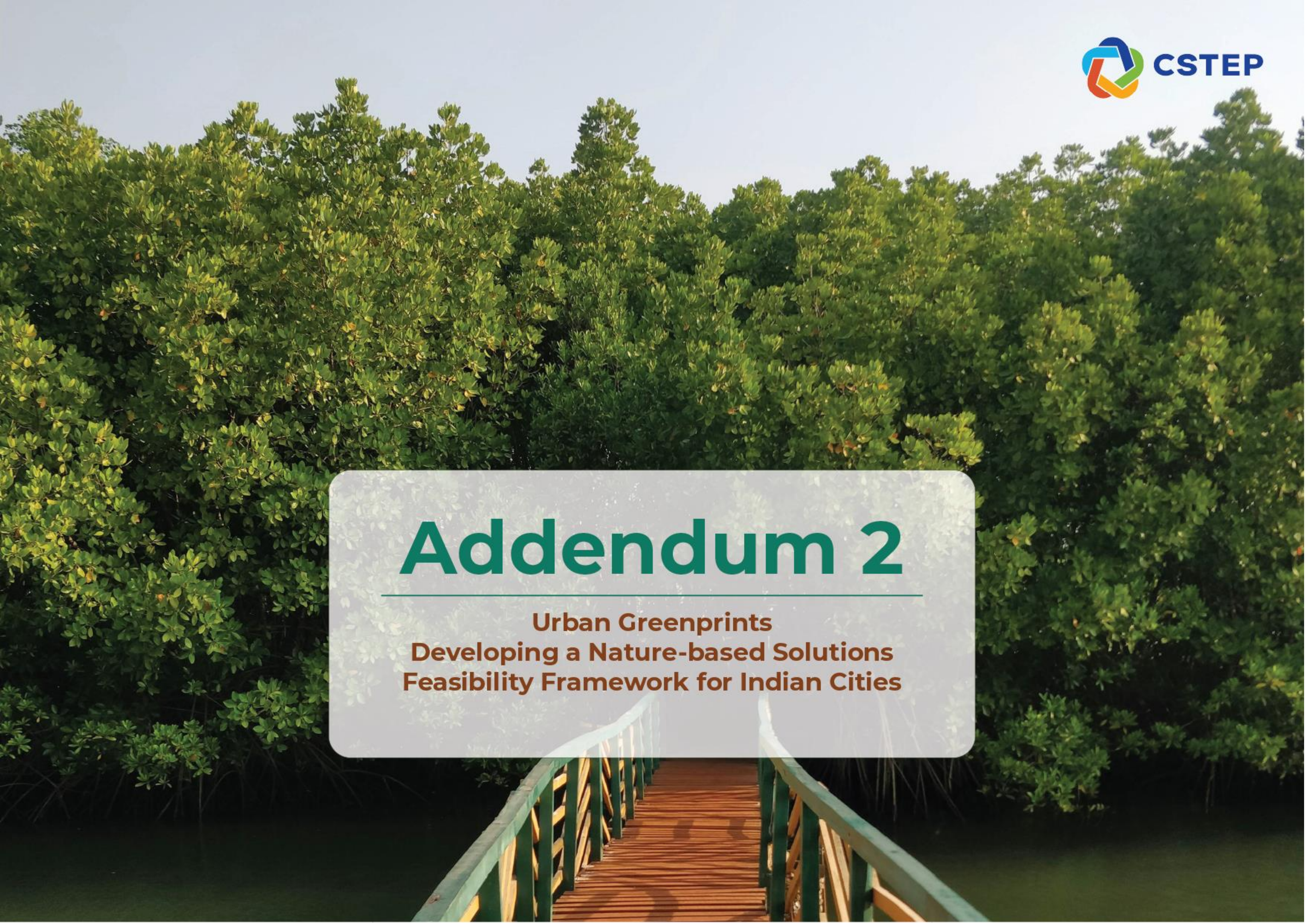

CSTEP

Addendum 2

Urban Greenprints
Developing a Nature-based Solutions Feasibility Framework for Indian Cities

Edited and Designed by CSTEP

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Contents

1. Identifying Suitable NbS

Type	ES Benefits	Land Requirement	Adaptation Benefits
Mangroves	30+ species/hectare; 5 tons CO_2/hectare/year; 95% stormwater absorption	High: 25 hectares upwards	High: 66% wave energy reduction; long-term resilience
Living Shorelines	10–15 species/hectare; 1–2 tons CO_2/hectare/year; moderate erosion control	Medium: 5–10 hectares	High: 30%–50% wave energy reduction; strong erosion control
Beach Nourishment	Limited biodiversity; recreational value; 10–30 m^3 sand deposition/linear meter	High: 10–30 hectares/km	Medium: 30%–50% erosion reduction; lacks long-term resilience
Dune Restoration	10 species/hectare; 0.2–0.5 tons CO_2/hectare/year; 20%–40% sediment stabilization	High: 30–100 hectares/km	High: 50% wave energy reduction; 30%–60% flood buffering
Salt Marshes	20–40 species/hectare; 4–8 tons CO_2/hectare/year; 30%–50% pollutant filtration	High: 50–150 hectares/km	Medium: 30%–50% wave energy reduction; 500–1,000 m^3 floodwater storage
Re-activating Floodplain	10–20 species/hectare; 1,500–3,000 m^3 floodwater retention/hectare; 1–2 tons CO_2/year	High: 200–500 hectares/km	High: 30%–70% flood peak reduction; sediment trapping
Urban Forest, Forest Corridors	15–30 species/hectare; 1–3 tons CO_2/hectare/year; 1–2°C cooling	Low: 0.1–1 hectare/block	Medium: localised cooling; 30%–50% stormwater absorption
Green Roofs	5–10 species/rooftop; 0.2–0.5 tons CO_2/hectare/year; 2–4°C cooling	Low: rooftop-based	Medium: 50%–80% rainfall retention; localised flood reduction
Bioretention Areas	15–20 species/hectare; 80–95% pollutant filtration; 0.5–1 tons CO_2/hectare/year	Medium: 100–200 m^2	High: 60%–80% stormwater retention; 30%–50% peak flow reduction
Permeable Pavements	30%–50% runoff reduction; 10–20 litres infiltration/m^2; limited biodiversity	Low: replaces existing pavements	Low: 20%–40% rainfall retention; limited localised impact
Inland Wetlands	Medium: 20–30 species/hectare; 500–1,000 m^3 water retention/hectare; 2–4 tons CO_2/year	Medium: 50–100 hectares	Low: 30%–50% sediment filtration; inland flood management
Naturalised Riverbanks	20–40 species/km; 50%–70% erosion reduction; 2–5 tons CO_2/km/year	Medium: 5–15 hectares/km	Medium: 20%–40% flood peak reduction; localised riverine impact
Artificial Reefs	10–20 species/reef; 50%–200% fish biomass increase; 0.5–1 ton CO_2/year	Low: no additional land required	Medium: 10%–20% wave energy reduction; buffer for mild surges

2. Justification for Scoring

2.1. Mangroves

Image	Component	Qualification	Scoring
 Source: https://upload.wikimedia.org/wikipedia/commons/7/7b/Mangroves_at_sunset.jpg	Ecosystem Service Benefits	• **Biodiversity:** India's mangroves support 46 crab species, around 60 commercially important fish species, and numerous bird species, significantly enriching biodiversity. [1] • **Carbon Sequestration:** Mangroves sequester 6–8 tons of CO_2 per hectare annually, outperforming mature tropical forests in carbon storage efficiency.[2] • **Wave Reduction:** Mangroves reduce wave heights by 13%–66% over 100 m, with the highest reduction near their edges.[3] • **Storm Protection:** Mangroves diminish storm surge height and water flow velocity, providing robust protection against cyclonic storms.[4]	3 (High)
	Land Requirement	The smallest recorded mangrove ecosystem is 25 hectares.[5]	1 (High)
	Effectiveness for Urban Coastal Adaptation	• **Coastal Shield:** Mangrove roots dissipate wave energy, safeguarding infrastructure and communities and enhancing coastal resilience and climate mitigation through carbon storage.[6] • **Resilience and Adaptation:** Mangroves shield against tidal waves and storms, trap carbon-rich particles, foster sediment accretion, mitigate saline intrusion, and support aquatic habitats, crucial for urban coastal adaptation.[6]	3 (High)

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2.2. Living Shorelines

Image	Component	Qualification	Scoring
 Source: https://www.flseagrant.org/workforce-training/living-shorelines-training/	Ecosystem Service Benefits	• **Biodiversity Support**: Living shorelines harbour 10–15 marine and coastal species per hectare, enhancing biodiversity and providing critical habitats.[7] • **Coastal Stabilisation**: Utilising native vegetation and natural materials, living shorelines reduce sediment loss and mitigate erosion.[7] • **Carbon Sequestration**: They store 1–2 tons of CO_2 per hectare annually through seagrasses and salt marsh vegetation.[7] • **Water Quality Improvement**: By filtering water and reducing nutrient and pollutant loads, living shorelines maintain healthy aquatic environments.[7] • **Wave Attenuation and Sediment Accretion**: Living shorelines effectively mitigate coastal erosion, improve sediment deposition, and enhance wave attenuation.[8]	Medium
	Land Requirement	• Requires moderate space and width depends on shoreline stability, wave energy, and sediment dynamics, with some projects needing minimal space and others more.[9]	Medium
	Effectiveness for Urban Coastal Adaptation	• **Storm Resilience**: They provide long-term protection against storm surges and flooding while supporting ecological functions and reducing pollution.[10]	High

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2.3. Beach Nourishment

Image	Component	Qualification	Scoring
 Source: https://www.northcarolinahealthnews.org/2022/09/02/youth-climate-stories-beach-nourishment-tourism-homes-outer-banks/	Ecosystem Service Benefits	• **Biodiversity:** It supports beach nourishment and focuses on cost-effectiveness and shoreline protection, but its benefits for biodiversity are uncertain. It offers limited support for species like shorebirds and intertidal organisms.[11] • **Habitat Creation and Ecosystem Stability:** Frequent sand disturbances hinder habitat creation, disrupt sediment transport, and threaten the stability of coastal ecosystems.[12] • **Erosion Control:** Nourishment temporarily mitigates erosion by adding 10–30 m^3 of sand per linear meter of beach, providing storm protection and limited habitat benefits.[13]	Low
	Land Requirement	• **Land Requirement:** It requires approximately 10–30 hectares of beach area per km for sand deposition and maintenance from 30–60-m width onwards.[14] • **Replenishment Frequency:** Periodic sand replenishment every 2–5 years is necessary to offset erosion losses and sustain recreational and protective functions.[15]	High
	Effectiveness for Urban Coastal Adaptation	• **Wave Energy Reduction:** Sand nourishment can reduce wave energy by 10%–20% during mild storms, offering modest buffering against storm surges.[16] • **Longevity and Management:** Effectiveness significantly decreases without regular replenishment, particularly after major storms, with protection reduced by 50%, requiring ongoing management and assessment.[17]	Medium

[11] Theodor, Kindeberg., B., Almström., Mona, Skoog., Pål, Axel, Olsson., Johan, Hollander. (2022). 2. Toward a multifunctional nature-based coastal defense: a review of the interaction between beach nourishment and ecological restoration. Nordic Journal of Botany, doi: 10.1111/njb.03751

[12] K., N., Hart., Rebecca, S., Beavers., Sam, Whitin., C., Overcash., M., LaFrance, Bartley. (2023). 1. National Park Service beach nourishment guidance (second edition). doi: 10.36967/2299256

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2.4. Dune Restoration

Image	Component	Qualification	Scoring
 Source: https://www.dakshin.org/wp-content/uploads/2017/06/Sand-Dunes_Policy-Brief.pdf	Ecosystem Service Benefits	• **Biodiversity:** Shifts in dune vegetation, including invasive species, and disruption of ecosystem services.[18] • **Erosion Control:** Vegetated dunes reduce erosion by up to 37% during wave collision through fine root biomass.[19] • **Carbon Sequestration:** Vegetation rehabilitation increases soil inorganic carbon (SIC); CO_2 storage data are contextual.[20]	Low
	Land Requirement	• **Land requirement:** Studies suggest that wider beaches with greater accommodation space are more conducive to dune formation and growth.[21] • **Urban Conflicts:** Restoration competes with development, requiring balanced stakeholder engagement.[22]	High
	Effectiveness for Urban Coastal Adaptation	• **Storm Protection:** Healthy dunes stabilise coasts and recover quickly after storms; wave energy reduction data are lacking.[23] • **Flood Mitigation:** Revegetation in Sicily reduced flooded urban areas by 42% during extreme wave events.[24] • **Resilience:** After 6 years of minimal restoration, dunes recover with increased sand accretion and vegetation.[25]	High

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2.5. Salt Marshes

Image	Component	Qualification	Scoring
 Source: https://www.nature.com/articles/s43017-021-00196-2	Ecosystem Service Benefits	• **Biodiversity:** Salt marshes host 20–40 species per hectare, including fish, shellfish, crabs, and waterfowl. Essential breeding and foraging habitats for birds and fish, supporting ecosystem productivity.[26] • **Carbon Storage:** Sequester 4–8 tons of CO_2 per hectare annually.[27] • **Nutrient Removal:** Remove 22% nitrogen and 60% phosphorus inputs, enhancing water quality.[28]	High
	Land Requirement	• **Land Requirement:** The size of a salt marsh ecosystem could range between 140 and 280 hectares along Tamil Nadu's coastline.[29] • **Habitat Limitation:** Salt marshes are restricted to low-lying tidal zones and face pressure from agriculture and urban development.[30]	High
	Effectiveness for Urban Coastal Adaptation	• **Wave Reduction:** Reduce wave energy by 30%–50% over 100 meters, aiding flood protection.[31] • **Flood Value:** Restoration valued at USD 21 million, increasing with sea level rise.[32] • **Adaptation Limits:** Moderately effective for urban adaptation but vulnerable to climate change.[33]	Medium

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2.6. Reactivating Floodplain

Image	Component	Qualification	Scoring
 Source: https://sandrp.in/2023/09/18/drp-nb-180923-floodplain-loss-the-biggest-in-asia-disaster-in-the-making/	Ecosystem Service Benefits	• **Floodwater Retention:** Reconnecting floodplains retains 1,500–3,000 m^3 of floodwater per hectare, reducing flood risk and restoring natural storage.[34] • **Biodiversity:** Supports 10–20 species per hectare, including wetland-dependent birds, amphibians, and aquatic species.[35] • **Carbon Sequestration:** Floodplain forests sequester 1–2 tons of CO_2 per hectare annually, aiding climate regulation.[36]	Medium
	Land Requirement	• **Land-Use Conflict:** Re-activation competes with agriculture and urban development, requiring careful management.[37]	High
	Effectiveness for Urban Coastal Adaptation	• **Flood Risk Reduction:** Reduces peak flood discharge by 30%–70%, depending on size and connectivity.[38] • **Water Quality Improvement:** Traps 20%–40% of sediments and pollutants, enhancing downstream water quality.[39] • **Low Maintenance:** Restored floodplains provide long-term flood mitigation, habitat restoration, and improved water quality with minimal upkeep.[37]	High

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2.7. Urban Forests

Image	Component	Qualification	Scoring
 Source: https://thecityfix.com/blog/trees-cities-implementing-nature-based-solutions-india/	Ecosystem Service Benefits	• **Biodiversity:** Urban forests host 15–30 species per hectare, including birds, pollinators, and small mammals, enhancing ecosystem health.[40] • **Wildlife Connectivity:** Green corridors in urban forests support wildlife movement and ecosystem services in urban areas.[41] • **Carbon Sequestration:** Canadian urban forests sequester 2.12 tons of CO_2 per hectare annually, with variability by species and age.[42] • **Urban Cooling:** Urban forests reduce temperatures by 1–2°C through shade and evapotranspiration.[41] • **Air Quality Improvement:** Urban trees filter 20–50 kg of particulate matter per hectare annually, improving air quality.[43]	High
	Land Requirement	• **Land Requirement:** Between 30 sq ft (Miyawaki forests), 1–10 ha (Nagar Vatika) to 10 hectares and upwards (Nagar Van).[44] • **Land Utilisation:** Urban forests adapt well to under-utilised spaces, enhancing biodiversity and resilience without disrupting infrastructure.[45]	Low
	Effectiveness for Urban Coastal Adaptation	• **Stormwater Management:** Tree canopies reduce rainfall intensity by 42%–50%, mitigating runoff and urban flooding.[46] • **Heat Island Mitigation:** Urban forests lower surface temperatures, with stronger cooling effects in coastal cities.[47] • **Climate Adaptation:** Urban forests address heat and flooding but have limitations against large-scale coastal risks, requiring broader strategies.[48]	Medium

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2.8. Green Roofs

Image	Component	Qualification	Scoring
 Source: https://www.purple-roof.com/post/green-roofs-answer-urban-resilience	Ecosystem Service Benefits	• **Urban Cooling:** Reduce rooftop temperatures by 2–4°C, mitigating the urban heat island effect.[49] • **Air Quality:** Filter 10–30 kg of particulate matter per hectare annually, improving urban air quality.[50] • **Biodiversity:** Support 5–10 species per rooftop, enhancing urban ecosystems.[51] • **Carbon Sequestration:** Store 0.2–0.5 tons of CO_2 per hectare annually.[52]	Medium
	Land Requirement	• **Space Needs:** A minimum area of 10 m^2; surface arranged to ensure natural vegetation and rainwater retention.[53] • **Integration:** Easily retrofitted onto buildings, promoting urban sustainability.[54]	Low
	Effectiveness for Urban Coastal Adaptation	• **Flood Reduction:** Reduce flood volume by up to 62% and runoff by 24%, effective at >25% application rates.[55] • **Peak Flow Mitigation:** Decrease peak flow rates by 22%–93%, mitigating urban flooding.[56] • **Localized Impact:** Effective for urban flood management in high-density areas but limited for large-scale coastal risks.[57]	Medium

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2.9. Bioretention Areas

Image	Component	Qualification	Scoring
 Source: https://raleighnc.gov/stormwater/services/green-stormwater-infrastructure-initiatives/roadway-bioretention-areas	Ecosystem Service Benefits	• **Particulate Removal:** Mature bioretention systems reduce particulates and particulate-bound metals by 82% and 83%, respectively, but are less effective against dissolved metals.[58] • **Biodiversity:** Enhance biodiversity and habitat creation, although species specifics **are** not detailed.[59] • **Carbon Sequestration:** Sequester 0.5–1 ton of CO_2 per hectare annually through vegetation and soil processes.[60] • **Urban Cooling:** Reduce localised temperatures by 1–2°C, mitigating urban heat islands.[61]	High
	Land Requirement	• **Area requirement:** Designed to treat 0.5–1 inch of runoff, 15 feet(W) x 4 feet(H), and a ponding depth of 6–8 inches capable of draining within 72 hours.[62] • **Scalability:** Flexible in design, suitable for integration into medians, parking lots, and parks.[63]	Medium
	Effectiveness for Urban Coastal Adaptation	• **Flood Mitigation:** Reduce peak flow magnitudes by over 80%, mitigating flash floods and runoff.[64] • **Coastal Adaptation:** Support sustainable stormwater management in urban coastal areas.[65]	High

[58] Kristen, Croft., Birthe, V., Kjellerup., Allen, P, Davis. (2024). 5. Interactions of particulate- and dissolved-phase heavy metals in a mature stormwater bioretention cell.. Journal of Environmental Management, doi: 10.1016/j.jenvman.2023.120014

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2.10. Permeable Pavements

Image	Component	Qualification	Scoring
 Source: https://pavementnetwork.com/permeable-pavements/	Ecosystem Service Benefits	• **Runoff Reduction:** Permeable pavements reduce surface runoff by 30%–50%, depending on soil infiltration and design.[66] • **Groundwater Recharge:** Infiltrate 10–20 litres of water per square metre during rainfall, enhancing hydrological cycles.[67] • **Biodiversity:** Support soil-dwelling insects like wild bees and wasps, providing valuable nesting sites.[68]	Low
	Land Requirement	• **Space Needs**: Replaces existing paved surfaces, requiring no additional land, making it highly space-efficient at ~20 m^2 onwards.[69] • **Applications:** Suitable for parking lots, sidewalks, and low-traffic areas, integrating easily into urban layouts.[66]	Low
	Effectiveness for Urban Coastal Adaptation	• **Flood Mitigation:** Improve drainage efficiency and mitigate localised flooding, supporting urban coastal adaptation.[70] • **Limitations:** Effective for small-scale flooding but not for large-scale stormwater or coastal adaptation strategies.[66]	Low

[66] Jinjun, Zhou., Yali, Pang., Wei, Du., Tianyi, Huang., Hao, Wang., Meilin, Zhou., Jiahong, Liu. (2024). 1. Review of the development and research of permeable pavements. Hydrological Processes, doi: 10.1002/hyp.15179

[67] Eneko, Madrazo-Uribeetxebarria., Maddi, Garmendia, Antín., Ignacio, Andrés-Doménech. (2023). 3. Analysis of the hydraulic performance of permeable pavements on a layer-by-layer basis. Construction and Building Materials, doi: 10.1016/j.conbuildmat.2023.131587

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2.11. Inland Wetlands

Image	Component	Qualification	Scoring
 Source: https://environment-review.yale.edu/making-way-coastal-wetlands-look-sea-level-rise-and-urban-development	Ecosystem Service Benefits	• **Biodiversity:** Inland wetlands support 20–30 species per hectare, including birds, amphibians, and aquatic plants.[71] • **Water Retention:** Retain 500–1,000 m^3 of water per hectare, aiding in flood mitigation.[71] • **Carbon Storage:** Sequester 2–4 tons of CO_2 per hectare annually, influenced by vegetation and hydrology.[72]	Medium
	Land Requirement	• **Area:** The minimum size for wetlands considered in the national inventory and assessment for India is 2.25 hectares, often located in peri-urban or rural areas.[73] • **Land Use:** Compete with agriculture, particularly in arid and semiarid regions.[74]	Medium
	Effectiveness for Urban Coastal Adaptation	• **Flood Management:** Manage inland flooding effectively but have limited impact on coastal challenges like storm surges.[75] • **Water Quality Improvement:** Reduce nitrogen by 18%–28% and phosphorus by 4%–11%, enhancing water quality.[76] • **Limitations:** Geographic and hydrological constraints reduce their impact on urban coastal resilience amid salinification and land-use changes.[75]	Low

[71] Igor, Zelnik., Mateja, Germ. (2023). 2. Diversity of Inland Wetlands: Important Roles in Mitigation of Human Impacts. Diversity, doi: 10.3390/d15101050

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2.12. Naturalised Riverbanks

Image	Component	Qualification	Scoring
 Source: https://stateofgreen.com/en/solutions/water-brings-life-to-bishan-ang-mo-kio-park/	Ecosystem Service Benefits	• **Erosion Control:** Reduce bank erosion by 50%–70% using vegetation and natural materials.[77] • **Biodiversity:** Support 20–40 species per kilometre, including riparian flora, fish, amphibians, and birds.[78] • **Water Quality:** Filter 30%–60% of sediments and pollutants, improving downstream water quality.[78] • **Carbon Sequestration:** Sequester 2–5 tons of CO_2 per kilometre annually, depending on vegetation density.[79]	High
	Land Requirement	• **Space Needs:** A minimum width of 30 feet is necessary, with 100 feet recommended for most conditions. For diverse wildlife habitats or steep slopes, a width of up to 300 feet (100 meters) is advisable.[80] • **Urban Integration:** Face moderate competition with urban development but are easier to integrate than inland wetlands.[81]	Medium
	Effectiveness for Urban Coastal Adaptation	• **Flood Mitigation:** Reduce flood peaks and stormwater runoff, enhancing urban resilience.[82] • **Limitations:** Effective for riverine systems but less suitable for coastal flooding or sea level rise adaptation.[83]	Medium

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[80] https://www.nrcs.usda.gov/sites/default/files/2022-09/Riparian_Forest_Buffer_391_CPS_10_2020.pdf ; https://www.arlis.org/docs/vol1/71303840.pdf

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[82] Md., Esraz-Ul-Zannat., Aysin, Dedekorkut-Howes., E., Morgan. (2024). 1. A review of nature-based infrastructures and their effectiveness for urban flood risk mitigation.   doi: 10.1002/wcc.889

[83] Veronica, Zagare. (2022). 2. Nature-based Solutions for climate adaptation and mitigation in Deltas and coastal areas..   doi: 10.59490/jdu.3.2022.6863

2.13. Artificial Reefs

Image	Component	Qualification	Scoring
 Source: https://reefwatchindia.org/initiative-4/reefgenerate/	Ecosystem Service Benefits	• **Biodiversity Support:** Artificial reefs host 10–20 species per structure, including fish, crustaceans, and coral colonies.[84] • **Ecosystem Services:** Enhance marine habitats, support trophic guilds, and improve local fisheries, although specific fish biomass increases are not detailed.[85] • **Carbon Sink Limitation:** Limited carbon sink potential due to low marine species diversity in certain areas.[86]	Medium
	Land Requirement	• **Integration:** Designed to minimise spatial conflicts with urban and coastal developments while promoting sustainable marine resource use.[87]	Low
	Effectiveness for Urban Coastal Adaptation	• **Wave Energy Reduction:** Reduce wave energy by 10–20%, aiding coastal erosion protection and shoreline stability.[88] • **Storm Surge Protection:** Buffer mild storm surges but are less effective during high-intensity events than natural reefs.[89] • **Maintenance:** Require regular upkeep to prevent degradation but offer long-term ecological and socio-economic benefits if managed properly.[89]	Medium

[84] Valeriya, Komyakova., Valeriya, Komyakova., Dean, Chamberlain., Stephen, E., Swearer. (2021). 3. A multi-species assessment of artificial reefs as ecological traps. Ecological Engineering, doi: 10.1016/J.ECOLENG.2021.106394 ; Shike, Gao., Bin, Xie., Yufeng, He., Shuo, Zhang., Yunkai, Li., Jikun, Lu., Guanghui, Fu. (2024). 1. Trophic Structure of Fish Community in Artificial Reef Ecosystem Based on Body Mass Using Stable Isotope. Water, doi: 10.3390/w16213034

[85] Ana, Maria, Madiedo., Jorge, Ramos., Francisco, Leitão. (2024). 1. Enhancing Ecosystem Services. Advances in environmental engineering and green technologies book series, doi: 10.4018/979-8-3693-2436-3.ch006

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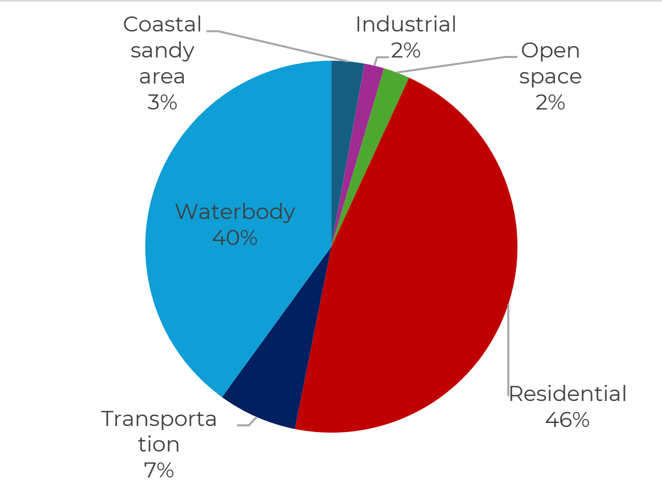
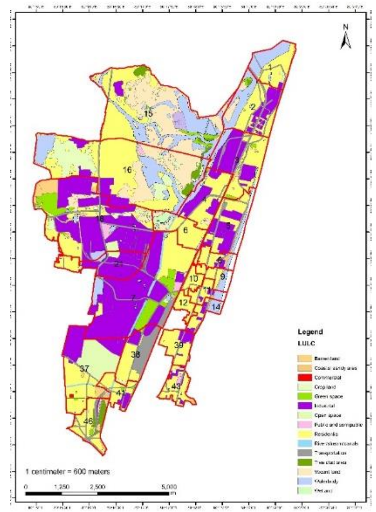
[89] Baptiste, Vivier., Jean-Claude, Dauvin., Maxime, Navon., Anne-Marie, Rusig., Isabelle, Mussio., Francis, Orvain., Mohamed, Boutouil., Pascal, Claquin. (2021). 9. Marine artificial reefs, a meta-analysis of their design, objectives and effectiveness. Global Ecology and Conservation, doi: 10.1016/J.GECCO.2021.E01538

3. Context Assessments: Chennai

3.1. Kathivakkam

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 1	1.75	Barren land	0.00
		Coastal sandy area	0.05
		Industrial	0.03
		Open space	0.04
		Residential	0.81
		Transportation	0.12
		Waterbody	0.70





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Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low

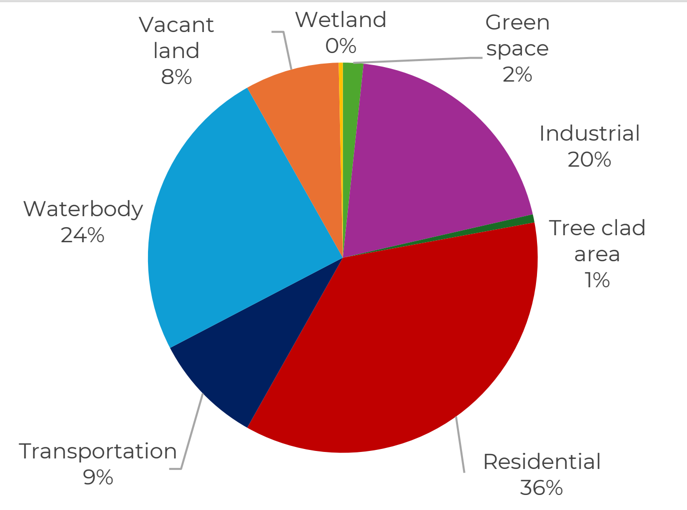
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.51	35.7	
Permeable Pavements	85%	0.01	0.85	
Bioretention Spaces	60%	0.70	42.0	
Urban Forests	12%	0.04	0.48	
Total		1.26	79.03	1.85

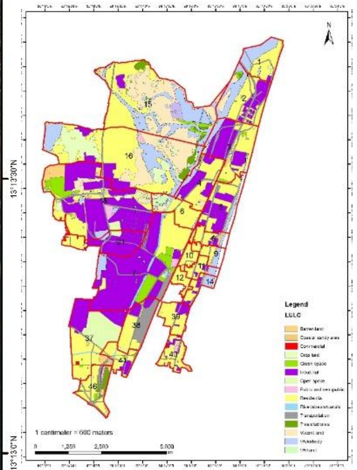
77%

potential increase in water detention

3.2. Ennore

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 2	2.94	Barren land	0.00
		Green space	0.05
		Industrial	0.58
		Residential	1.06
		Transportation	0.27
		Tree clad area	0.02
		Vacant land	0.23
		Waterbody	0.72
		Wetland	0.01





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

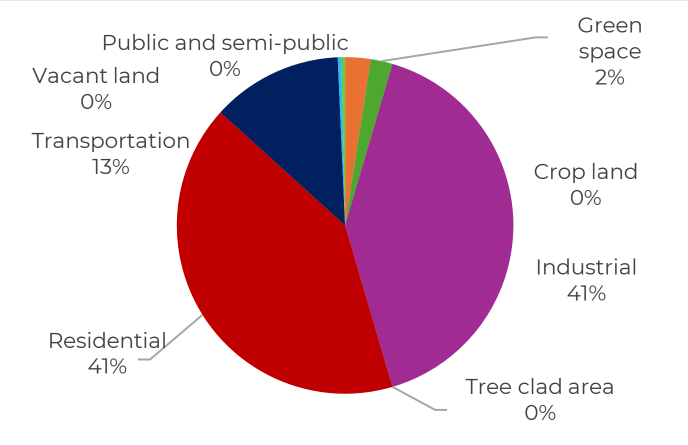
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.72	50.30	
Permeable Pavements	85%	0.73	0.67	
Bioretention Spaces	60%	0.04	43.83	
Urban Forests	12%	0.01	0.50	
Total		1.50	95.31	14.72

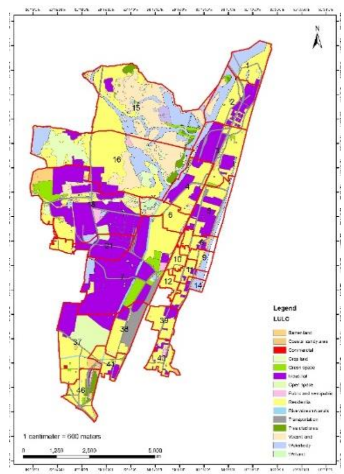
81%

potential increase in water detention

3.3. Ernavoor

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 3	3.16	Barren land	0.07
		Crop land	0.01
		Green space	0.06
		Industrial	1.17
		Public and semi-public	0.00
		Residential	1.18
		Transportation	0.36
		Tree clad area	0.00
		Vacant land	0.01
		Waterbody	0.27
		Wetland	0.03





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

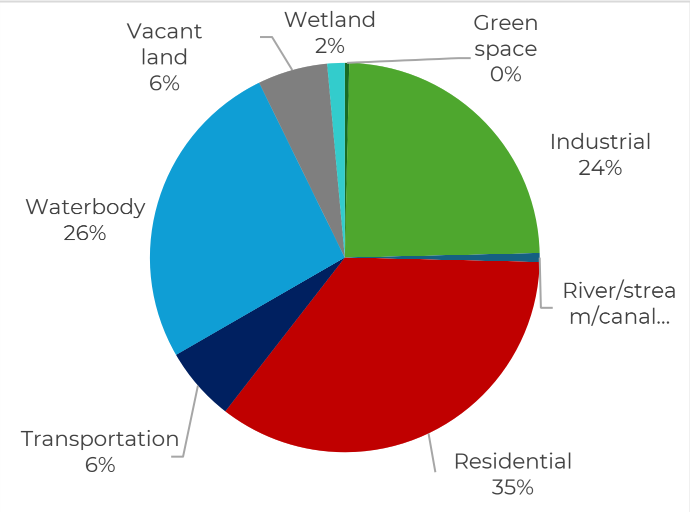
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.90	63.03	
Permeable Pavements	85%	0.31	0.75	
Bioretention Spaces	60%	0.34	18.56	
Urban Forests	12%	0.01	4.14	
Total		1.56	86.47	8.81

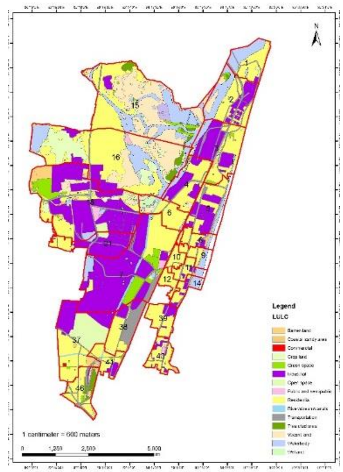
78%

potential increase in water detention

3.4. Ajax

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 4	2.10	Green space	0.01
		Industrial	0.67
		Residential	0.97
		River/stream/canals	0.02
		Transportation	0.17
		Vacant land	0.05
		Waterbody	0.16
		Wetland	0.04





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low

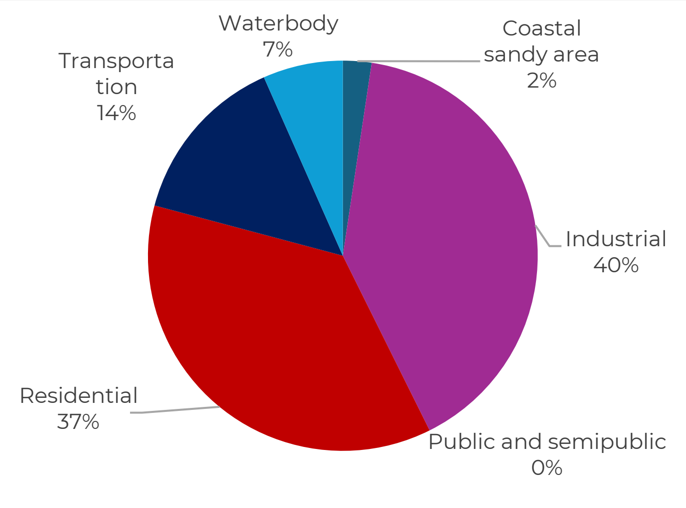
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.70	48.89	
Permeable Pavements	85%	0.22	0.62	
Bioretention Spaces	60%	0.00	13.40	
Urban Forests	12%	0.01	0.00	
Total		0.93	62.91	5.47

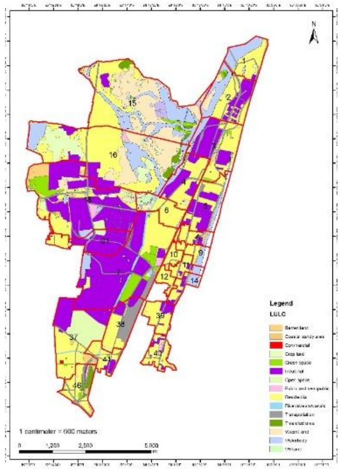
57%

potential increase in water detention

3.5. Tiruvottriyur

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 5	2.10	Coastal sandy area	0.05
		Industrial	0.85
		Public and semipublic	0.00
		Residential	0.77
		Transportation	0.30
		Waterbody	0.14





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium

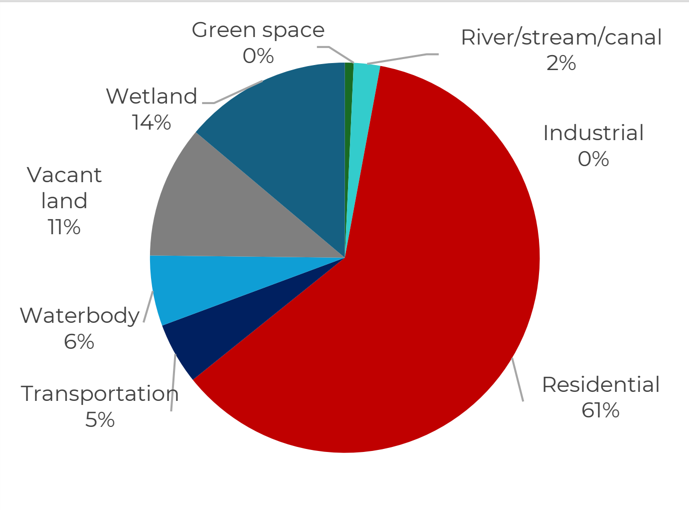
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.52	36.43	
Permeable Pavements	85%	0.14	0.49	
Bioretention Spaces	60%	0.19	8.15	
Urban Forests	12%	0.01	2.24	
Total		0.85	47.30	0.72

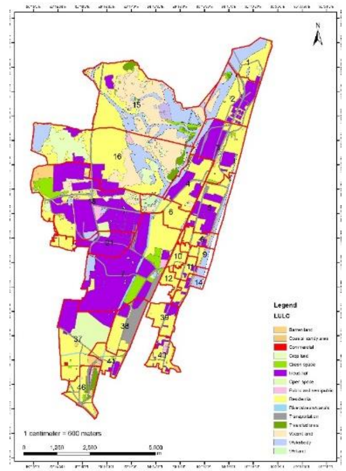
47%

potential increase in water detention

3.6. Kaladipet

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 6	1.39	Crop land	0.01
		Green space	0.00
		Industrial	0.00
		Residential	0.84
		River/stream/canals	0.03
		Transportation	0.07
		Vacant land	0.15
		Waterbody	0.08
		Wetland	0.19





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium

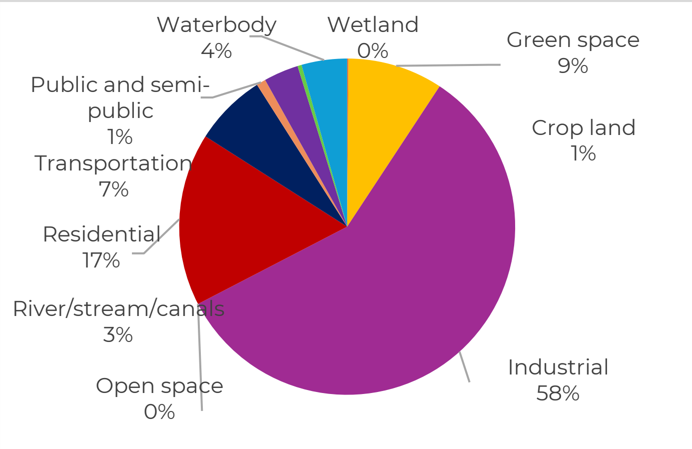
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.65	45.23	
Permeable Pavements	85%	0.30	0.54	
Bioretention Spaces	60%	0.00	18.12	
Urban Forests	12%	0.01	0.00	
Total		0.95	63.89	17.41

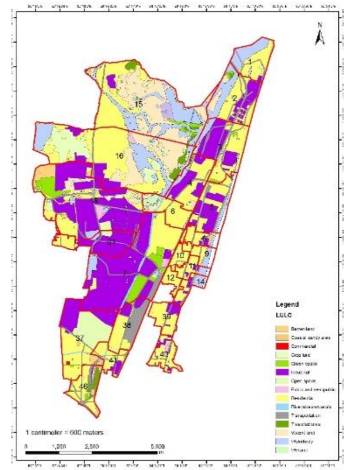
46%

potential increase in water detention

3.7. Rajakadai

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 7	7.77	Barren land	0.01
		Crop land	0.03
		Green space	0.71
		Industrial	4.51
		Open space	0.00
		Public and semipublic	0.07
		Residential	1.29
		River/stream/canals	0.26
		Transportation	0.54
		Waterbody	0.34
		Wetland	0.00





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low

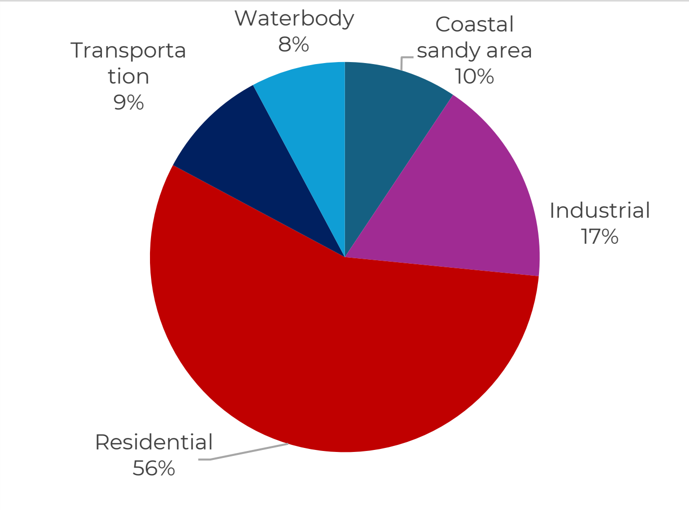
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.82	57.46	
Permeable Pavements	85%	0.66	0.82	
Bioretention Spaces	60%	0.00	39.62	
Urban Forests	12%	0.01	0.00	
Total		1.49	97.90	37.09

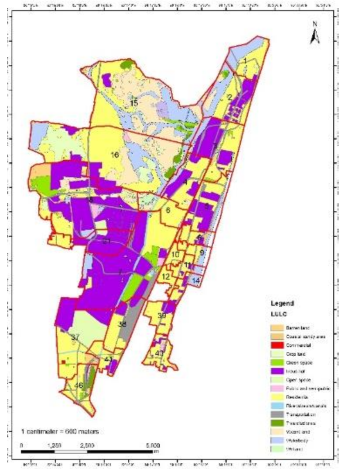
61%

potential increase in water detention

3.8. Edyanchavadi

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 8	0.63	Coastal sandy area	0.06
		Industrial	0.11
		Residential	0.36
		Transportation	0.06
		Waterbody	0.05





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

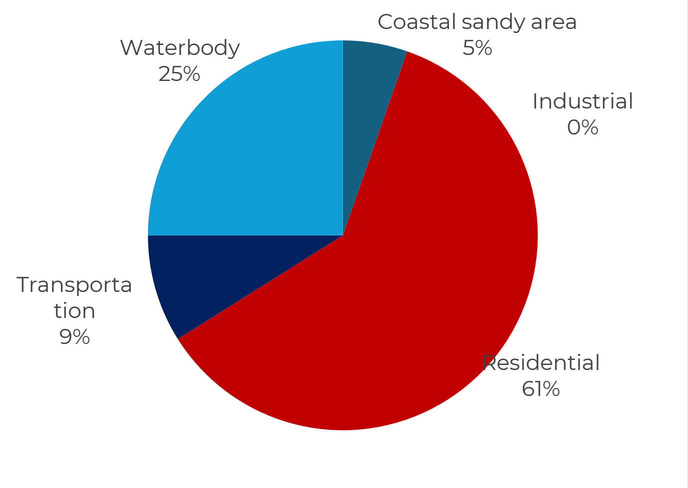
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.24	16.94	
Permeable Pavements	85%	0.05	0.23	
Bioretention Spaces	60%	0.00	3.00	
Urban Forests	12%	0.00	0.00	
Total		10.29	20.17	0.85

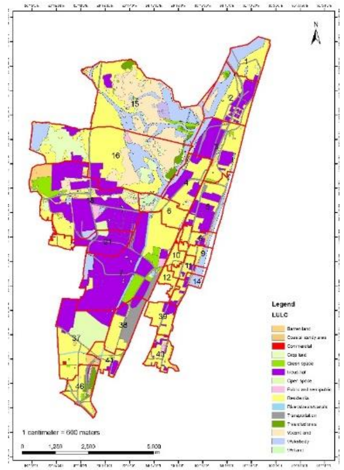
19%

potential increase in water detention

3.9. Kadapakkam

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 9	0.56	Coastal sandy area	0.03
		Industrial	0.00
		Residential	0.34
		Transportation	0.05
		Waterbody	0.14





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low

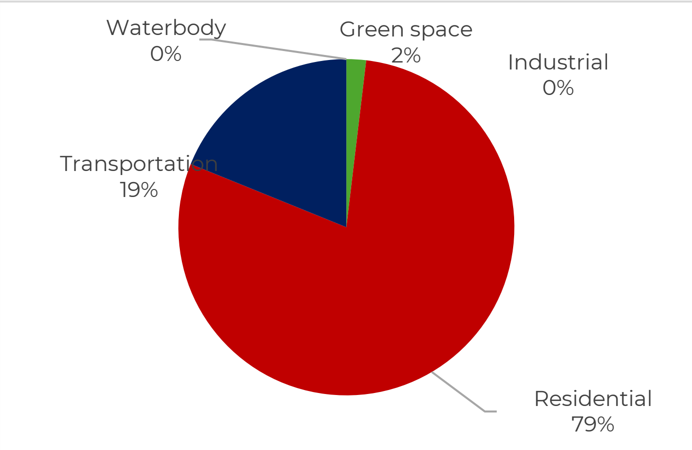
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.22	15.10	
Permeable Pavements	85%	0.14	0.22	
Bioretention Spaces	60%	0.00	8.62	
Urban Forests	12%	0.00	0.00	
Total		0.36	23.93	0.40

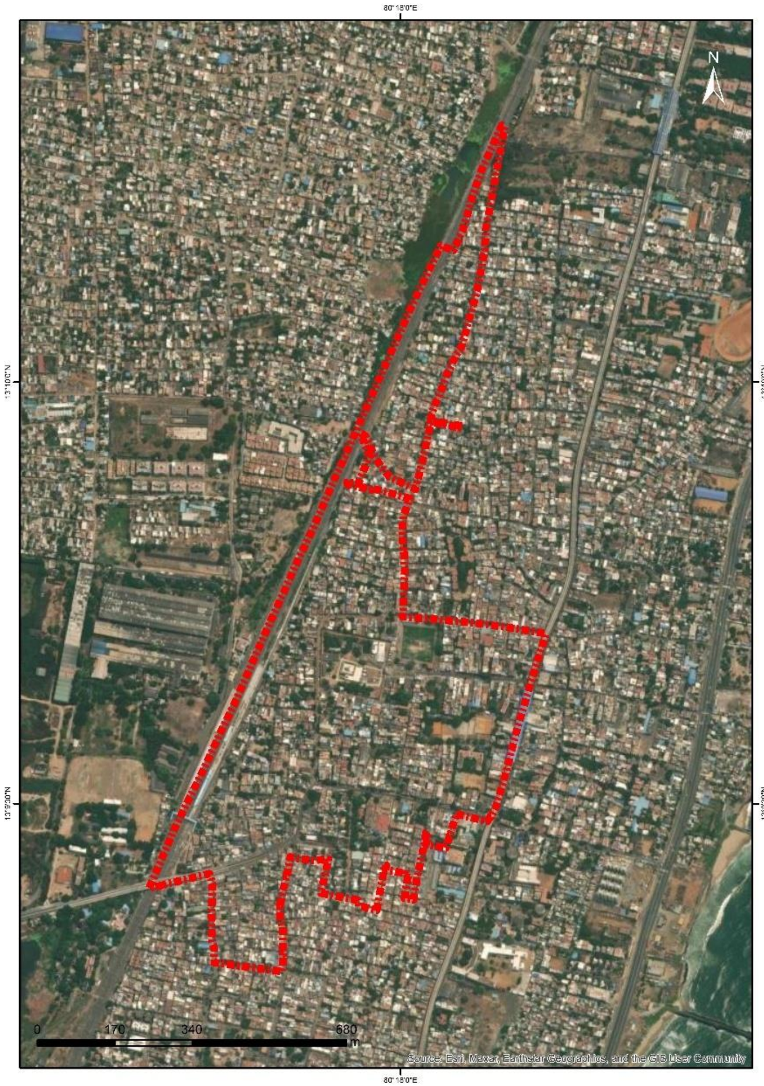
24%

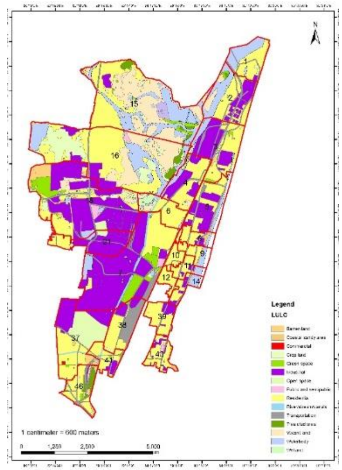
potential increase in water detention

3.10. Theeyambakkam

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 10	0.53	Green space	0.01
		Industrial	0.00
		Residential	0.42
		Transportation	0.10
		Waterbody	0.00







CSTEP

Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

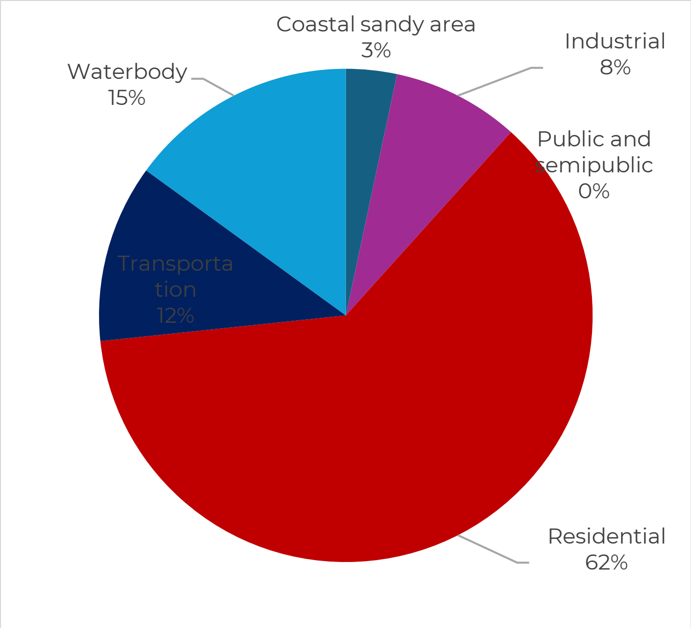
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.29	20.00	
Permeable Pavements	85%	0.00	0.27	
Bioretention Spaces	60%	0.00	0.02	
Urban Forests	12%	0.00	0.00	
Total		0.29	20.28	0.34

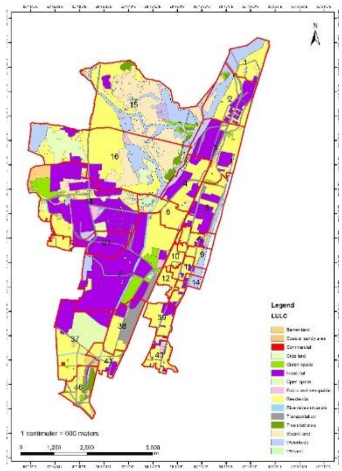
20%

potential increase in water detention

3.11. Manali

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 11	0.60	Coastal sandy area	0.02
		Industrial	0.05
		Public and semipublic	0.00
		Residential	0.37
		Transportation	0.07
		Waterbody	0.09





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low

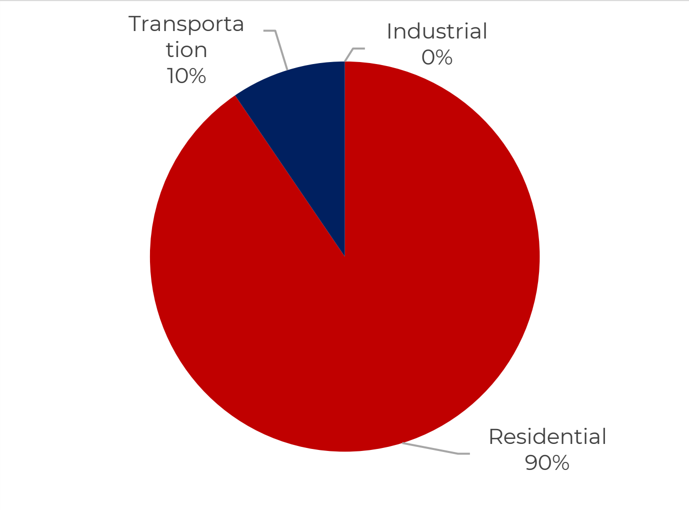
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.25	17.66	
Permeable Pavements	85%	0.09	0.24	
Bioretention Spaces	60%	0.00	5.47	
Urban Forests	12%	0.00	0.00	
Total		0.35	23.37	0.25

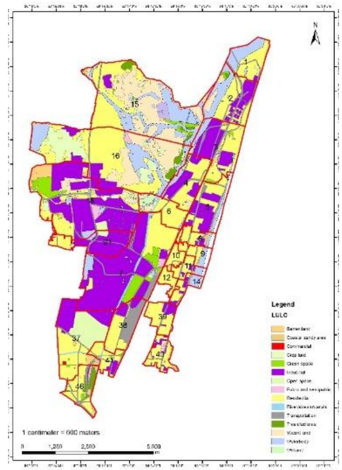
23%

potential increase in water detention

3.12. Mathur

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 12	0.42	Industrial	0.00
		Residential	0.38
		Transportation	0.04





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

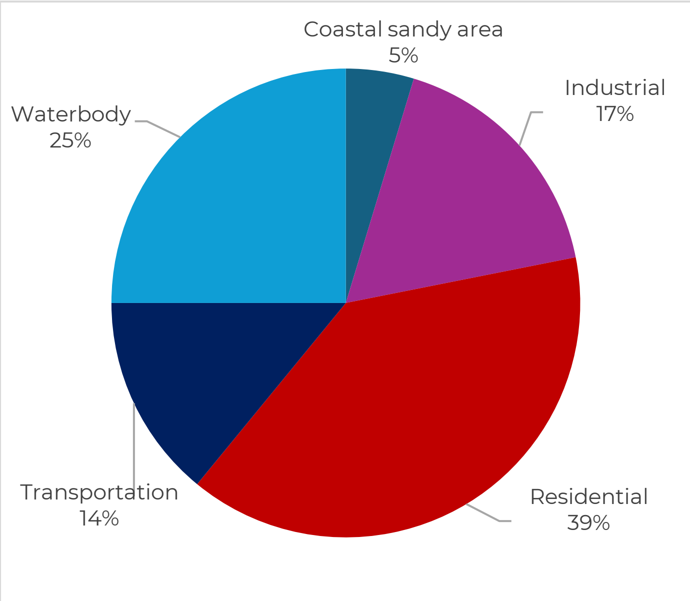
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.28	19.37	
Permeable Pavements	85%	0.00	0.24	
Bioretention Spaces	60%	0.00	0.00	
Urban Forests	12%	0.00	0.00	
Total		0.28	19.61	0.00

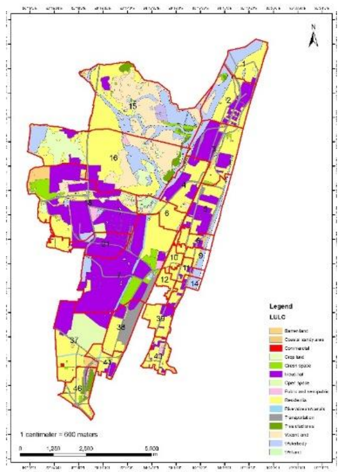
20%

potential increase in water detention

3.13. Puzhal

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 14	0.63	Coastal sandy area	0.03
		Industrial	0.11
		Residential	0.25
		Transportation	0.09
		Waterbody	0.16





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Bioretention Areas	High	Medium	High
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium
Salt Marshes	High	High	Medium
Re-activating Floodplain	Medium	High	High
Artificial Reefs	Medium	Low	Medium

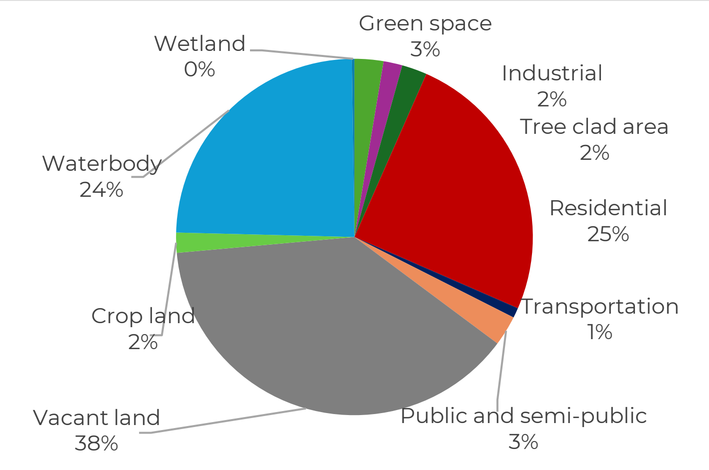
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.16	11.13	
Permeable Pavements	85%	0.16	0.16	
Bioretention Spaces	60%	0.00	9.45	
Urban Forests	12%	0.00	0.00	
Total		0.32	20.73	0.42

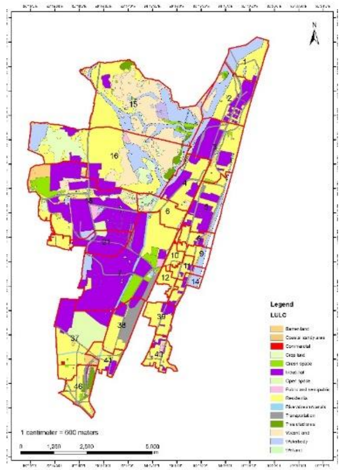
20%

potential increase in water detention

3.14. Puthagram

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 15	8.77	Crop land	0.16
		Green space	0.23
		Industrial	0.15
		Public and semi public	0.24
		Residential	2.19
		Transportation	0.08
		Tree clad area	0.20
		Vacant land	3.37
		Waterbody	2.14
		Wetland	0.02





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

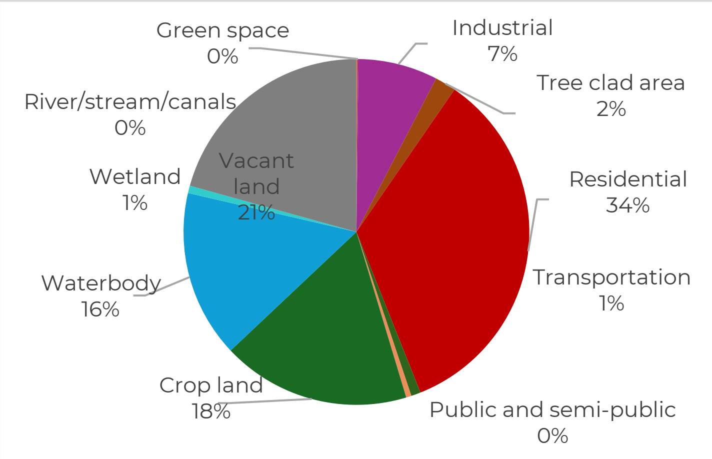
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	1.11	78.01	
Permeable Pavements	85%	0.00	1.39	
Bioretention Spaces	60%	0.00	0.14	
Urban Forests	12%	0.02	0.00	
Total		1.13	79.54	20.25

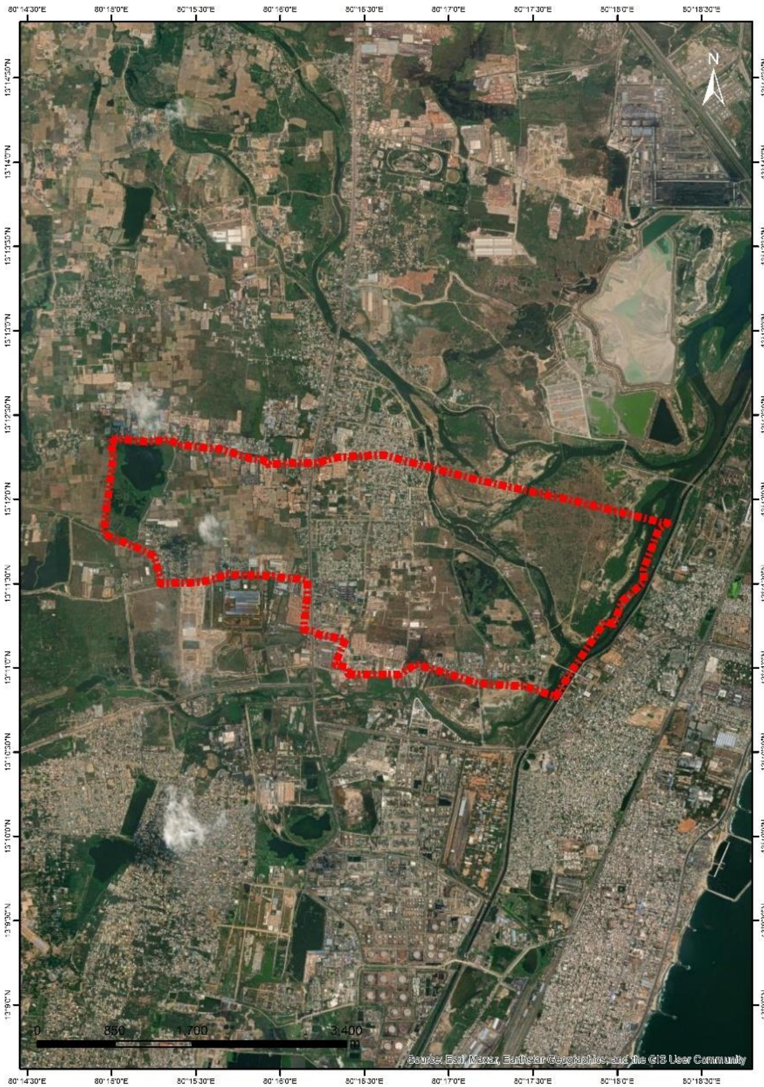
59%

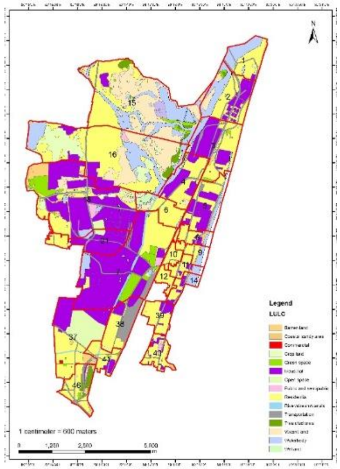
potential increase in water detention

3.15. Kathirvedu

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 16	10.11	Barren land	0.01
		Crop land	1.78
		Green space	0.01
		Industrial	0.75
		Public and semipublic	0.05
		Residential	3.47
		River/stream/canals	0.00
		Transportation	0.09
		Tree clad area	0.20
		Vacant land	2.09
		Waterbody	1.58
		Wetland	0.07







Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

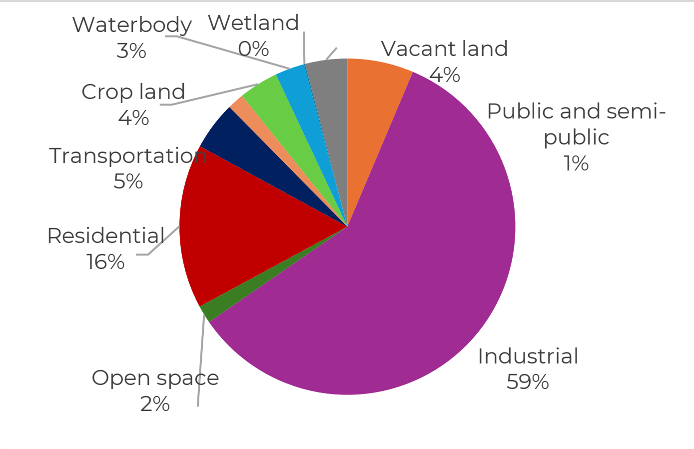
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	2.22	155.05	
Permeable Pavements	85%	1.71	2.22	
Bioretention Spaces	60%	0.00	102.51	
Urban Forests	12%	0.03	0.00	
Total		3.95	259.78	165.44

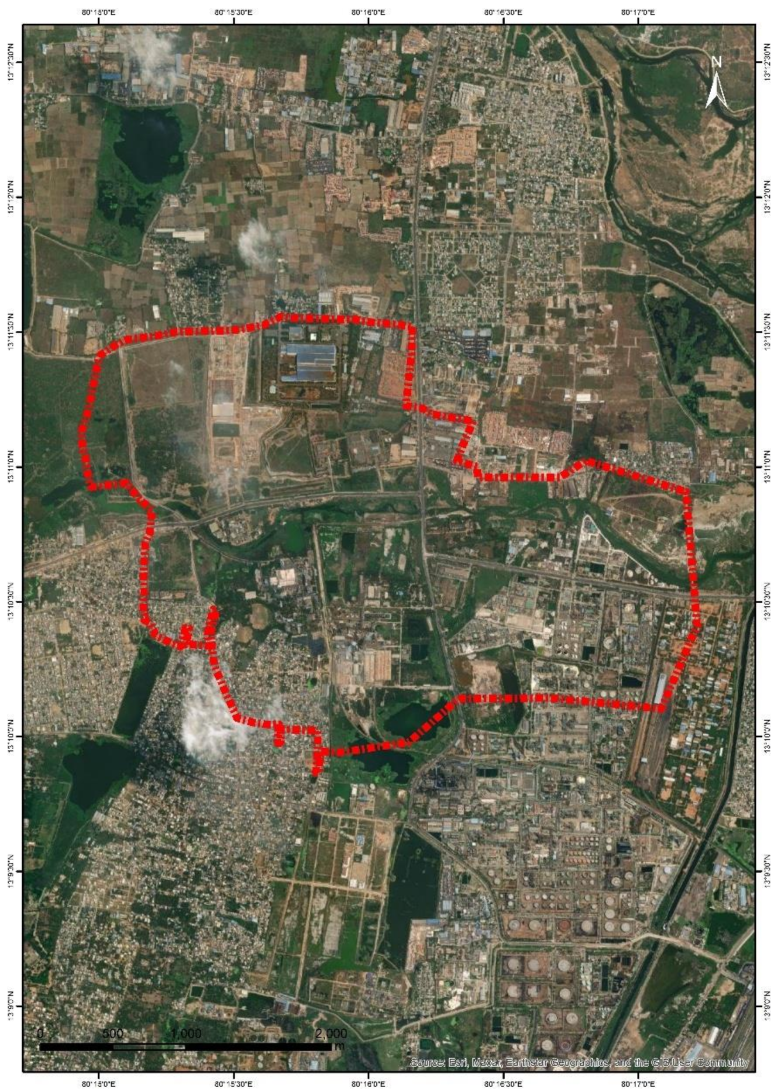
94%

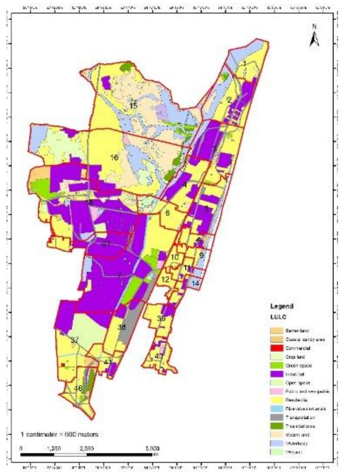
potential increase in water detention

3.16. Assisi Nagar – 9th St

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 18	8.70	Barren land	0.52
		Crop land	0.31
		Green space	0.55
		Industrial	4.81
		Open space	0.14
		Public and semipublic	0.13
		Residential	1.29
		Transportation	0.38
		Vacant land	0.33
		Waterbody	0.23
		Wetland	0.01







CSTEP

Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium

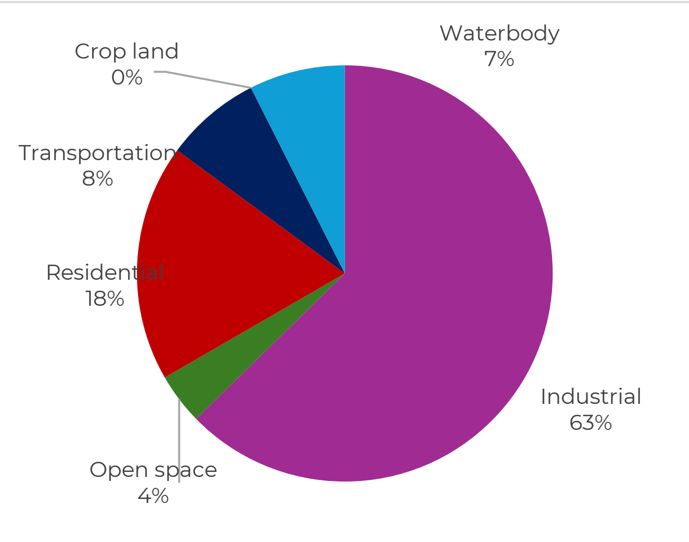
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.77	53.61	
Permeable Pavements	85%	0.30	0.82	
Bioretention Spaces	60%	0.32	18.29	
Urban Forests	12%	0.01	3.89	
Total		1.40	76.62	67.74

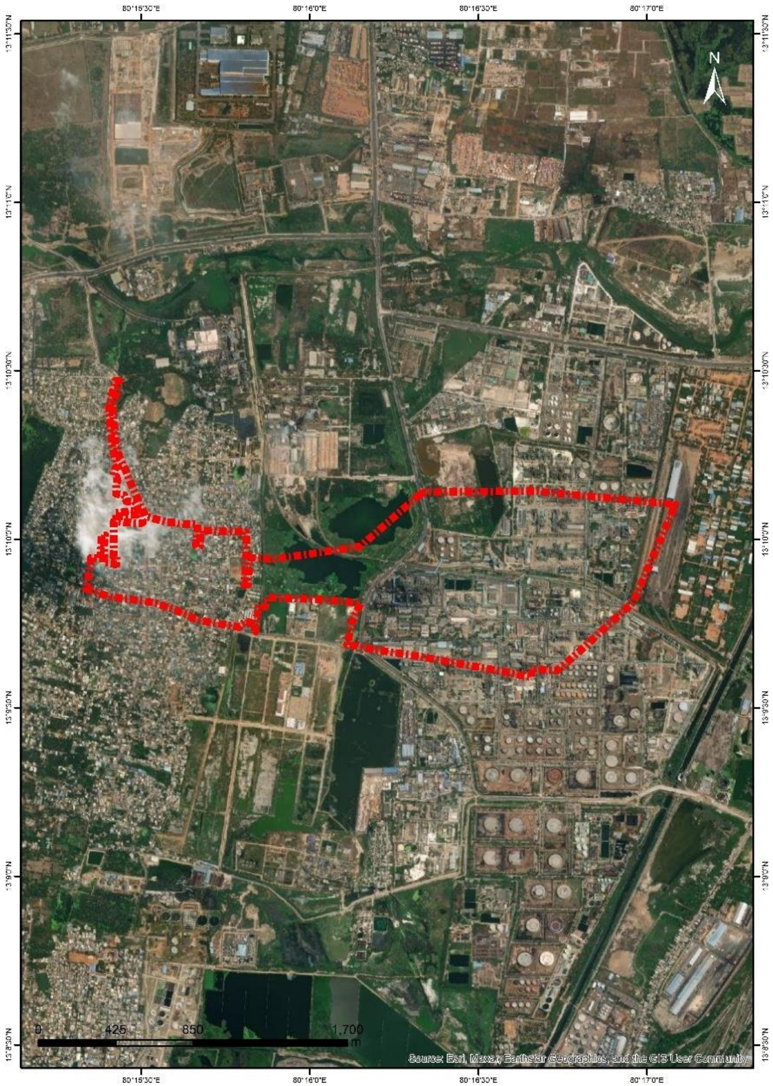
9%

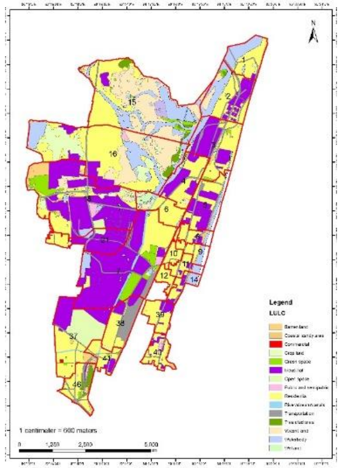
potential increase in water detention

3.17. Kodungaiyur

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 21	3.12	Barren land	0.00
		Crop land	0.00
		Industrial	1.26
		Open space	0.08
		Residential	0.37
		Transportation	0.15
		Waterbody	1.26







Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low

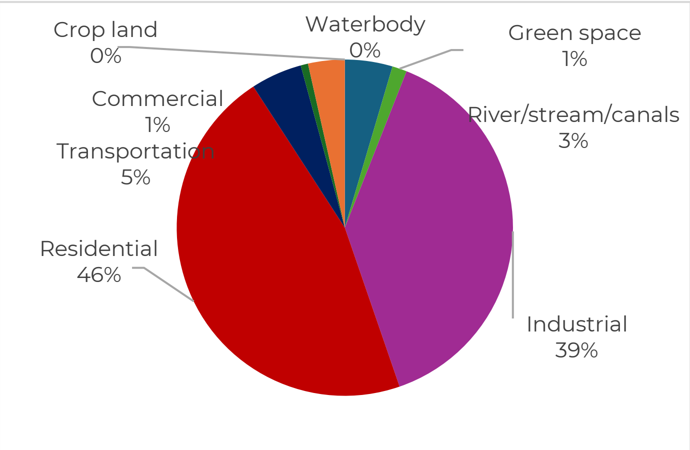
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.28	19.59	
Permeable Pavements	85%	1.26	0.23	
Bioretention Spaces	60%	0.01	75.77	
Urban Forests	12%	0.00	0.16	
Total		1.56	95.75	2.49

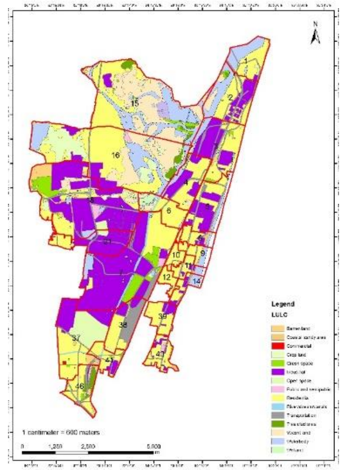
93%

potential increase in water detention

3.18. Sowcarpet

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 37	4.13	Barren land	0.13
		Commercial	0.02
		Crop land	0.00
		Green space	0.04
		Industrial	1.10
		Open space	1.28
		Residential	1.31
		River/stream/canals	0.10
		Transportation	0.14
		Tree clad area	0.00
		Waterbody	0.00





CSTEP

Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium

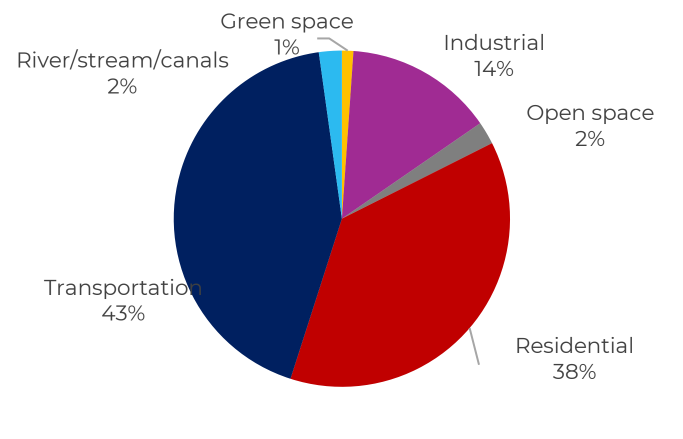
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.95	66.43	
Permeable Pavements	85%	0.11	0.84	
Bioretention Spaces	60%	0.07	6.83	
Urban Forests	12%	0.01	0.84	
Total		1.14	74.94	47.24

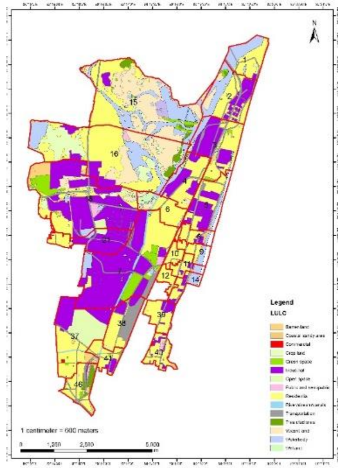
28%

potential increase in water detention

3.19. Central

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 38	1.82	Green space	0.02
		Industrial	0.26
		Open space	0.04
		Residential	0.68
		River/stream/canals	0.04
		Transportation	0.78





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low

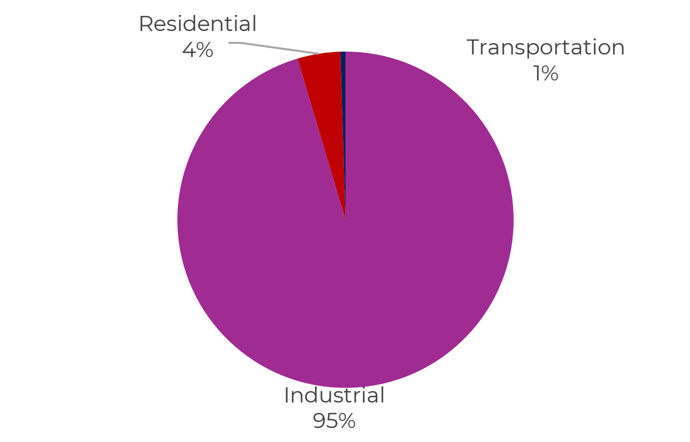
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.49	34.39	
Permeable Pavements	85%	0.04	0.43	
Bioretention Spaces	60%	0.06	2.24	
Urban Forests	12%	0.01	0.70	
Total		0.59	37.76	2.21

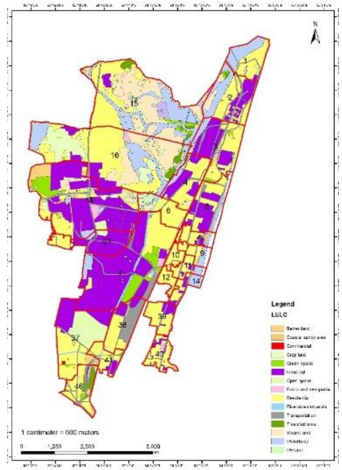
36%

potential increase in water detention

3.20. Choolai

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 39	1.05	Barren land	0.00
		Industrial	0.18
		Residential	0.78
		Transportation	0.09





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

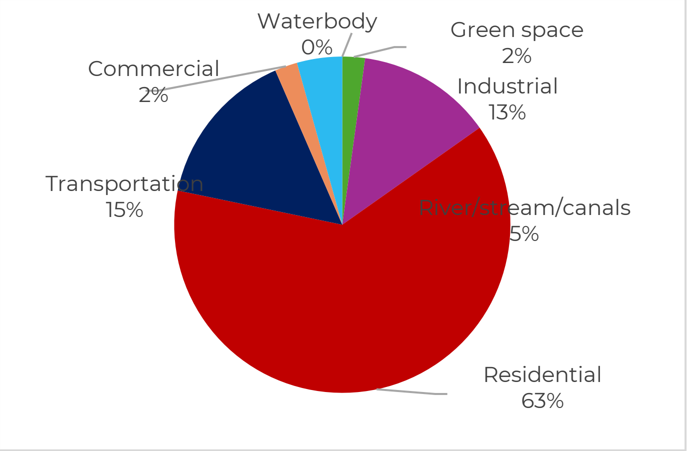
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.36	25.52	
Permeable Pavements	85%	0.00	0.50	
Bioretention Spaces	60%	0.04	0.00	
Urban Forests	12%	0.01	0.48	
Total		0.41	26.50	0.08

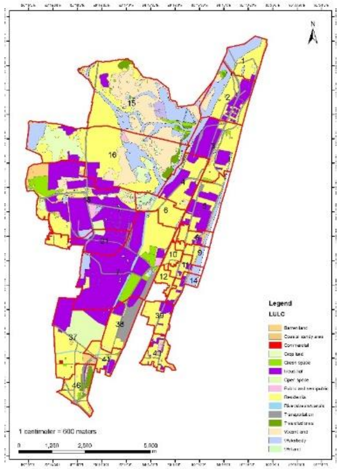
26%

potential increase in water detention

3.21. Purasaivakkam

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 41	0.90	Barren land	0.00
		Green space	0.02
		Industrial	0.12
		Residential	0.58
		River/stream/canals	0.04
		Transportation	0.14
		Waterbody	0.00





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

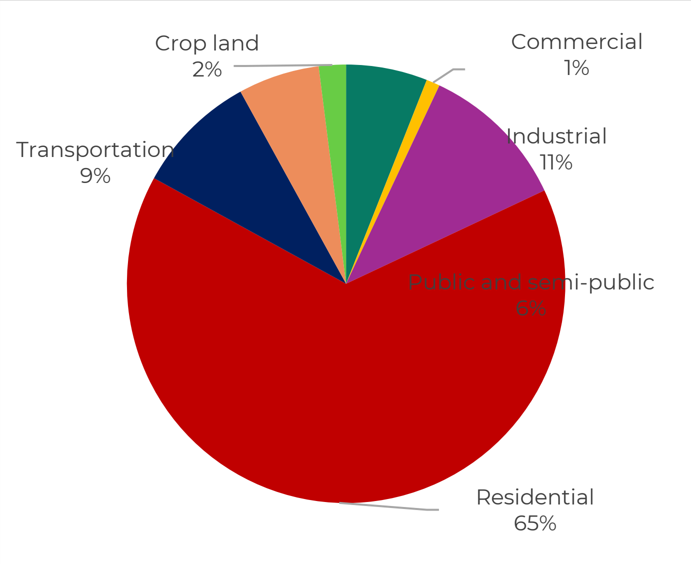
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.45	31.26	
Permeable Pavements	85%	0.04	0.37	
Bioretention Spaces	60%	0.00	2.23	
Urban Forests	12%	0.00	0.00	
Total		0.49	33.86	0.99

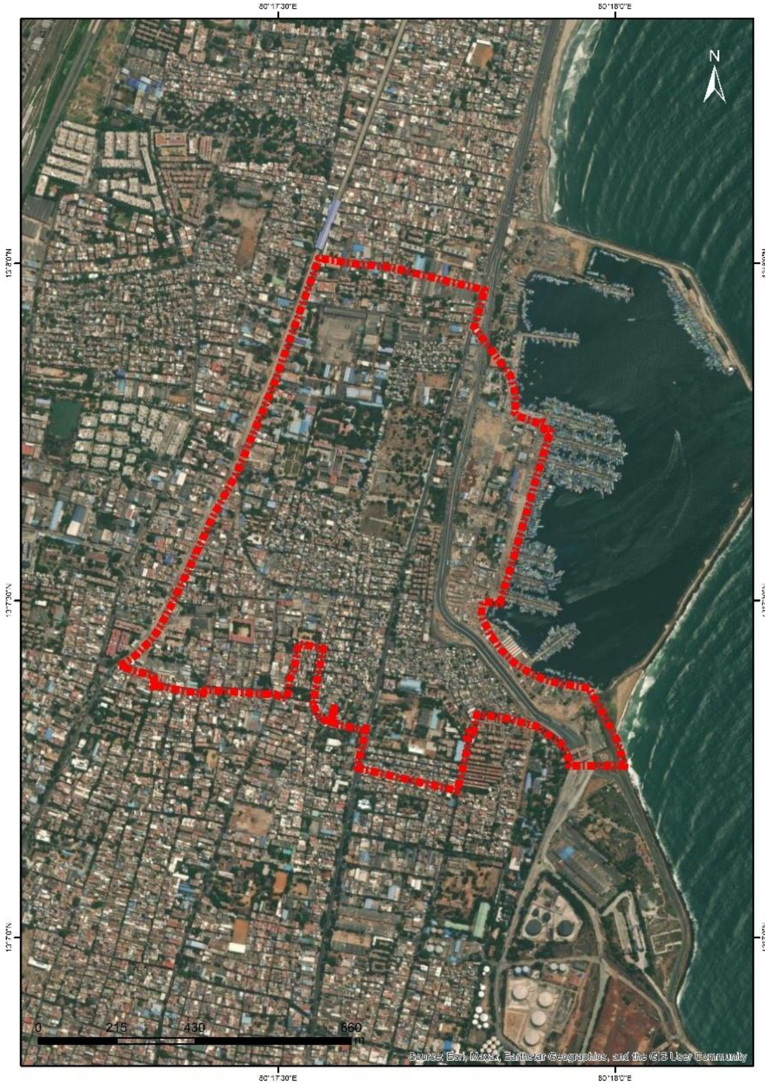
33%

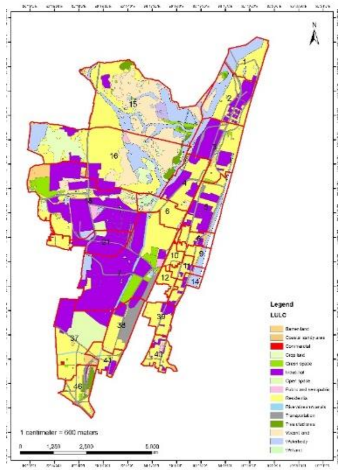
potential increase in water detention

3.22. Anna Salai

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 43	1.00	Coastal sandy area	0.06
		Commercial	0.01
		Crop land	0.02
		Industrial	0.11
		Public and semipublic	0.06
		Residential	0.65
		Transportation	0.09







Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

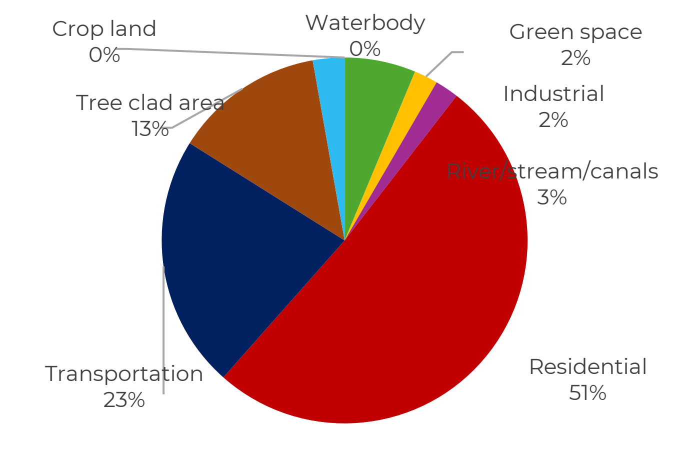
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.41	28.91	
Permeable Pavements	85%	0.00	0.41	
Bioretention Spaces	60%	0.02	0.00	
Urban Forests	12%	0.00	0.24	
Total		0.44	29.57	1.55

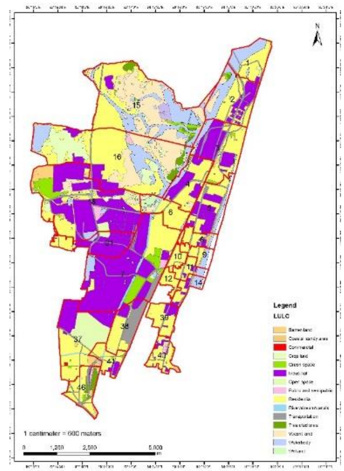
28%

potential increase in water detention

3.23. George Town

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 46	1.45	Barren land	0.09
		Crop land	0.00
		Green space	0.03
		Industrial	0.03
		Public and semipublic	0.00
		Residential	0.73
		River/stream/canals	0.04
		Transportation	0.32
		Tree clad area	0.19
		Waterbody	0.00





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.44	30.60	
Permeable Pavements	85%	0.05	0.47	
Bioretention Spaces	60%	0.05	2.76	
Urban Forests	12%	0.01	0.66	
Total		0.54	34.38	9.03

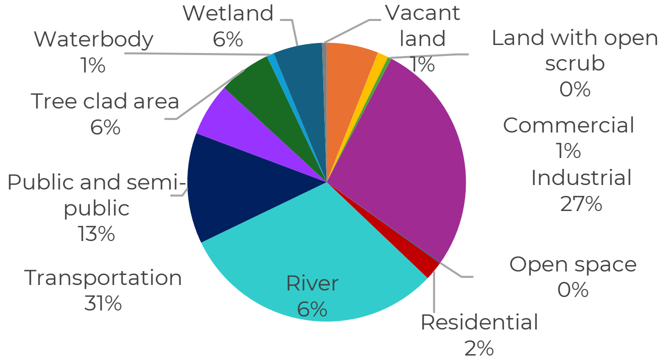
25%

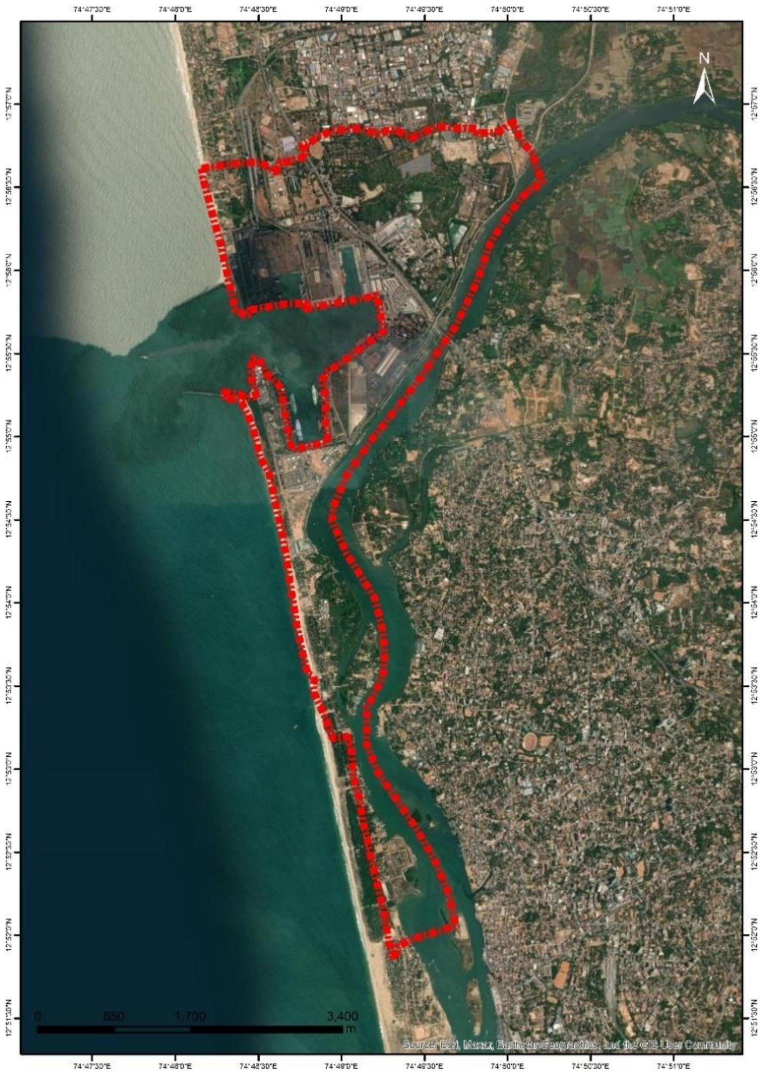
potential increase in water detention

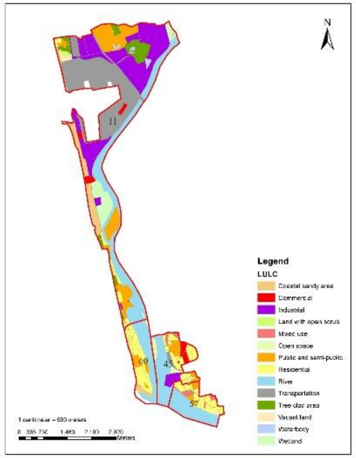
4. Context Assessments: Mangaluru

4.1. Panambur

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 11	10.82	Coastal sandy area	0.57
		Commercial	0.12
		Industrial	2.57
		Land with open scrub	0.04
		Open space	0.01
		Public and semi-public	1.22
		Residential	0.21
		River	1.92
		Transportation	2.92
		Tree clad area	0.58
		Vacant land	0.05
		Waterbody	0.08
		Wetland	0.54







Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Bioretention Areas	High	Medium	High
Permeable Pavements	Low	Low	Low
Inland Wetlands	Medium	Medium	Low
Naturalised Riverbanks	High	Medium	Medium

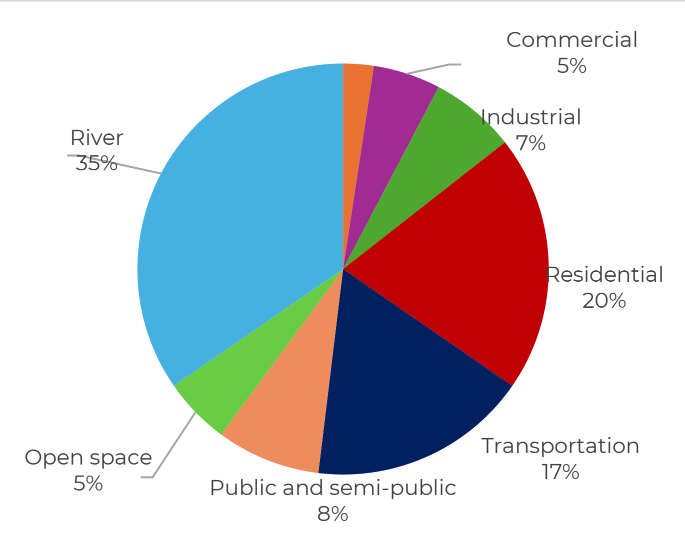
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.15	10.42	
Permeable Pavements	85%	0.05	0.13	
Bioretention Spaces	60%	0.71	2.84	
Urban Forests	12%	0.00	8.53	
Total		0.91	21.93	14.30

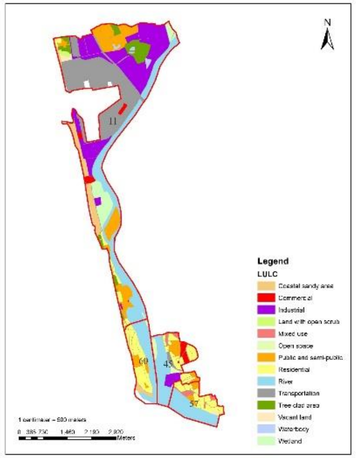
8%

potential increase in water detention

4.2. Port

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 45	1.97	Commercial	0.11
		Industrial	0.14
		Mixed use	0.05
		Open space	0.11
		Public and semi-public	0.17
		Residential	0.42
		River	0.72
		Transportation	0.26





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

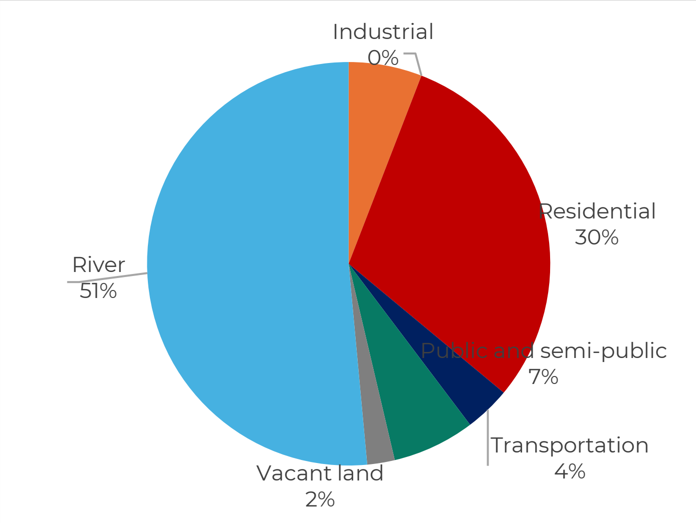
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.28	19.87	
Permeable Pavements	85%	0.00	0.27	
Bioretention Spaces	60%	0.03	0.00	
Urban Forests	12%	0.00	0.37	
Total		0.32	20.50	0.56

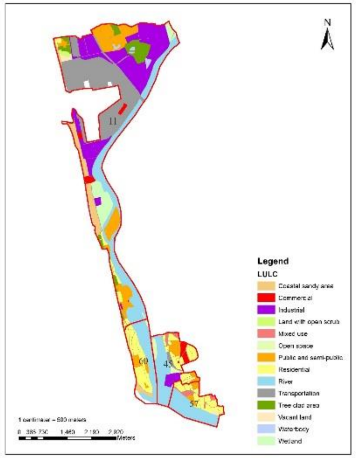
20%

potential increase in water detention

4.3. Hoige Bajar

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 57	1.36	Industrial	0.00
		Mixed use	0.08
		Public and semi-public	0.09
		Residential	0.41
		River	0.70
		Transportation	0.05
		Vacant land	0.03





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Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

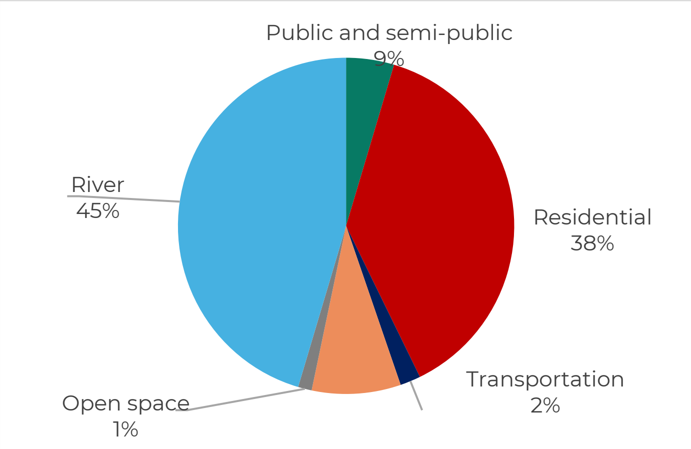
NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.28	19.50	
Permeable Pavements	85%	0.00	0.26	
Bioretention Spaces	60%	0.03	0.11	
Urban Forests	12%	0.00	0.38	
Total		0.32	20.26	0.89

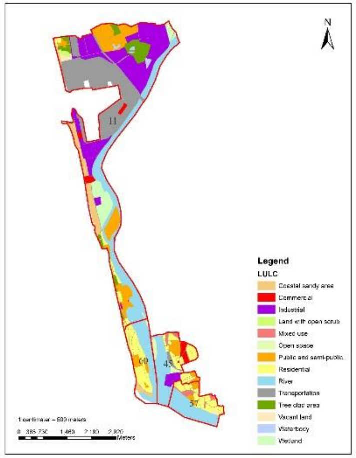
19%

potential increase in water detention

4.4. Bengre

Ward	Net Area (sq km)	Land Use	Area (sq km)
Ward 60	1.51	Coastal sandy area	0.07
		Open space	0.02
		Public and semi-public	0.13
		Residential	0.58
		River	0.69
		Transportation	0.03





Flood Mitigation Potential

Type	ES Benefits	Land Requirement	Adaptation Benefits
Urban Forest, Forest Corridors	High	Low	Medium
Green Roofs	Medium	Low	Medium
Permeable Pavements	Low	Low	Low
Artificial Reefs	Medium	Low	Medium

NbS Type	Average Rain Detention	Area (sq km)	Water Detention Potential (ML) per storm event of 100 mm	Water Detained (ML) per storm event of 100 mm without NbS interventions
Green Rooftops	70%	0.37	25.67	
Permeable Pavements	85%	0.00	0.37	
Bioretention Spaces	60%	0.02	0.04	
Urban Forests	12%	0.00	0.21	
Total		0.39	26.28	1.15

25%

potential increase in water detention

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