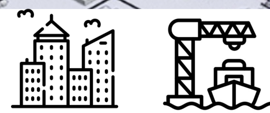
NbS-66: GRAVEL WETLANDS

Gravel wetlands are engineered systems designed to mimic the functions of natural wetlands by using gravel substrates, vegetation, and microbial activity to manage stormwater, treat wastewater, and enhance biodiversity. These systems are particularly suited for implementation along roadsides in urban, industrial, and rural areas of Southeast Asia, where rapid urbanization and industrial expansion have increased water pollution and flood risks. Technically, gravel wetlands filter pollutants, trap sediments, and remove nutrients such as nitrogen and phosphorus, making them effective for water quality improvement. They enhance urban and rural aesthetics, create green buffers along roads, and stabilize soils to prevent erosion. Socially, gravel wetlands provide co-benefits such as recreational spaces, educational opportunities, and improved resilience against climate impacts like flooding and heat stress. By combining ecological functionality with landscape and community benefits, gravel wetlands offer a sustainable, low-maintenance solution that supports the region's environmental and social priorities.

LANDSCAPES SUPPORTED



EbA (ECOSYSTEM-BASED APPROACHES)

- FLOOD MANAGEMENT
- EROSION CONTROL
- WATER QUALITY IMPROVEMENT
- BIODIVERSITY CONSERVATION
- CLIMATE RESILIENCE
- HABITAT CONNECTIVITY

MAIN PROBLEMS ADDRESSED

BIODIVERSITY LOSS

SOIL EROSION

AIR QUALITY IMPROVEMENT

FLOOD CONTROL

ECOSYSTEM SERVICES AND ACTIONS

SUPPORTING

- **Habitat Creation**: Provide habitats for aquatic and semi-aquatic species, enhancing biodiversity.

REGULATING

- **Water Quality Improvement**: Remove pollutants such as nutrients, sediments, and heavy metals from stormwater and wastewater.

PROVISIONING

- **Water Resource Management**: Store and slowly release treated water for potential reuse in irrigation or other non-potable applications.

SOCIAL BENEFITS

- **Aesthetic and Recreational Value**: Enhance landscapes along roads and offer opportunities for community engagement and education.

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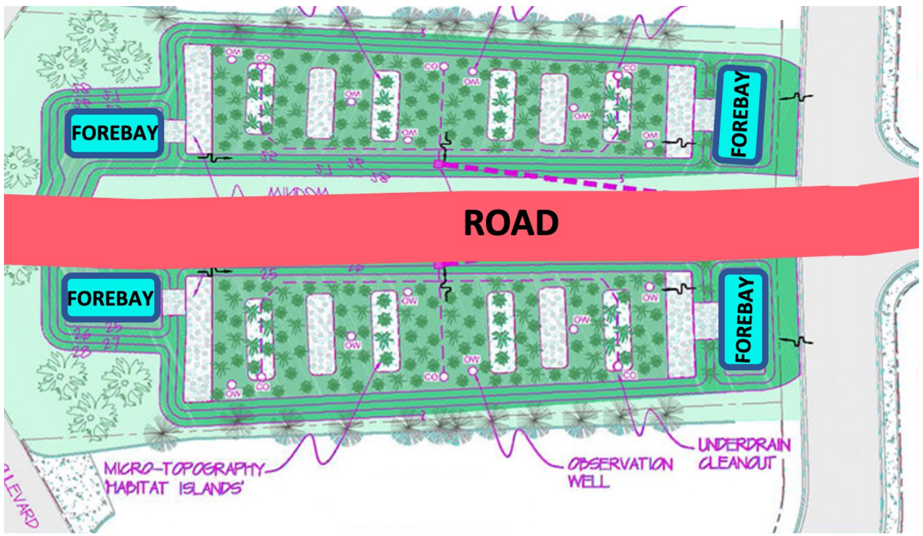

PROJECT'S CHALLENGES & RISKS

- **High Initial Costs**: Gravel wetlands require significant upfront investment, which may be challenging for local governments with limited budgets.
- **Maintenance Needs**: Regular sediment removal, vegetation management, and monitoring are necessary, but lack of funding or technical capacity can hinder long-term functionality.
- **Land Availability**: Securing suitable land in densely populated urban areas or along busy roads can be difficult due to competing land uses.
- **Climatic Extremes**: Heavy rainfall, prolonged droughts, or flooding in Southeast Asia can impact the performance and structural stability of gravel wetlands.

NbS co-BENEFITS AND THEIR INDICATORS

Improved Water Quality
Reduction in nutrient and pollutant concentrations in outflow water.

Flood Risk Mitigation
Volume of stormwater retained and peak flow reduction during heavy rainfall events (m3).

Biodiversity Enhancement
Increase in the number and diversity of aquatic and terrestrial species within the wetland.

Urban Cooling
Measurable reduction in temperature in areas around the gravel wetland compared to grey surfaces.

Aesthetic and Recreational Value
Community satisfaction surveys and increased use of wetland-adjacent spaces for recreational activities.

Erosion Control
Reduction in sediment deposition downstream or along adjacent land areas.

COST ANALYSIS

Direct Costs
Initial construction costs : from $100k to $200k per ha (excavation, gravel, plants, and labor).

Indirect Costs
Annual maintenance costs: from $5k to $10k per ha, covering sediment removal and monitoring.

Time Horizon and Discount Rate
Project life expectancy is around 20–25 years, with a discount rate of 3–7% for cost-benefit analysis.

Direct Benefits
Water treatment savings around $50k to $80k /ha/year, depending on pollutant loads and water quality.

Indirect Benefits
Urban cooling and biodiversity enhancement can provide $10k to $20k/ha/year in non-market benefits.

Risk Assessment
Potential risks (e.g. flooding or structural failure) might incur $5 to $15k per ha for periodic repairs or adaptive measures.

REFERENCES:

Singapore, Changi Airport Gravel Wetland.
Thailand, Bangkok, Suan Luang Rama IX Park.
Malaysia, Johor Bahru,UTM Campus Wetland.
Indonesia, Yogyakarta Urban Wetland Project.

IMPLEMENTATION OPPORTUNITIES:

Indonesia, Jakarta's riverbanks and low-lying urban zones.
Vietnam, HCMC and Hanoi's road corridors and urban green spaces.
Greater Manila agglomeration.