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AdaptHCMC

Guidelines on Climate Change Adapted Urban Planning & Design for Ho Chi Minh City/ Vietnam

Future
Megacities
Megastädte von morgen

THANH PHỐ HỒ CHÍ MINH

Prepared in the Framework of the Megacity Research Project TP. HCM
in Cooperation with the HCMC Department of Planning and Architecture

Impressum

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Second Edition

ISBN 978-3-00-042085-6

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in Vietnamese language:
http://www.tu-cottbus.de/projekte/de/megacity-hcmc/urban-development/overview/
2013_edition_guidelines_on_climate_change_adapted_urban_planning_and_design_VN.pdf

in English language:
http://www.tu-cottbus.de/projekte/de/megacity-hcmc/urban-development/overview/
2013_edition_guidelines_on_climate_change_adapted_urban_planning_and_design_ENG.pdf

Acknowledgement

These guidelines were designed and prepared within the work package 7 “Climate change adapted and energy efficient neighbourhoods” as part of the research project “Integrative Urban and Environmental Planning Framework for the Adaptation of HCMC to Climate Change“. The project was funded by the German Federal Ministry of Education and Research in the framework of the research programme “Future Megacities“.

Preface

In a leadership role of the strategic socio-economic polygon in the region, Ho Chi Minh City has become the economic and cultural center of the country. Ho Chi Minh City is the largest port city of Vietnam, a key transportation hub of road, waterway and airway connecting the provinces in the region and also an important international gateway.

The City is located downstream of the Saigon-Dongnai River with a relatively flat terrain; the hydrology of its rivers and canals is highly affected not only by the East Sea tide but also by water reservoirs upstream at the present and in the future.

In the context of global climate change, adaptation to climate change becomes an unavoidable challenge to urban planning and management of the city. In fact, climate change has direct impacts to the life of people in HCMC such as urban flooding, heat island effect and abnormal climate. These fast-growing climate change hazards are becoming key factors in urban planning. In particular, energy efficiency and adaptation to climate change have to be improved.

The Master Plan of Ho Chi Minh City towards 2025 was approved by the Prime Minister Decision No. 24 in 2010. In the current amendment, the master plan has been approached from the hydrological and land conditions towards the directions of socio-economic development of the city. However, to date there are no regulations in place to concentrate the general directives in the city master plan for adaptation to natural condition and climate change.

These *Guidelines on Climate Change Adapted Urban Planning & Design for Ho Chi Minh City, Vietnam* are a first approach to integrate the topic into guidelines and recommendations for the lower levels of urban planning in the city, i.e. zoning and detailed planning.

The present guidelines focus on adaptation measures in the flooding and urban climate sector. The guidelines should help to integrate different aspects such as environmental concerns in the making, assessment and approval of urban plans as well as in the coordination with other sectoral plans.

These *Guidelines* are the outcome of a research in cooperation between Ho Chi Minh City Department of Planning and Architecture and Megacity Research Project Ho Chi Minh City; the research findings are presented in the *Handbook on Climate Change Adapted Urban Planning & Design for Ho Chi Minh City, Vietnam*.

This is also a contribution of DPA for the *Ho Chi Minh City Action Plan to Response to Climate Change*, which is part of the National Target Program.

We hope that the compact content of the *Guidelines* shall be useful for policy makers, city departments and organizations, management authorities, architectural and planning consultants, project developers and the community in the urban planning of the city for a sustainable, climate change adapted development.

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List of Abbreviations

DARD	Department of Agriculture and Rural Development
DoC	Department of Construction
DoNRE	Department of Natural Resources and Environment
DoT	Department of Transportation
DPA	Department of Planning and Architecture
EIA	Environmental Impact Assessment
HCMC	Ho Chi Minh City
HCMUARC	HCMC University of Architecture
HIDS	Institute for Development Studies
SEA	Strategic Environmental Assessment

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Introduction

These guidelines on Climate Change Adapted Urban Planning & Design for Ho Chi Minh City (HCMC) presents urban planning and design strategies related to the city's main environmental and climate change risks. The guidelines are intended to aid authorities, developers and members of the design professions in the design of new developments and to serve as a policy guide for HCMC's administration to support planning decisions and approval processes at the municipal level.

Purpose of the guidelines

Increasing frequency and severity of environmental hazards like flooding in HCMC have recently begun to raise the awareness of climate change. Urban development, rather than climate change, is viewed as the main reason for environmental hazards and urban planning is therefore considered to have a key role for the city's adaptation to these environmental and climate change threats. Current urban development hardly takes climate-related risks for the built environment and its inhabitants into consideration. The rapid expansion of residential areas into wetland surroundings is one of the city's greatest concerns. However, while research into the identification of climate change adaptation measures is ongoing, the results are yet to be successfully integrated into urban design and planning processes."

The main approach of these guidelines is the down-scaling of general climate change adaptation strategies into specific urban planning and design guidelines and recommendations. These recommendations should act as a reference for sustainable and climate change adapted urban design during development project design and approval processes.

The intended short-term impact of these guidelines is to raise the general awareness among planning authorities of climate change adaptation options in the field of urban planning and design. An improved knowledge of climate change adaptation among institutional and private stakeholders and a mainstreaming into urban planning are seen as potential long-term impacts of the guidelines.

Target group

The guidelines is targeted at HCMC's planning institutions and authorities, such as the Department of Planning and Architecture (DPA), the Department of Construction (DoC) and their subordinated Urban Management Divisions at the district level, as well as research institutions like the Institute for Development Studies (HIDS) and the HCMC University of Architecture (HCMUARC). It is intended to assist the authorities in assessing the sustainability of development projects during the approval process and in establishing binding and nonbinding climate change adapted urban planning and urban design codes. Furthermore it promotes urban design measures to private investors, private developers, architects and urban designers.

Content and structure of the guidelines

The guidelines of urban planning and design principles were mainly identified for the site and building level, however they also take the city and district level into consideration. These guidelines address HCMC's main environmental risks related to flooding and climate change.

The guidelines are related to the overarching sectors of flood protection, water management, greenery & natural systems and solar control and are comprised of measures related to the adaptation of urban structures. Measures for the reduction of energy consumption and transport emissions are not part of this handbook (Fig. 1).

Relationship to other documents

The guidelines should be used in conjunction with the "AdaptHCMC - Handbook on Climate Change Adapted Urban Planning & Design for Ho Chi Minh City/ Vietnam" and any other documents necessary to accomplish a comprehensive urban design for new developments in Ho Chi Minh City.

Other document may include, but are not limited to:

- Socialist Republic of Vietnam (2003 a): Law on Land No.13/2003/QH11
- Socialist Republic of Vietnam (2003 b): Construction Law No. 16/2003/QH11
- Socialist Republic of Vietnam (2005): Law on Environmental Protection No.52/2005/QH11
- Socialist Republic of Vietnam (2008): Vietnam Building Code - Regional and Urban Planning and Rural Residential Planning QCXDVN 01: 2008/BXD
- Socialist Republic of Vietnam (2009): Law on Urban Planning No.32/2009/ QH12
- Ministry of Construction (2011): Technical Guidelines for Strategic Environmental Assessment (SEA) of Construction and Urban Planning (Technical Guidelines)
- HCMC People's Committee Decision 150 (Decision 150/2004/QD-UB)
- Gravert, A.; Wiechmann, T.; Schwartze, F. and Kersten, R. (2012): Climate Change Adaptation of Urban Planning in the City Region of Ho Chi Minh City. Final Report. Megacity Research Project TP. Ho Chi Minh.
- Storch, H. and Downes, N. (Eds.) (2012): Land-use Planning Recommendations. Adaptation Strategies for a changing climate in Ho Chi Minh City
- Schinkel, U.; Le Dieu Anh and Schwartze, F. (2011): How to respond to Climate Change Impacts in Urban Areas – A Handbook for Community Action
- ICEM (International Centre for Environmental Management) (2009): Ho Chi Minh City Adaptation to Climate Change Study Report – Volume 2: Main Report – Draft 4.

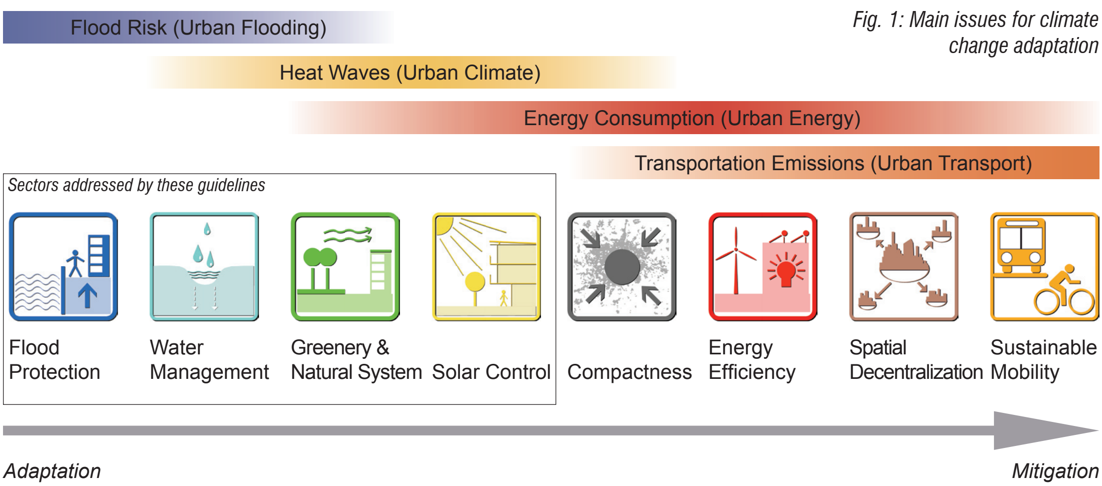


Fig. 1: Main issues for climate change adaptation

I.
Managing Flood Risk

For the successful implementation of these guidelines, it is necessary to decide on the necessary steps. This decision chain for "Managing Flood Risk" should guide the authorities and private developer in this process.

Step 1: Consideration of zone-wide regulations for flood-prone areas
Step 2A: Division of preserved floodplains on development site
Step 2B: Protection of buildings in "Buffer Zones"
Step 3A: Structural flood protection for high priority development areas
Step 3B: Backfill sites for high priority development areas
Step 4: Managing surface water
with Stormwater Management Concept or Minimum Requirements:
- reduction of impervious area;
- permeable pavement and surfaces;
- temporary water storage in urban areas;
- rainwater harvesting and re-use; and
- infiltration drainage.

As well as considering these steps the guidelines have to be implemented at different, interrelated planning levels.

City Level

District Level

Site Level

Building Level

City Level

District Level

Step 1: Consideration of zone-wide regulations for flood-prone areas

To limit development in flood-prone areas, vulnerable zones should be indicated on an environmental map. The relevant administrative department should create such environmental maps at the city or district level and these should be elaborated in the early stage of planning to adjust new developments. The planning results at the district level will establish the necessary measures at the project site level.

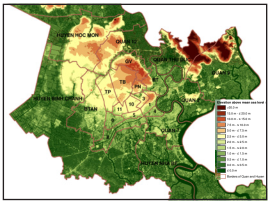


Fig. 2: Digital Elevation Model of HCMC

Source: Storch, H. et al. 2012

Identify flood-prone areas

To identify if the project site is located in a flood-prone area, the developer should consult an Environmental District Map as part of the Environmental Impact Assessment (EIA). If the project site is in a flood-prone area, special measures regarding flood protection should apply (Fig. 2).

→ *To be decided according to Environmental District Map/ Strategic Environmental Assessment (SEA) on general planning level (Construction Master Plan, Land Use Plan) and on district planning level (Zoning Plan)*

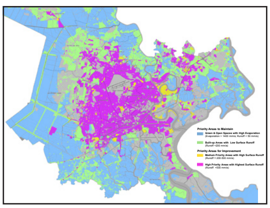


Fig. 3: Maintaining the urban water balance in HCMC

Source: Goedecke, M. and Rujner, H. (2012)

Decentralised urban basins

To decrease flood level in rivers and channels during flood events, a network of urban basins should be planned (Fig. 3). Excess floodwater will be diverted from rivers and channels to the basins, and released back to the water network when flood events are over, or when river capacity is available. These urban basins should be located in the Zoning Plan, which indicates the land use zones on city and district level. Impact on these urban basins must be avoided.

→ *To be decided according to an Environmental District Map / Strategic Environmental Assessment (SEA) at the general planning level (Construction Master Plan, Land Use Plan) and on district planning level (Zoning Plan)*

Re-naturalising rivers and channels

To assure a successful flood protection, rivers and channels should be re-naturalised to their original state. This will encourage infiltration, help to reduce bank erosion and enhance the natural habitat along the rivers and channels.

There are four main strategies to re-naturalise rivers:

- Remove obstruction such as solid waste, fallen trees, weirs and impounding constructions in order to increase flood retention capacity and retain the original flow velocity. Modifying rivers and channels by removing sediments and increasing the depth and or width of channels are not recommended, unless the assessments of the modifications are positive.
- Re-meandering riverbeds to their natural curves to enhance storage capacity of river plains and delay flood peak. Other benefits are reduced flow rates and erosion, increased bank infiltration and wider distribution of silt deposition.
- Reconnecting rivers with floodplains to allowed better water storage capacity. Possible measures to reconnect rivers include lowering riverbanks to their natural levels; lowering embankments, setting back levees and dikes, and reconnecting borrow pits.

- Re-naturalising embankments: Embankments should only be considered for highly vulnerable stretches of the riverbank, less vulnerable banks should be returned to close to natural conditions. Where necessary, embankment design should reflect natural conditions, using techniques such as planted gabion or cellular concrete blocks instead of solid concrete lining. These measures help to protect embankments from erosion, enhance infiltration of floodwater and slow down flow velocity. Additionally, the wider distribution of sediment deposition will provide better conditions for vegetation growth creating wildlife habitat and improving the aesthetics of the rivers and channels.

→ *To be decided according to an Environmental District Map/ Strategic Environmental Assessment (SEA) at the general planning level (Construction Master Plan, Land Use Plan) and on district planning level (Zoning Plan)*

Step 2A: Division of preserved floodplains on development sites

It is recommended that the natural floodplains should be preserved to provide space for streams and rivers to expand during periods of high rainfall (Fig. 4). The hydrologic functions of natural floodplains can be preserved by limiting building structures, or by promoting “flood-friendly” land use or development such as agriculture, parks, playgrounds or flood-proofed buildings. Additionally, floodplains help to reduce non-point source pollution and provide habitat for flora and fauna. Furthermore, to protect built structures, parks, recreation areas and streets, which can be temporarily flooded without extensive damage, should be located along the water. This has the added advantage of creating public waterfronts.

Floodplains should be classified, in relation to the “Flood-safe Zone” and the setback line, in two different zones:

- “Taboo Zone”/ Restricted zone, which is strongly vulnerable to tidal floods; and
- “Buffer Zone”, where seasonal and occasional floods are experienced,

as shown in Fig. 5.

Site Level

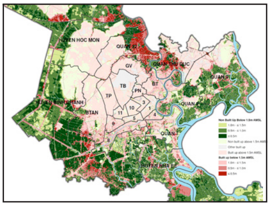


Fig. 4: Urban Floodplains in HCMC

Source: Storch, H. et al. 2012

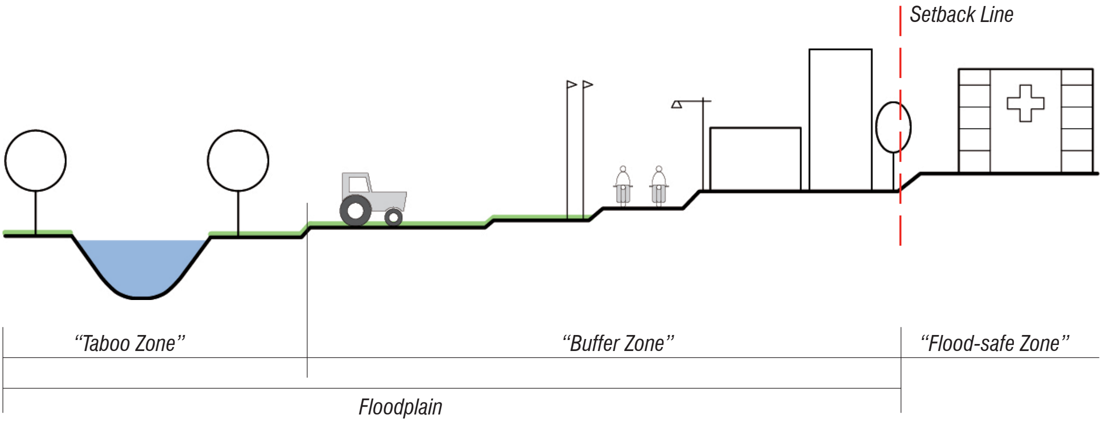


Fig. 5: Example of floodplain management zones

Define „Taboo Zones“ for construction in flood-prone areas

To ensure safety, designated zones should be established according to flood risk and site elevation, which define areas where construction is allowed and areas where construction is forbidden. “Taboo Zones” are areas, which are extremely vulnerable to tidal floods and are used to retain the regular tidal floods. Any housing structure or land use, which impacts the natural setting of the river or channel, in these zones should be banned.

→ *Environmental Impact Assessment (EIA) for each development site is required*

Create “Buffer Zones” in flood-prone areas

To utilise land within a floodplain and to ensure that floodwater are not constrained, a “Buffer Zone” in the floodplain should be created. Within this “Buffer Zone” limited development according to regulations defined in the district level Zoning Plan on development density and building typologies, is allowed. This area contains only “flood-friendly” land use or development such as agriculture, parks, playgrounds or flood-proofed buildings, to ensure the hydrologic function of the natural floodplain.

→ *Environmental Impact Assessment (EIA) for development site is required*

Regulate setback of construction in flood-prone areas

To provide sufficient distance from water bodies, a construction setback from riverbanks, floodplains, flood ways (bayou) and generally flood-prove areas/ “Flood-safe Zone” should be maintained. The setback line should be defined within the Environmental Impact Assessment. If the Environmental Impact Assessment is not available, the minimum requirement according to the HCMC People’s Committee Decision 150 (Decision 150/2004/QD-UB) should apply. The existing setback regulation of the Decision 150 shall provide a baseline, where a setback line from 10m to 50m according to water stream width is recommended.

→ *Environmental Impact Assessment (EIA) for development site is required*

Building Level

Step 2B: Building protection in “Buffer Zones”

The following solutions apply to areas or buildings that are located

- within existing developments or
- within “Buffer Zones”, which experience seasonal or occasional flooding.

Existing buildings should be retrofitted to meet the requirements for flood protection. All of these measures should be designed in close coordination with environmental specialists and according to the ‘state of art’.

Backfill and elevation of single buildings

To enable development close to water bodies with flood risk, a filling of a single building block to a minimum height can be considered according to flood risk and elevation of the site (Fig. 6). This measure is called "backfill" and intended to fill the foundations to above the level of the groundwater table. Filling materials can be for example soil or gravel pack. Based on forecast and in cooperation with the department of environment, the necessary height of the required backfill and the methods should be defined. This measure should be designed in close coordination with environmental specialists and according to the 'state of art'. While this measure helps to protect the building from floods, it does not help to mitigate flood risk in general and it is a costly solution, therefore it is not recommended.

→ *Environmental Impact Assessment (EIA) for development site is required*

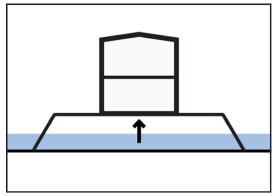


Fig. 6: Backfill of single buildings

Permanent waterproof building floors and walls

To increase the built structure resilience to flooding, permanent waterproof floors and walls should be installed according to the 'state of art' (Fig. 7). To prevent seepage, ground floors and basements should be sealed by flood resistant walls, reaching a height of at least 50cm above the maximum projected flood level. In addition, doorsteps should be raised as high as possible.

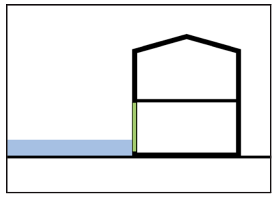


Fig. 7: Permanent waterproof building floors and walls

Temporary flood barriers and floodgates for buildings

To provide additional protection, temporary barriers for building skirts and building openings such as doors and windows are necessary. Flood boards or beams should be installed in the frame around the openings and suitable materials should be used to protect the building skirt according to the 'state of art' (Fig. 8). The use of temporary sealable openings such as floodgates or doors can create a temporarily waterproof and sealable ground floor.

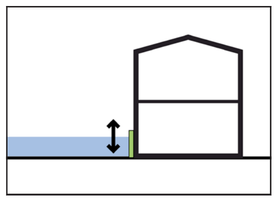


Fig. 8: Temporary flood barriers and floodgates

Flood resilient ground floor

To allowed development without impacting the site elevation, buildings should be designed on stilts or alternatively the floor levels intended for residential or commercial use should be raised, so that the ground floors with temporary uses like parking or storage are allowed to temporarily flood without extensive damage (Fig. 9).

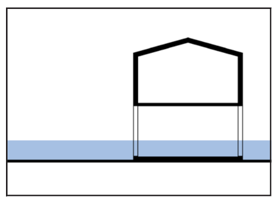


Fig. 9: Flood resilient ground floor

Site Level

Step 3A: Structural flood protection for high priority development areas

In case of an existing urban area or a planned high priority development area that is identified in the Zoning Plan after a critical discussion about the environmental impact, the developer is allowed to consider structural protection for the development site. These measures should not be planned within the defined "Taboo Zone", but can be consider for the flood-prone "Buffer Zone". Dry flood-protection is costly; requires professional engineering technologies, good operation and maintenance; and can increase downstream floods. These methods are therefore generally not recommended.

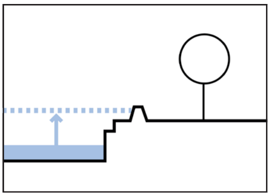


Fig. 10: Elevated permanent waterfront

Elevated permanent waterfront

To protect development sites from rising floodwater, a permanent flood defence for urban areas below the projected flood level is recommended (Fig. 10). These defences can be dykes, dams, levees, sand bags or floodgates. All of these dry flood-protection measures should be designed in close coordination with environmental specialists and according to the 'state of art'.

→ *Environmental Impact Assessment (EIA) for development site is required*

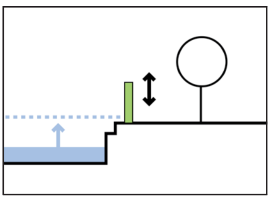


Fig. 11: Temporary and mobile flood walls

Temporary and mobile flood walls on site

To reduce the impact on the waterfront appearance, temporary or mobile flood walls for urban areas below the projected flood levels are to be installed (Fig. 11). Furthermore temporary or mobile flood walls can be added to permanent flood defence installations. This measure should be designed in close coordination with environmental specialists and according to the 'state of art'.

→ *Environmental Impact Assessment (EIA) for development site is required*

City Level

District Level

Step 3B: Backfill sites for high priority development areas

In case of an existing urban area or a planned high priority development area, identified in the Zoning Plan, which is located in flood risk zone, the developer is allowed to consider backfill solutions for the development site after a critical discussion about the environmental impact. Backfill describes the filling of the foundations to above the level of the groundwater table. Filling materials can be for example soil or gravel pack. These measures should not be planned within the defined "Taboo Zone", but can be considered for the flood-prone "Buffer Zone". Backfill is costly and can cause new flood risk for the surrounding areas and increase downstream floods; and can result in land subsidence. It is generally not recommended.

Backfill control in flood-prone areas

To limit backfill in flood-prone areas, only urban areas with a high priority should be allowed to use backfill measures to facilitate future development. A Zoning Plan should be put in place, which indicates the land use zones at the city and district levels. Furthermore a comprehensible ranking of risk levels should be created and the percentage of allowable backfill should be worked out. The developer should consult this Zoning Plan to identify if the site is within a high priority urban area.

→ *To be decided according to an Environmental District Map/ Strategic Environmental Assessment (SEA) at the general planning level (Construction Master Plan, Land Use Plan) and on district planning level (Zoning Plan)*

Backfill and elevation of construction site

Site Level

To enable development close to water bodies with flood risk, a filling of the overall construction site to a minimum height can be considered according to flood risk and elevation of the site (Fig. 12). Based on forecast and in cooperation with the department of environment, the necessary height of the required backfill and the methods should be defined. This measure should be designed in close coordination with environmental specialists and according to the 'state of art'.

→ *Environmental Impact Assessment (EIA) for development site is required*

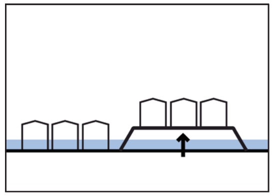


Fig. 12: Backfill of construction site

Step 4: Managing surface water

Site Level

Building Level

Stormwater Management Concept

Based on an environmental impact assessment and related research (Fig. 13), the developer should provide an urban stormwater management concept. Implementing an overall stormwater management plan requires performance targets that indicate how much rainfall should be kept on-site or by how much water run-off should be reduced? Performance targets provide the foundation for implementing common sense solutions that eliminate the source of stormwater related problems. They provide a starting point to guide early actions of the HCMC planning authorities in at-risk areas. The performance targets set in the management concept have then to be translated into design criteria and guidelines, which can be applied at the site level to design stormwater systems that mitigate the impacts of land development. The following solutions should be part of the stormwater management concept. For further details, see the Annex entitled "Instructions for Stormwater Management Concept".

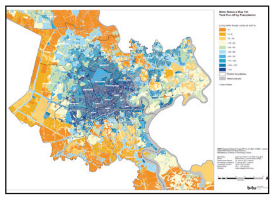


Fig. 13: Average Surface Water Run-off by precipitation for HCMC

Source: Goedecke, M. and Rujner, H. (2012)

Minimum Requirements

If a comprehensive stormwater management concept is not provided, the following guidelines should be applied as minimum requirements:

- reduction of impervious area;
- permeable pavement and surfaces;
- temporary water storage in urban areas;
- rainwater harvesting and re-use; and
- infiltration drainage.

Infiltration and Permeability

Reduction of impervious area

To reduce the overall run-off and to provide more space for water retention and infiltration, the impervious coverage of the site should be limited to a minimum. To reduce the building footprint, the building density has to be increased on built-up surfaces by relaxing the building height limitations. Reduction of road widths and the amount of surface parking should be considered, especially in compact high-density communities where public transport and services are within walking distance. Impervious surface materials for recreational open spaces should be avoided.

→ *Minimum requirement*

Absorbent landscape

To optimise stormwater runoff, the landscape on site should be designed to allow infiltration and evapotranspiration. Typically, landscape soils store between 7% (sand) and 18% (loam) of their volume as water, before becoming saturated and generating flow-through or runoff. The absorbent soil surface layer should have a high organic content (about 10-25%) and the surface vegetation should be composed of herbaceous plants with a thickly matted rooting zone (like shrubs or grass), deciduous trees with high leaf density, or mixed growth forests. Runoff from landscape areas can be reduced by up to 50% by providing a 300 mm layer of landscaped, absorbent soil, even under very wet conditions where the hydraulic conductivity of the underlying soil is low.

→ *Preparatory soil survey is required.*

Permeable pavements and surfaces

To prevent a runoff from paved surfaces, permeable paving materials should be used. Permeable paving allows infiltration, either because it is porous or because specific openings such as spaces between paving blocks have been provided. In areas with limited vehicular traffic permeable paving can be applied on driveways, shoulders of roadways, sidewalks and parking areas. A prerequisite for the use of pervious paving designed for infiltration is that the groundwater table seasonal high must be more than 1m below the base of the paved area, therefore it is only effective in HCMC's elevated areas. Infiltration in urban areas should be restricted if a risk of polluting groundwater resources exists.

→ *Minimum requirement*

Infiltration basins

To temporarily store surface water runoff, infiltration basins should be considered. These allow water to gradually infiltrate through the soil of the basin floors. This practice helps to recharge groundwater to balance the water resources. Infiltration basins may take any shape and should also receive stormwater from drainage solutions (see “Infiltration drainage”) on site. The basins and drainage systems should be part of the landscape design as they can both contribute to the site’s aesthetic value, and facilitate biodiversity protection through habitat provision.

Retention and Storage

Constructed wetlands

To improve the urban stormwater quality, constructed (artificial) wetlands should be designed as part of the accessible open space areas on site. Constructed wetland systems are shallow extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater.

Temporary water storage in urban areas

To attenuate flood flow, water storage options should be explored. Water storage allows a significant volume of storage and a controlled overflow. Storage occurs naturally in a catchment, for example within a floodplain, or in ponds. Artificially created storage facilities include flood storage reservoirs, retention and detention ponds. In an urban context where space is limited, it is possible to make use of areas with other primary functions, for example parkland, playing fields or car parks, to provide stormwater storage.

⟶ *Minimum requirement*

Rainwater harvesting and re-use

To increase the supply of water in areas where water is scarce, rainwater should be harvested. The “areal” approach to managing rainwater within a watershed, especially in urban areas, by collecting and then storing the water in numerous tanks and storage structures, can reduce peak runoff. The water thus stored can be used for non-drinking water (grey water) purposes resulting in conservation of potable water resources. It can be also be used for drinking purposes if proper purification measures are installed.

⟶ *Minimum requirement*

Green roofs and façades

To limit the impact of unavoidable impervious surfaces, green roofs of buildings should be designed. Green roofs collect rainwater, which is used for building cooling and insulation and providing water for rainwater re-use. Green roofs can be installed on a variety of roof types and on any property size, although large areas are generally more cost-effective. Green façades or rain gardens also collect rainwater and are made up of climbing plants; either growing directly on a wall or specially designed supporting structures.

Drainage and Conveyance

Infiltration drainage

It is recommended that infiltration drainage solutions are developed to transfer water to those areas of the development or urban basins indicated in the Zoning Plan, where infiltration and therefore a reduction in drained runoff volume can take place. If these solutions cannot be applied, relief channels, drainage or sewers might be an option in dense and highly developed areas.

Infiltration techniques are, for example:

- Swales
  Shallow linear channels that are designed to convey runoff and remove pollutants. They have significant pollutant-removal potential and can be designed to allow infiltration. They are particularly suitable for diffuse collection of surface water runoff from small residential or commercial developments, paved areas and roads. Swales can also be used for runoff attenuation, treatment (by settlement or filtration though vegetation) and disposal (by allowing infiltration through the base of the swale).
- Grassed filter strips
  Grassed filter strips are wide, relatively gently sloping areas of grass or other dense vegetation that treat runoff from adjacent areas. A filter strip should be a minimum width of 15m – 23m, plus additional 1.2m for each 1% slope.
- Filter Drains
  Filter drains comprise a perforated or porous pipe in a trench surrounded with a suitable filter material, granular material or lightweight aggregate fill. The fill may be exposed at the surface or covered with turf, topsoil or other suitable capping material. Filter drains collect and convey runoff from the edge of paved areas; they also provide limited temporary storage.

Infiltration rates vary with soil type and condition, and over time. There are situations where infiltration drainage is not appropriate:

- where poor runoff water quality may pose a pollution threat to groundwater resources,
- where infiltration capacity of the ground is low,
- where groundwater levels are high,
- where stability of foundations may be at risk.

→ *At least one of these measures is required*

II.

Managing High Heat Load

For the successful implementation of these guidelines, it is necessary to define the necessary steps in the management process. This decision chain of “Managing High Heat Load” should guide the authorities and private developer in this process.

Step 1: Consideration of zone-wide regulations
Step 2: Reduction of ground temperature on site
Step 3: Integration of landscape design and architectural measures

As well as considering these steps the guidelines have to be implemented at different, interrelated planning levels.

- City Level
- District Level
- Site Level
- Building Level

City Level

District Level

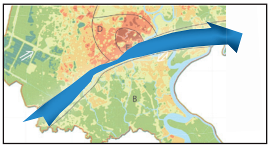


Fig. 14: Main fresh air corridor in HCMC
adapted from Katzschner, L et al. 2012

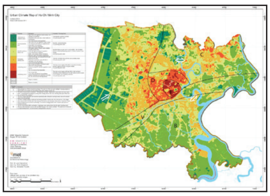


Fig. 15: Urban Climate Map of HCMC
Source: Katzschner, L et al. 2012

Step 1: Considerations of zone-wide regulations

In terms of cooling down urban areas and to providing fresh air for heat-stressed zones, the importance of fresh air corridors should be emphasised. The main fresh air corridor of HCMC cuts the city from the southwest to the eastern part (Fig. 14). The urban climate maps at the city (Fig. 15) and district levels should be utilised in the early stage of planning to adjust new developments. The planning results at the district level will establish the necessary measures at the project site level.

Fresh air corridors

To identify whether the project site is part of a fresh air corridor, the developer should consult the aforementioned urban climate map as part of the environmental impact assessment. Smaller, district level corridors should also be clearly defined and kept free from development. For smaller corridors it is important that they are as long and as wide as possible within the existing planning constraints since this will have an effect on the wind exposure. Green areas and canals, motorways and rail tracks are also suited to serve as such corridors.

→ *To be decided according to Urban Climate Map/ Strategic Environmental Assessment (SEA) at the general planning level (Construction Master Plan, Land Use Plan) and on district planning level (Zoning Plan)*

Site Level

Step 2: Reduction of ground temperature on site

The developer has to provide an urban design concept to prove that measures are applied to ensure sufficient cooling at the development site. The aim is to create a pleasant climate at the pedestrian level.

These measures are classified in two categories:

- Mandatory measures and
- Optional measures.

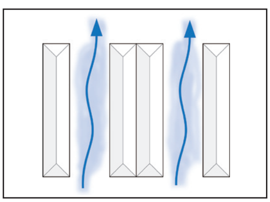


Fig. 16: Streets should be orientated to prevailing wind.

Orientation to prevailing wind

To ensure fresh air supply within city quarters both street pattern and single houses should be oriented to the prevailing winds. As wind directions in the tropics are seasonally variable, the most reasonable orientation is the direction of the monsoonal wind. Streets should either be parallel to the wind flow or angled by 30 to 60 degree (Fig. 16). Furthermore, road cross-sections must be wide, following the Vietnam Building Code - QCXDVN 01: 2008/BXD, and should not be blocked by smaller buildings or trees. The developer should consult the urban climate map to identify the prevailing wind direction.

→ *Mandatory measure to be decided according to Urban Climate Map/ Environmental Impact Assessment (EIA) for development site is required*

Avoidance of wind blockers

To circulate the wind flow at the pedestrian level, sufficiently dimensioned corridors between podia should be assured. Generally huge blocks should be avoided (Fig. 17). Particularly along waterfronts, it is crucial to create as many corridors as possible to ensure wind flow.

→ *Mandatory measure to be decided according to Urban Climate Map/ Environmental Impact Assessment (EIA) for development site is required*

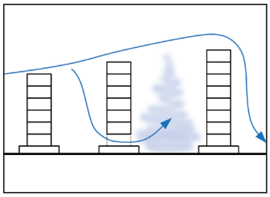


Fig. 17: Podia should allow air passing.

"Down-wash" effect by different building heights

To improve ventilation, buildings with different heights should be designed to allow variations in wind speeds. Taller buildings are able to catch wind on higher levels and "down-wash" it, redirecting fresh air to the ground level (Fig. 18). Therefore, these taller buildings should be located downwind of lower buildings. The developer should consult environmental specialists to help to decide the appropriate building heights.

→ *Mandatory measure to be decided according to Urban Climate Map/ Environmental Impact Assessment (EIA) for development site is required*

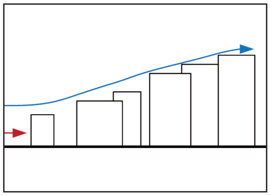


Fig. 18: Buildings located in prevailing wind direction should be lowest.

High ratio of vegetated green surfaces

To provide fresh and cool air for city blocks, planning for green areas, which are orientated to the prevailing winds, to enhance their fresh air distribution capacity, should be given priority. Wide park areas for example are able to provide fresh air distribution for a whole district, while small green surfaces in neighbourhoods can help to enhance micro air ventilation. The impact of a network of many small green areas can be just as positive as that of a single bigger area (Fig. 19). The green ratio of 20% for residential areas, 30% for public amenities areas and 20% for industrial areas, according to the Vietnam Building Code - Regional and Urban Planning and Rural Residential Planning QCXDVN 01: 2008/BXD, should be followed. It is recommended, to select native or climate adapted trees and plants to minimise artificial irrigation requirements and to lower the demand on the general water supply of the city.

→ *Mandatory measure, referring to established citywide regulation of required minimum percentage of green areas for new development sites*

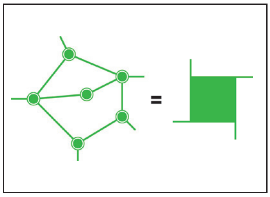


Fig. 19: A network of small green areas is as beneficial as one big green open space.

Open water surfaces

To reduce the temperature through evaporation, open water bodies should be created. The water bodies store heat, which is consumed through evaporation thereby reducing local temperatures. Moving water is more beneficial for the cooling effect than standing water. The most significant water surface cooling effect can be felt northeast and southwest of the water body, due to the effect of monsoon. Furthermore, basins - for example infiltration basins (see section "Infiltration basins") -, which temporarily contain water, can also provide a cooling effect.

→ *Optional measure refers to citywide regulation of required minimum percent of water bodies for new development site (to be established)*

Site Level

Building Level

Step 3: Integration of landscape design and architectural measures

The developer has to provide a landscape design concept and an architecture concept to prove that measures are applied for the reduction of heat load and the management of solar radiation at the development site. The aim is to create a pleasant climate in particular at the pedestrian level and within buildings.

The measures are classified in two categories:

- No-regret measures and
- Optional measures.

Green roofs and façades

To reduce the room temperature and help to save on energy required for cooling, green roofs can be installed. Furthermore, green roofs have positive effects on air quality; however the contribution of green roofs to cooler temperatures at the pedestrian level is low. Green roofs can be used on a variety of roof types and on any property size, although large area roofs are generally more cost-effective. Green façades have similar benefits to green roofs. They can reach up to 1m to 2m into the street and therefore help to provide cooling at the pedestrian level. Green façades are suitable for use where space is limited. Green façades are created using climbing plants; either growing directly on a wall or on specially designed supporting structures.

→ *The use of green roofs and façades is an optional measure and can either be regulated by public authorities or is decided individually by developers.*

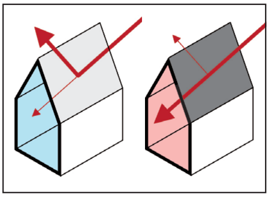


Fig. 20: Light colours reflect more solar radiation then dark ones.

White, reflective roofs and façades

To lower the indoor temperature and to reduce the cooling energy consumption, white reflective roofing and façade materials are recommended (Fig. 20). However it should be noted that, while helpful, the roof temperature reduction efficiency of reflective roof materials is less than that of green roofs. The use of steel and some types of glass as façade construction materials should be limited, because these materials warm up to a large extent when exposed to direct solar radiation. Natural materials like wood or bamboo warm up significantly less.

→ *No-regret measure*

Reflective and bright coloured materials for public spaces

To reduce urban heat islands, reflective and bright coloured surface materials should be used for public open spaces. Even with the use of reflective materials, the amount of paved areas should be minimized. Recommended are porous and permeable pavements, which can be cooled by evaporation and allow for rainwater infiltration. Light colours reflect more solar radiation than dark ones; therefore the surface temperature at the pedestrian level can be decreased. There are several possibilities to enhance the reflective properties of paving materials: For instance, the use pf light-coloured aggregates in asphalt and white cement in concrete.

→ *No-regret measure*

Shading

To limit the rise of air temperature during daytime and to provide an attractive and pleasant ambience for people, shade for pedestrian areas should be provided. As for buildings, shading on their façades can also lower the building energy cost.

Shading solutions are, for example:

- Preservation or cultivation of a large tree canopy
  Tree canopies protect both, open spaces and buildings from direct solar radiation. In addition, it is recommended, to select native or climate adapted trees to minimize artificial irrigation and to lower the demand on the general water supply of the city.
- Shade provided by buildings
  In general to avoid direct sunlight in public open spaces, especially the afternoon sun between 12pm and 3pm, buildings situated to the west and south should be tall enough to provide the most efficient shading.
- Overhanging roofs, balconies and arcades
  Façades to the north and south can be shaded by horizontal elements, whereas vertical elements are necessary for eastern and western façades. Usually these design elements can be added to existing buildings and therefore are also suited for urban renewal.
- Shading elements in public spaces
  Permanent installations such as pavilions or art installations can provide shade in public spaces. Furthermore, there are several construction techniques, allowing shade structures to be used for shorter periods. For example for events such as festivals, which take, place over several weeks.

→ *No-regret measures, at least one of these measures is required*

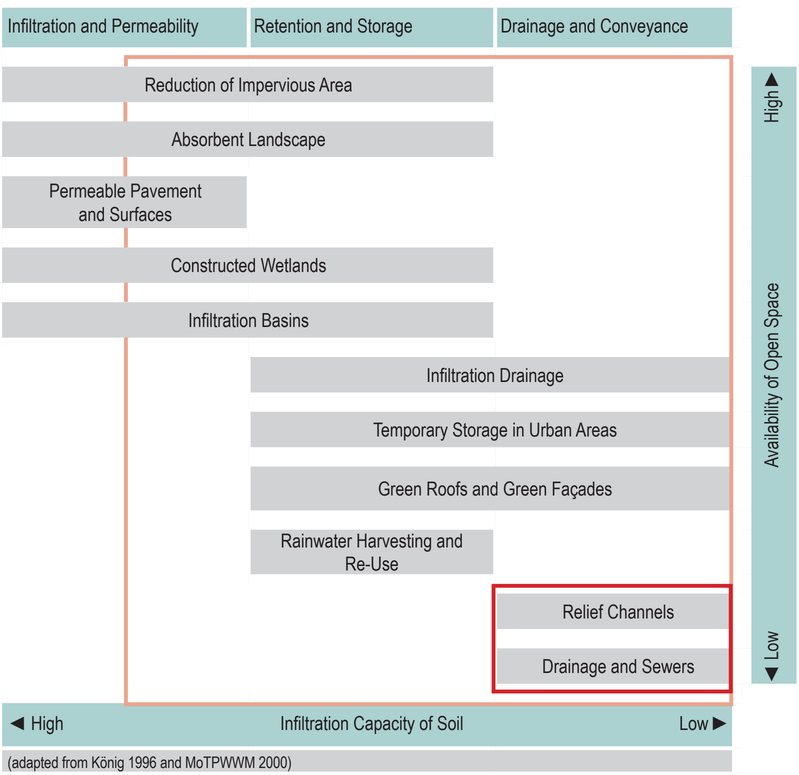
Instructions for Stormwater Management Concept

Performance targets

The stormwater management concept has to be based on performance targets. For a performance target to be effective, it must be quantifiable. It must also have a feedback loop, so adjustments can be made over time. To be understood and accepted, a performance target needs to reduce complexity into a single number that is simple to understand and achievable, yet is comprehensive in its scope. A run-off volume- or ratio-based performance target, like “maximum run-off 20 mm/h” or “maximum run-off 30% of peak rainfall” fulfils these criteria.

Site- or zone-specific criteria

Targets for stormwater management can be defined for a specific site as an agreement or requirement for a single land developer; or for a specific zone as a requirement for all developments in a defined area, according to the new introduced zoning level in the Vietnamese Urban Planning Law 2009.



Tab. 1: Overview on selected stormwater management strategies and the dependency of their effectiveness to the infiltration capacity of soil and the availability of open space.

Current standard in HCMC

Options for improved standard

The effectiveness of stormwater management, depends among other things on the following site-specific criteria:

- Natural conditions: soil structure, groundwater level, infiltration capacity of soil, topography (slopes, etc.), existing vegetation, distance to natural water courses
- Climate conditions: average and peak rainfall, evaporation rate
- Infrastructure conditions (in adjacent urban areas): existing drainage access, drainage capacity, access to street network
- Urban development objectives: intended land-use, expected emissions to water cycle, intended building/ population density, intended housing typologies, target group of development

For the development of a stormwater management concept, data regarding the above mentioned criteria are needed. These data have to be collected by HCMC's responsible departments, mainly the DoNRE, DARD, DoT and DoC or to be obtained during the concept finding process. Some of the strategies can be realized on a low-budget basis, others like green roofs are more cost-intensive. Here the economic feasibility of the development project has to be taken into account.

Stage	Recommended Strategies
Inlet Control	Rainwater Harvesting and Re-Use (Building) Green Roofs and Green Façades
Source Control	Reduction of Impervious Areas Permeable Pavements and Surfaces
▼	Infiltration Drainage Drainage and Sewers
Site Control	Absorbent Landscape Temporary Storage in Urban Areas Rainwater Harvesting and Re-Use (Site)
▼	Relief Channels Drainage and Sewers
Catchment Control	Infiltration Basins Constructed Wetlands

Tab. 2: Surface water management train and related strategies

Combination of strategies for stormwater management

An effective stormwater management will not consist of a single measure; instead a well-designed mix of different strategies is required. Each site needs a specific assessment of the planned urban form and the natural conditions. Therefore, the Tab. 1 “Overview of selected stormwater management strategies” provides a brief outline of which strategies are feasible depending on the infiltration capacity of the soil and the availability of open space.

Decentralised stormwater management

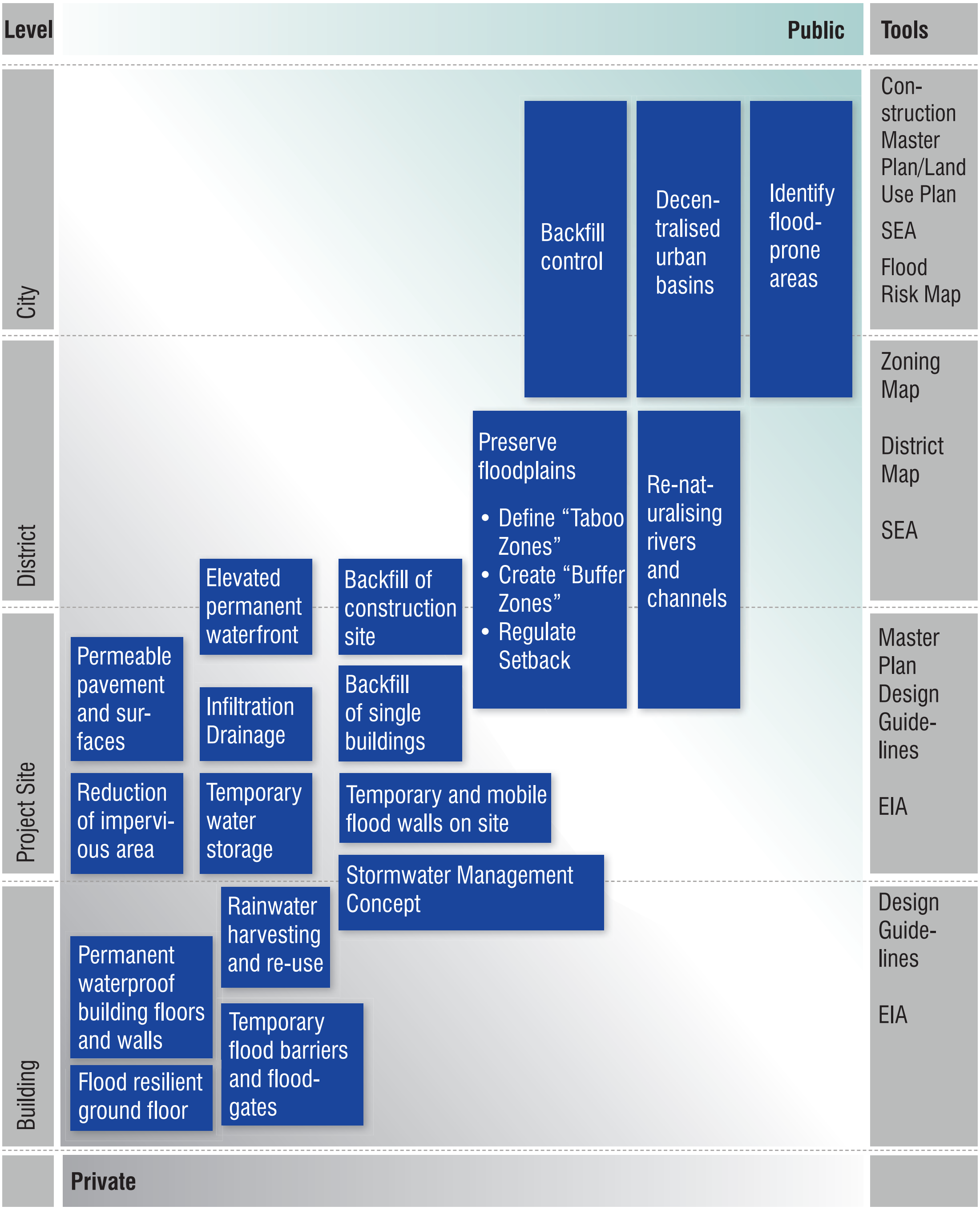
A useful stormwater management concept is a decentralised stormwater management. Similar to a natural catchment, drainage techniques can be used in series to change the flow and quality characteristics of the runoff at different stages. The management train starts with collection of stormwater from individual sites and progresses through local source controls to larger downstream sites and regional controls (see Tab. 2). Runoff does not need to pass through all stages in the management train; it could flow straight to a site control. As a general principle it is better to deal with runoff locally, returning the water to the natural drainage system as near to the source as possible. If the water cannot be managed on site, due to the necessity for additional treatment before disposal or to quantities of runoff being greater than the capacity of the natural drainage system, it should be conveyed into the conventional drainage system.

The design of a decentralised stormwater management concept will require active decisions between different options, often depending on the risks associated with each course of action. The flood risk of an area has to be balanced with the costs of protection from different flood levels. The decentralised stormwater management concept promotes the division of an area to be drained, into sub-catchments. When dividing catchments, it is important to retain a perspective on how this affects the whole catchment management and the hydrological cycle.

Overview of "Managing Flood Risk" guidelines according to decision level

The following overview shows the selected tidal and fluvial floods management strategies and surface water management strategies including the responsible actors and level where they can be applied.

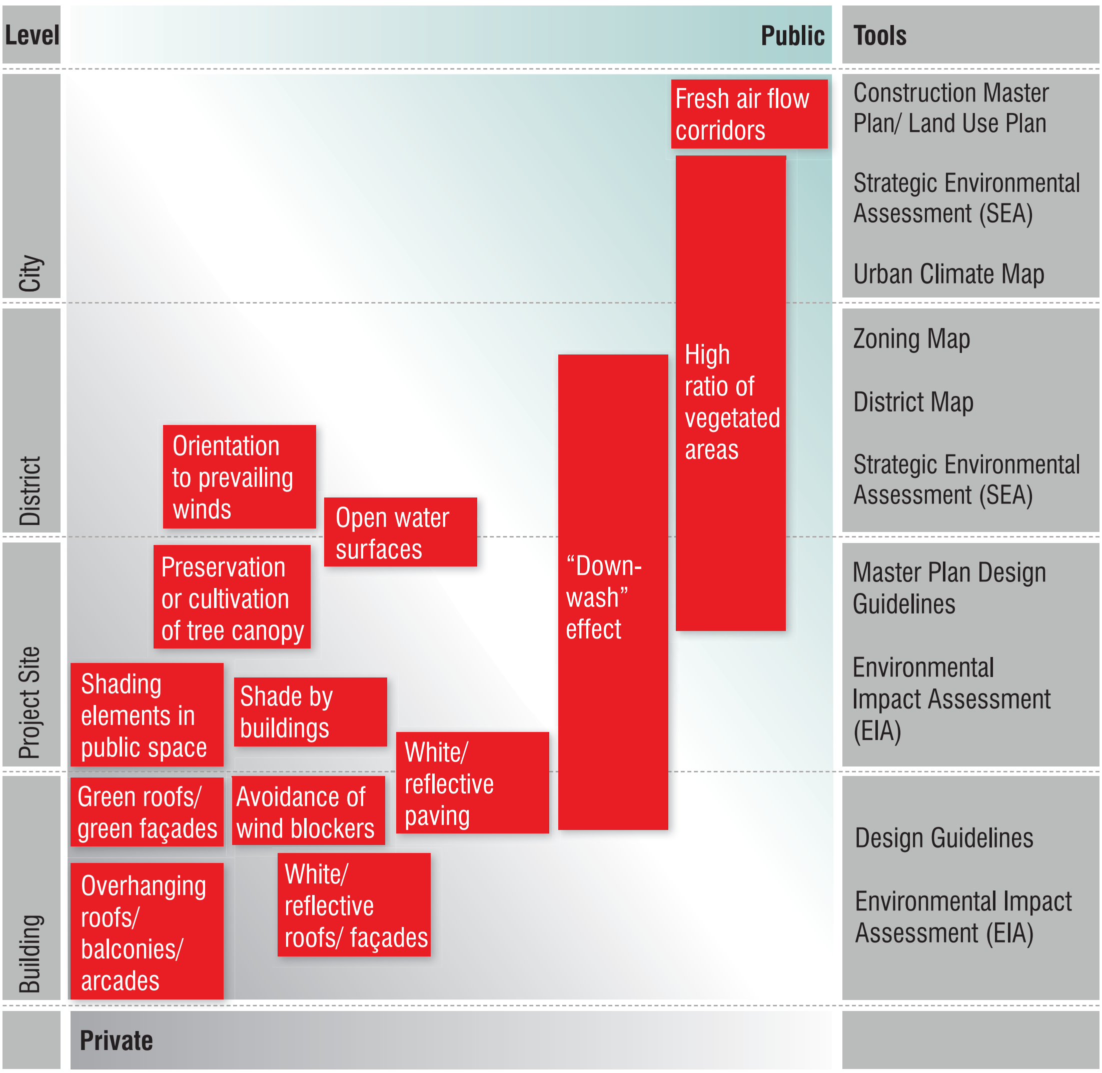
Tab. 3: Overview of selected "Managing Flood Risk" strategies



Overview of "Managing High Heat Load" guidelines according to decision level

The following overview shows the selected high heat load management strategies including the responsible actors and level where they can be applied.

Tab. 4: Overview of selected "Managing High Heat Load" strategies



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References of figures

Figure 1: Main issues for climate change adaptation
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Figure 3: Maintaining the urban water balance in HCMC
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Figure 4: Urban floodplains in HCMC
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Figure 13: Average surface water run-off by precipitation for HCMC
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Figure 14: Main fresh air corridor in HCMC
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Figure 15: Urban Climate Map of HCMC
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Table 2: Surface water management train and related strategies
Own illustration.

Table 3: Overview of selected “Managing Flood Risk” strategies
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Table 4: Overview of selected “Managing High Heat Load” strategies
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Cover: Ronald Eckert, privately owned

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Prepared in the framework of the
Megacity Research Project TP. HCM

Funded by the German Federal Ministry of Education and Research in the framework of the research programme „Future Megacities“

ISBN 978-3-00-042085-6