The Largest Megalopolis in the World: Assessing the Urbanization of the Pearl River Delta

世界最大的城市集群：评估珠江三角洲地区的城市化

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THE LARGEST MEGALOPOLIS IN THE WORLD

ASSESSING THE URBANIZATION OF THE PEARL RIVER DELTA

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THE PEARL RIVER DELTA IN CONTEXT
PEARL RIVER DELTA TODAY
SCALE COMPARISON: NY-DC MEGALOPOLIS
A CITY 200 KILOMETERS (120 MILES) LONG
PRIMARY DELTA ECOSYSTEMS
FIVE KEY ECOSYSTEMS

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PEarl River Delta, 1988
Smaller cities separated by diverse wetlands

PEarl River Delta, 1995
200% urban expansion in ten years
THE PRD ECONOMY RELATIVE TO OTHER REGIONS
A ONE TRILLION DOLLAR ECONOMY
THE ASCENDANCY OF CHINA IN THE PRD
A TRANSITION FROM OFF-SHORE INVESTMENT TO ON-SHORE PRODUCTION

The Pearl River Delta Megacity
Will it be the death of Hong Kong?

The Pearl River Delta is slowly growing into a single colossal megapolis. And as controversy reigns over the continued urban development into the HKSAR's northeastern territories, we dissect the future of the extravagant sprawling metropolis and see how its emergence will affect – and perhaps eventually kill – Hong Kong. By Samuel Lai
SCALE COMPARISON: NEW YORK, TOKYO, LONDON
DISPERSED DEVELOPMENT MODEL VERSUS CENTRALIZED DEVELOPMENT MODEL
HONG KONG SKYLINE TODAY

A COMMITMENT TO TRANSIT AND OPEN SPACE = MORE HIGH RISES THAN ANY CITY IN THE WORLD
THE 20 TALLEST BUILDINGS, 2020
FOUR WILL BE IN THE PEARL RIVER DELTA....MORE THAN ANY OTHER CITY
SCALE COMPARISON: NY-DC MEGALOPOLIS
FUTURE HIGH-SPEED RAIL LINKS DIRECTLY TO HONG KONG
PLANNED AND EXISTING TRANSIT NETWORKS

FUTURE PRD RAIL AND TRANSIT SYSTEMS WILL FORM AN INTERCONNECTED NETWORK
PRINCIPLE 1: PRIORITY CULTURAL CONSERVATION

MAINTAIN THE UNIQUENESS OF LOCAL CULTURE AND BUILDING TRADITIONS
PRINCIPLE 2: SET A COMPREHENSIVE SUSTAINABLE FRAMEWORK FOR THE DELTA

ESTABLISH SHARED ENVIRONMENTAL GOALS

- Improved air quality (20%)
- Health & prosperity (500%)
- Regenerative materials (80%)
- Restoration of natural systems (500%)
- Balanced water cycle (50%)
- Reduced energy dependence (32%)

- CO₂ savings equivalent to the energy required to power 168,265 residential units.
- Clean over 300 hectares of contaminated industrial land.
- Waste savings equivalent to removing over 44,000 trash vehicles from local Baitean streets each year.
- Habitat to support over 380 species of fish, plus native flora and mammals.
- Savings of 70 million RMB in foregone power Plant expansion.
- For the previous wastewater treatment Plant expansion.
PRINCIPLE 2: SET A COMPREHENSIVE SUSTAINABLE FRAMEWORK FOR THE DELTA

ESTABLISH URBANIZATION LIMITS BASED ON RESILIENCY GOALS
PRINCIPLE 3: STRUCTURE GROWTH AROUND ECOLOGICAL CONSERVATION & RESTORATION

COMMIT TO ECOLOGICAL RESTORATION. BUILD IN AREAS OF LEAST IMPACT ON ECOLOGICAL SYSTEMS.
PRINCIPLE 4: CREATE DISTINCT PLACES & COMMIT TO TRANSIT
DENSIFY AROUND TRANSIT AND CREATE WALKABLE MIXED-USE DISTRICTS
PRINCIPLE 5: DENSIFY AND IMPROVE EXISTING CITIES

UNDERSTAND AND ACKNOWLEDGE THE DELTA’S INDUSTRIAL AND MANUFACTURING HISTORY
PRINCIPLE 6: ESTABLISH A LONG-TERM DEVELOPMENT VISION

PLAN FOR 50 YEARS
PRINCIPLE 6: ESTABLISH A LONG-TERM DEVELOPMENT VISION

PROTECT WATERFRONTS AND AREAS OF HIGH PUBLIC VALUE
Deltas and estuaries are home to incredibly diverse and delicate ecosystems.

Deltas and coastal areas are among the most densely populated areas in the world.
MAJOR ENVIRONMENTAL ISSUES
LOST OF WETLANDS AND OFF-BALANCE ECOSYSTEMS

NATURAL WETLAND LOST

519 km²
BETWEEN 1979 AND 2009

OVER EIGHT TIMES THE SIZE OF MANHATTAN'S LAND AREA

Source: Zhao et al. 2010
MAJOR ENVIRONMENTAL ISSUES

DRASTIC INCREASE OF IMPERVIOUS SURFACES

CAUSING MORE SEVERE FLOODING, EROSION, SEDIMENT IN WATER AND RUNOFF POLLUTION

URBANIZED AREA INCREASE

4,500 $\text{km}^2$ IN 2000

7,000 $\text{km}^2$ IN 2010


Diagram source: Zhang, L., Weng, Q.
MAJOR ENVIRONMENTAL ISSUES
FLOW REGIME ALTERATIONS AND HABITAT DEGRADATION
CAUSING CHANGE IN SEDIMENT PATTERN, SALT WATER INTRUSION AND LOSS OF BIODIVERSITY

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A town along the upstream of the Pearl River after days of flooding
Image: Kaiping Tan
MAJOR ENVIRONMENTAL ISSUES
SHORTAGE OF WATER AND LAND SUBSIDENCE

GROUND WATER SUPPLY DECREASE
512 MILLION m³
BETWEEN 2000 AND 2014
MAJOR ENVIRONMENTAL ISSUES
SHORTAGE OF WATER AND LAND SUBSIDENCE

WATER QUALITY DECLINE
25% OF STREAMS AND RIVERS RANKED UNUSABLE

Waste water being discharged into the river, Zhongshan, Guangdong
Image: Greenpeace
Data source: PRWRC, 2011
THREE MAIN CASE STUDIES

SAN FRANCISCO BAY

MISSISSIPPI RIVER DELTA

THE NETHERLANDS

Image: Wikimedia Commons
Image: NASA
Image: blogs.agu.org
RECOMMENDED STRATEGIES

- Multi-jurisdictional watershed management
- Promoting low-impact development
- Preserving room for nature and environmental restoration
- Mitigation banking/compensation for development impact
RECOMMENDED STRATEGY ONE:
MULTI-JURISDICTIONAL WATERSHED MANAGEMENT

SAN FRANCISCO BAY
THE JOINT AUTHORITY - REGIONAL WATER BOARDS

Map of the Urban Areas in the SF Bay Basin and State Water Board Boundary

Map of the hydrologic planning areas around the SF Bay Basin  
Source: http://www.swrcb.ca.gov/
RECOMMENDED STRATEGY ONE:
MULTI-JURISDICTIONAL WATERSHED MANAGEMENT
ONE MASTERPLAN - THE BAY PLAN

The plan includes policies on issues critical to the Bay ranging from port activities and public access to urban development. The plan maps the entire Bay and designates areas for water-related purposes such as ports, industry, public recreation, airports and wildlife refugees.
RECOMMENDED STRATEGY ONE: 
MULTI-JURISDICTIONAL WATERSHED MANAGEMENT

THE JOINT AUTHORITY - COASTAL PROTECTION AND RESTORATION AUTHORITY, MISSISSIPPI RIVER DELTA

0.75 HECTARE PER HOUR

Map shows the land change along the Louisiana coast over the next fifty years. Red indicates areas likely to be lost, and green indicates areas of new land (based on assumptions about increases in sea level rise, subsidence, and other factors. 1.880 square miles of land have been lost in the last 80 years. 1.750 square miles of additional land are at risk of being lost in the next 50 years

Source: coastal.la.gov
RECOMMENDED STRATEGY ONE:  
MULTI-JURISDICTIONAL WATERSHED MANAGEMENT

ONE MASTERPLAN - COASTAL PROTECTION AND RESTORATION AUTHORITY (CPRA) MASTER PLAN

Projects Included:
- Structural Protection
- Bank Stabilization
- Oyster Barrier Reef
- Ridge Restoration
- Shoreline Protection
- Barrier Island Restoration
- Marsh Creation
- Sediment Diversion
- Hydrologic Restoration

Source: http://coastal.la.gov/
RECOMMENDED STRATEGY TWO:
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION
THE ROOM FOR THE RIVER PROGRAM, THE NETHERLANDS
RECOMMENDED STRATEGY TWO:
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION

THE ROOM FOR THE RIVER PROGRAM, THE NETHERLANDS

Deepening summer bed
The river bed is deepened by excavating the surface layer of the river bed. The deepened river bed provides more room for the river.

Water storage
The Volkerak-Zoommeer lake provides for temporary water storage when exceptional conditions result in the combination of a closed storm surge barrier and high river discharges to the sea.

Dike relocation
Relocating a dike land inwards increases the width of the floodplains and provides more room for the river.

Work in progress lowering groynes.
Image: waterandthedutch.com

Strengthening dikes
Dikes are strengthened in areas in which creating more room for the river is not an option.

High-water channel
A high-water channel is a ditched area that branches off from the main river to discharge some of the water via a separate route.

Lowering of floodplains
Lowering (excavating) an area of the floodplain increases the room for the river during high water levels.

Lowering groynes
Groynes stabilise the location of the river and ensure that the river remains at the correct depth. However, at high water levels groynes can form an obstruction to the flow of water in the river. Lowering groynes increases the flow rate of the water in the river.

Depoldering
The dike on the river side of a polder is relocated land inwards and water can flow into the polder at high water levels.

Removing obstacles
Removing or modifying obstacles in the river bed where possible, or modifying them, increases the flow rate of the water in the river.
RECOMMENDED STRATEGY TWO: 
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION
THE SAND ENGINE, THE NETHERLANDS

The Sand Motor (also known as Sand Engine) is a great volume of sand that has been applied along the coast of Zuid-Holland at Ter Heijde in 2011. Wind, waves and currents will spread the sand naturally along the coast of Zuid-Holland. This is called ‘Building with Nature’. The sand engine will gradually change in shape and will be part of the dunes and the beach. 2.1 million cubic meters of sand Area at outset 128 hectares. Additional 35 hectares of new beaches and dunes will be added.
RECOMMENDED STRATEGY TWO:
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION

CONSERVATION LANDS NETWORK, SAN FRANCISCO

The Conservation Lands Network collectively and strategically protect 2 million acres of the Bay Area’s upland habitats and rare landscapes for biodiversity conservation.

Between 2006 and 2011, the Bay Area Open Space Council partnered with 125 regional experts to develop the Conservation Lands Network as a tool for conservation practitioners, landowners, land managers, policy makers and the public.

Map of Conservation Lands Network shows the areas important and essential to conservation goals

<table>
<thead>
<tr>
<th>Conservation Lands Network</th>
<th>Stream Conservation Targets</th>
<th>Protected Lands</th>
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<td>Areas Essential to Conservation Goals</td>
<td>Priority 1</td>
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<td>Areas Important to Conservation Goals</td>
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<td>Not part of the Conservation Lands Network</td>
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Converted Landscapes
- Rural
- Residential
- Urbanized Areas

Source: www.bayarealands.org
RECOMMENDED STRATEGY TWO:
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION

RESTORATION OF SAN FRANCISCO BAY

Between 1800 and 1998, 79 percent of tidal marshes (150,000 acres) and 42 percent of tidal flats (21,000 acres) were lost to diking and filling.

Restoration projects completed by the year 1998 added 4,000 acres of tidal marsh and 2,000 acres of diked wetlands.

The Baylands projects envisions conservation of 100,000 acres of historic tidelands that surround the bay area. Produced by a collaborative of 21 management agencies, these projects will add around 28,000 acres of tidal marsh - including 5,000 acres of previously restored tidal flat that will evolve into tidal marsh to baylands habitats mapped in the 2009 map on the left.

source: www.bayarealands.org
RECOMMENDED STRATEGY TWO:
PRESERVING ROOM FOR NATURE AND ENVIRONMENTAL RESTORATION

PEARL RIVER DELTA RESTORATION EFFORTS

Mai Po Natural Reserve, Hong Kong
Source: www.gdgnewway.net
RECOMMENDED STRATEGY THREE:
PROMOTING LOW-IMPACT DEVELOPMENT

HAMMARBY SJÖSTAD MODEL

- Tram-line as the main commuting mode
- Extensive bicycle and pedestrian network
- Dense Urban form with 4-5 story buildings
- A large car pooling system
- Spacious green areas

image: cityncountrybranding.files.wordpress.com
RECOMMENDED STRATEGY FOUR:
MITIGATION BANKING/COMPENSATION FOR DEVELOPMENT IMPACT

Diagram: Patrick W. Hook & Spencer T. Shadle
Image: Huffman-Broadway Group, Inc.
TRENDS AND STRATEGIES SUMMARY

DEVELOPMENT TRENDS

• Slowing suburban growth
• Transformation of city centers
• A commitment to walkability and bicycling
• The next generation of urban brownfield sites

MOBILITY

• Increase Rail and Transit Mode Split
• Increase Natural Habitat through Infrastructure Projects
• Expand and Enhance Inter-Delta Ferry Systems
• Connect Airports with Multi-Modal Systems

ENVIRONMENT

• Multi-jurisdictional watershed management
• Preserving room for nature and environmental restoration
• Promoting low-impact development
• Mitigation banking/compensation for development impact