HCMC CLIMATE CHANGE IMPACT AND ADAPTATION STUDY

ADB/HCMC PPC

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Adaptation planning capacity

- Increasing capacity in modeling the level of threat in coastal and riverine areas. But difficulties with:

1. Modeling threats to inland and mountainous areas
2. Communicating scientific knowledge on threat in ways that planners can understand and use
3. Using information on climate threats in impact and vulnerability assessment (tools, procedures, guidance)
4. Defining what needs to be done and taking action in situations of uncertainty (“how high should we make the dykes?!”)
5. Systematically integrating adaptation with development planning (when, how, who, what)

HCMC Study contributes to National Target Plan priorities:

1. Assessment of climate change threats and impacts on sectors, communities and areas
2. Development of actions plans to respond to climate change
3. Mainstreaming adaptation in socio-economic and spatial planning, and
4. Strengthening capacity in organization, institutions and policies on climate change.

HCMC study scenarios

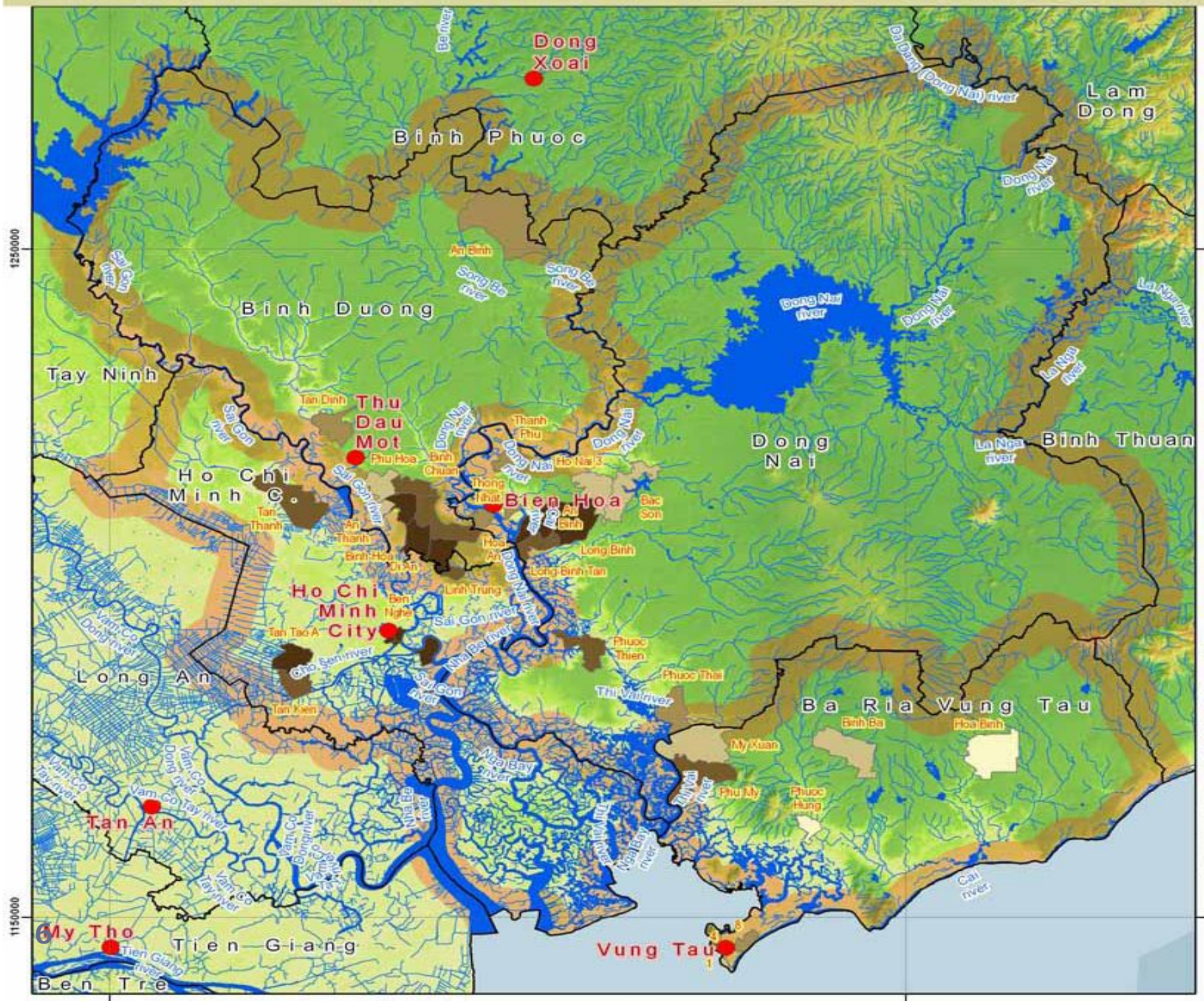
- **One time horizon** for assessing climate extent and impact: 2050
- **Two IPCC scenarios:**

1. A2: High emission - Minimal innovation to current practice (SLR 26cm)
2. B2: Medium emission – Mitigation measures applied (SLR 24cm)

- **Regular and extreme** climate situations – flood, drought and saline intrusion
- **With and without planned comprehensive dyke system** – designed for current climate (USD750 million)


CAMBODIA
DAKLAK
Lake Phuoc Mieng
Lake Thac Mo
BINH PHUOC
Be river
Lake Dong Nai 4
Lake Dong Nai 3
Lake Don Duong
LAM DONG
Lake Dai Ninh
NINH THUAN
Lake Dau Tieng
TAY NINH
Sai Gon river
Dong Nai river
BINH DUONG
Lake Tri An
DONG NAI
Lake Ham Thuan
Lake Song Luy
BINH THUAN
Vam Co Dong river
LONG AN
Vam Co Tay river
Soai Rap river
Sai Mep river
BA RIA-VUNG TAU
THAP
South China Sea
TIEN GIANG
BEN TRE
106°0'E
107°0'E
108°0'E
12°0'N
11°0'N
Province boundary
SGDN river basin boundary
VIET NAM: Sai Gon - Dong Nai river basin
0 10 20 40 Km
N

Communes with Highest Pollution Load and River Network



The steps to adaptation planning

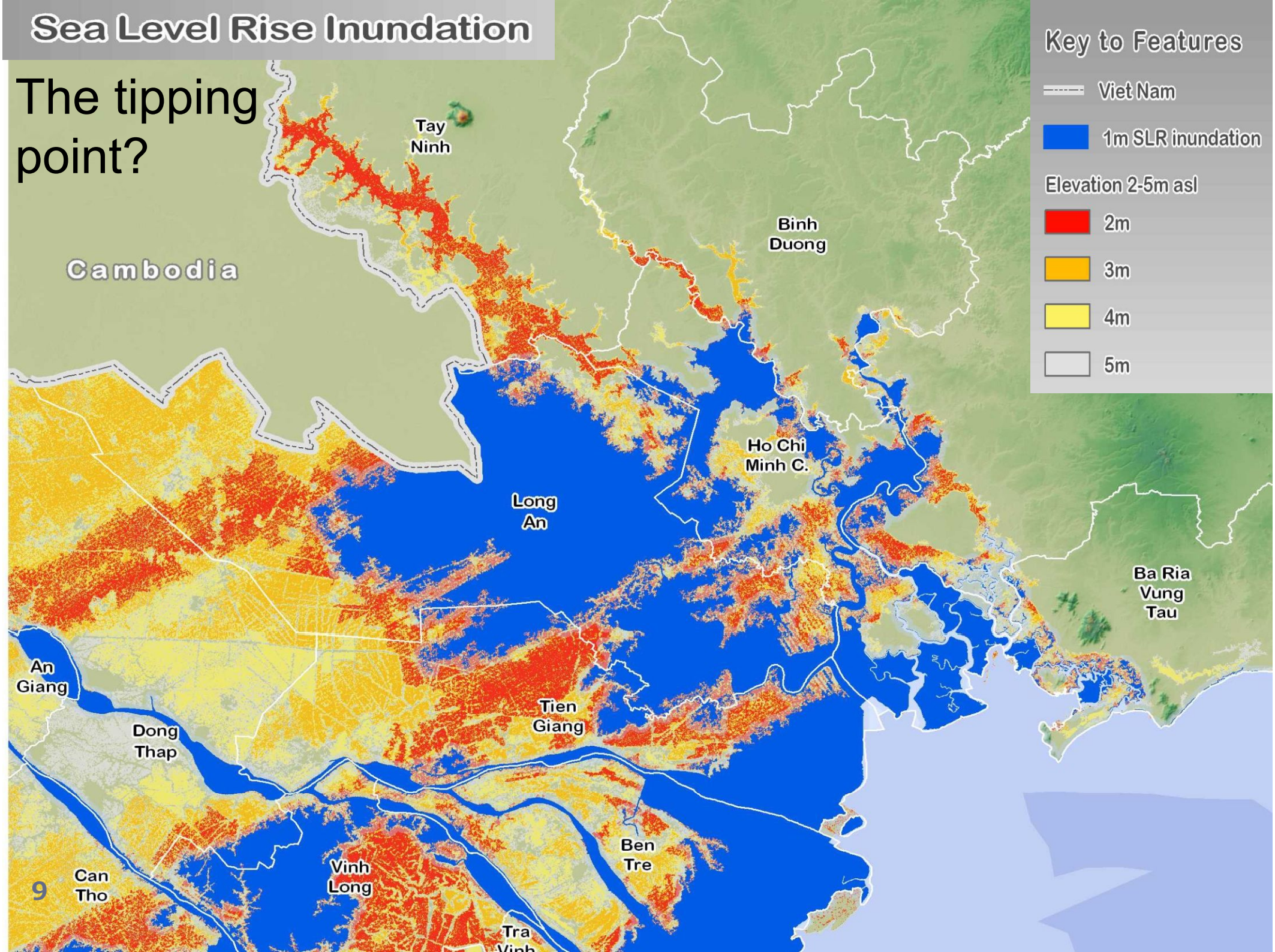
1. Assessing the threat: Estimating the kinds of climate and hydrodynamic changes and their nature, scale and location
2. Socio-economic projections: Modeling socio-economic conditions in future climate situations
3. Assessing the impact: Linking estimates of climate threat to potential socio-economic and environmental impacts
4. Assessing vulnerability: Identifying areas, sectors and communities sensitive to climate change impacts
5. Identifying adaptation options and priorities: Defining what needs to be done, by whom and when
6. Integrating with development planning: policies, procedures, design standards, budgets, projects
7. Implementation of adaptation measures: including monitoring, learning and adjustment

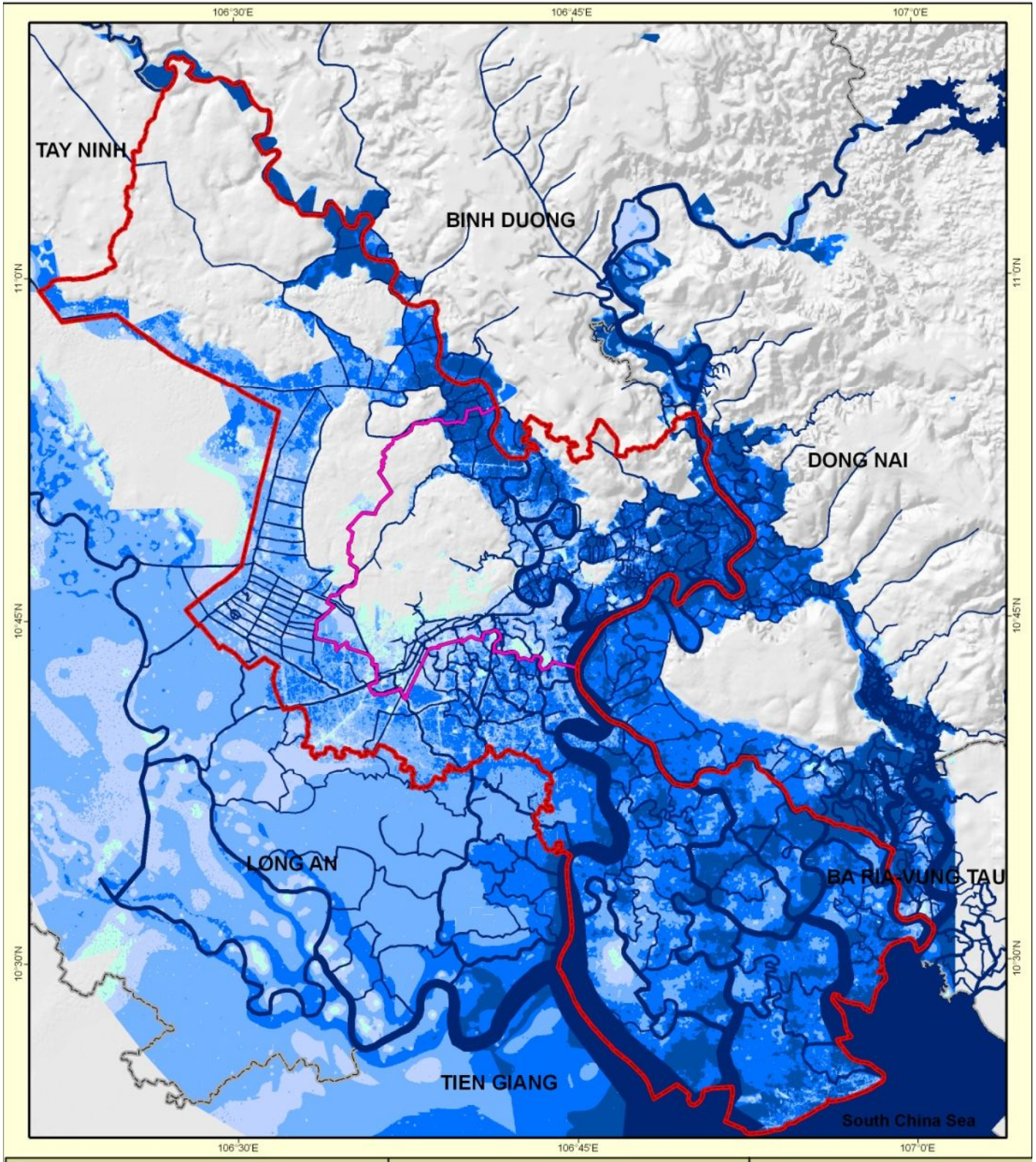
The 2050 climate change threat

- Regular events (ie daily or seasonal)
  - Temperature (seasonal and rising)
  - Monsoon rainfall (annual and more intense)
  - Tides (twice daily and increasing amplitude)
  - Wind (annual and more intense)
  - Drought (annual and more intense)
  - Saline intrusion (regular and greater inland reach)
  - Sea level rise (incremental increase – 26cm/25cm)
- Extreme events (eg 10 or 30 year return period)
  - Tropical storms – wind and rain (more frequent)
  - Storm surge (more intense)

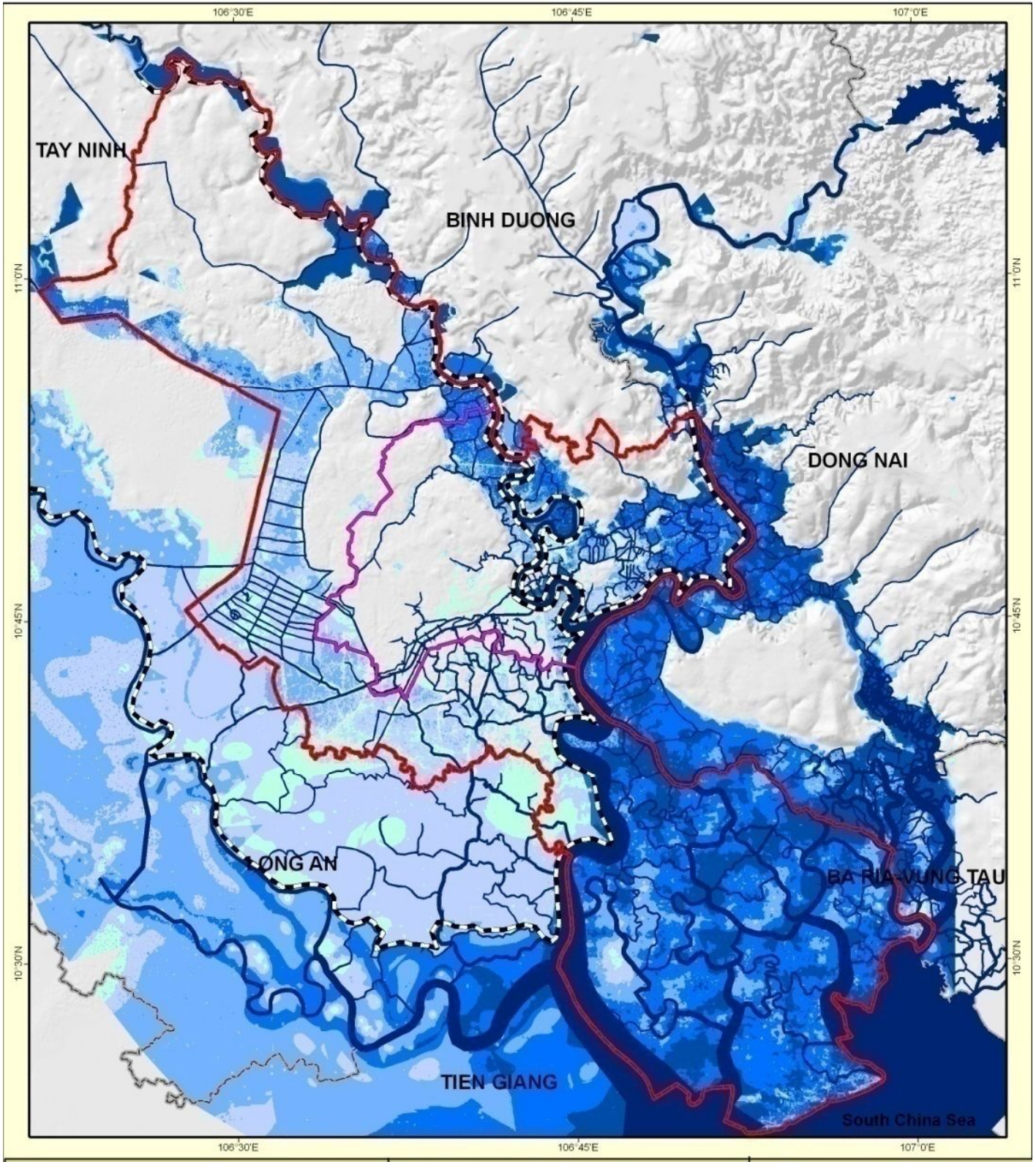
Sea Level Rise Inundation

The tipping point?

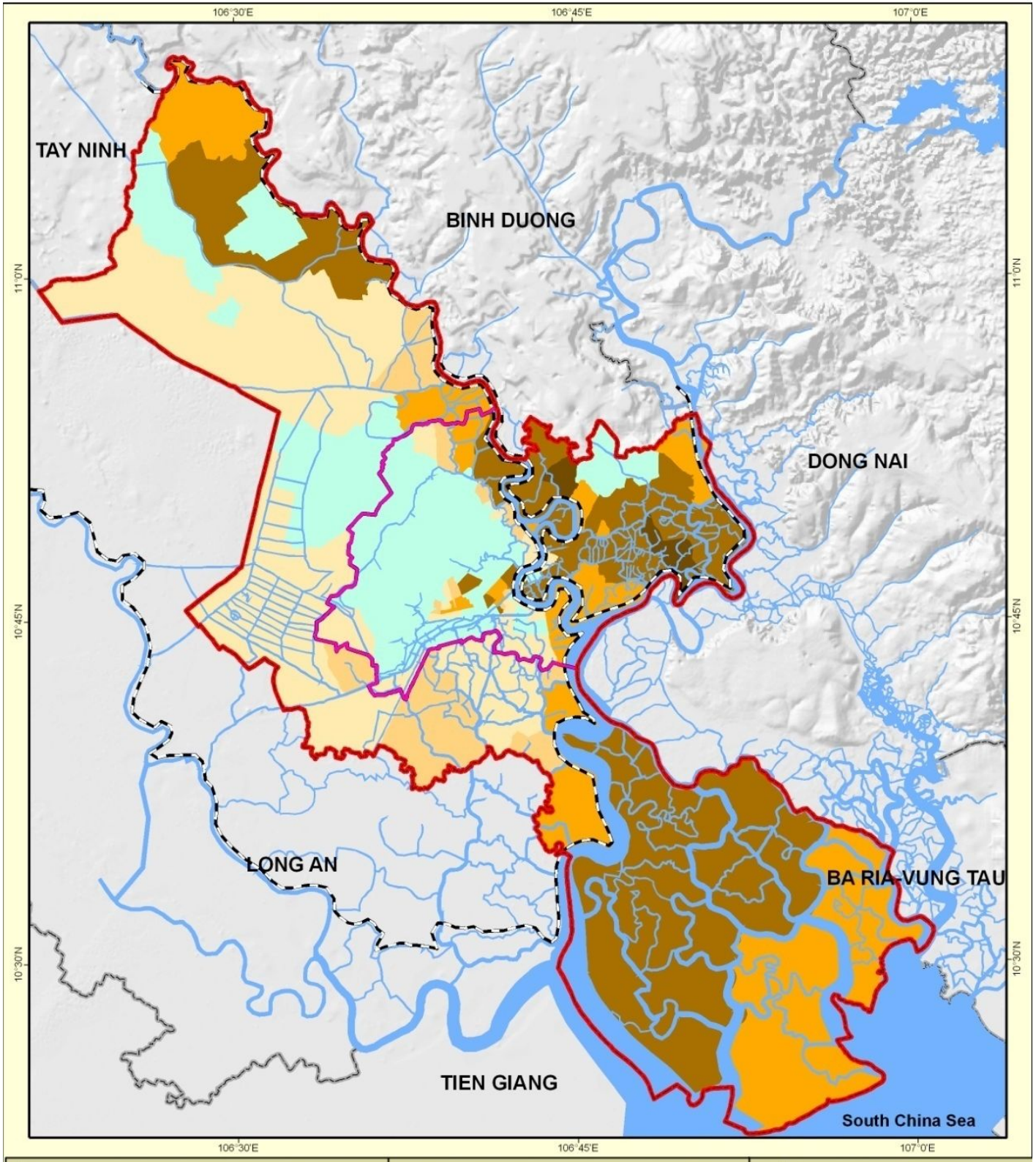




2050 extreme flood event without dykes



2050 extreme flood event with dykes



2050 regular flood duration by commune (days/year) with dyke system

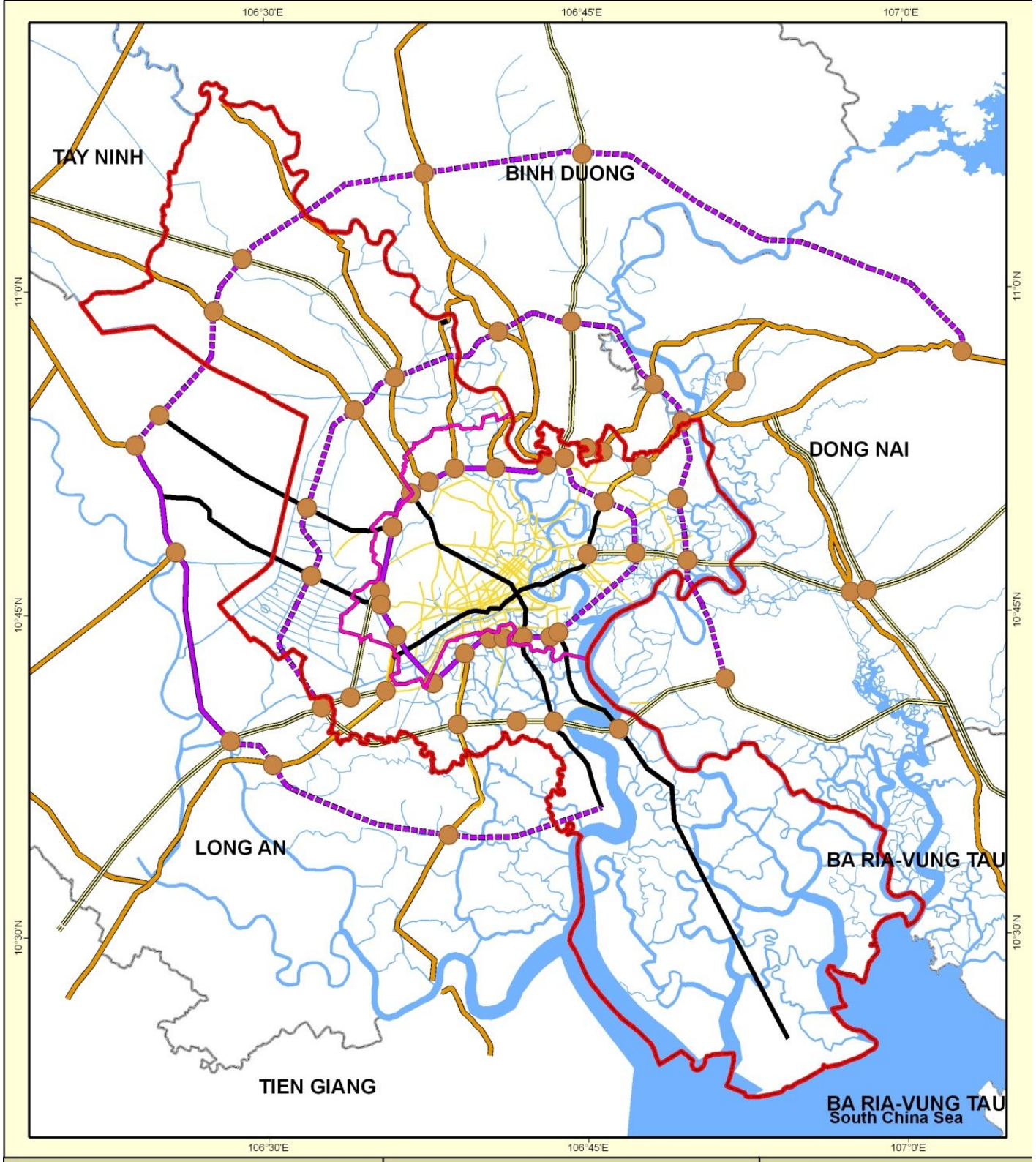
Impact assessment

An assessment of the impacts on

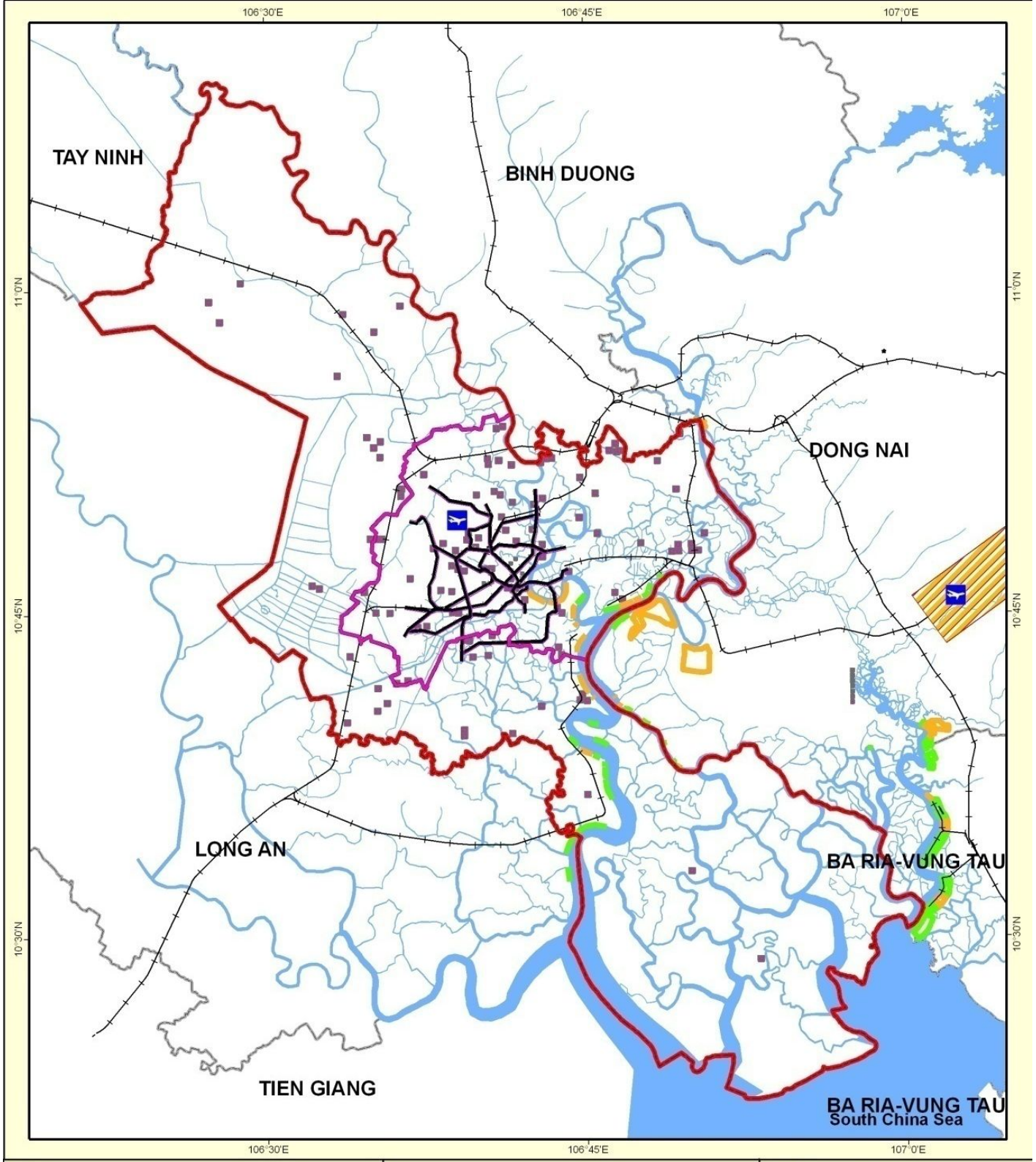
1. **Economic assets:** Industrial assets, water, transport, agriculture and energy, public health infrastructure
2. **Social variables and assets:** population affected, livelihood/income types most affected, poor communities affected
3. **Environmental assets**: aquatic systems, forest resources, fish resources affected, biodiversity lost
4. **Environmental quality**: (i) Areas affected by salinity, and (ii) areas affected by wastewater/pollution

2050 - Populations effected by flood – top ten districts

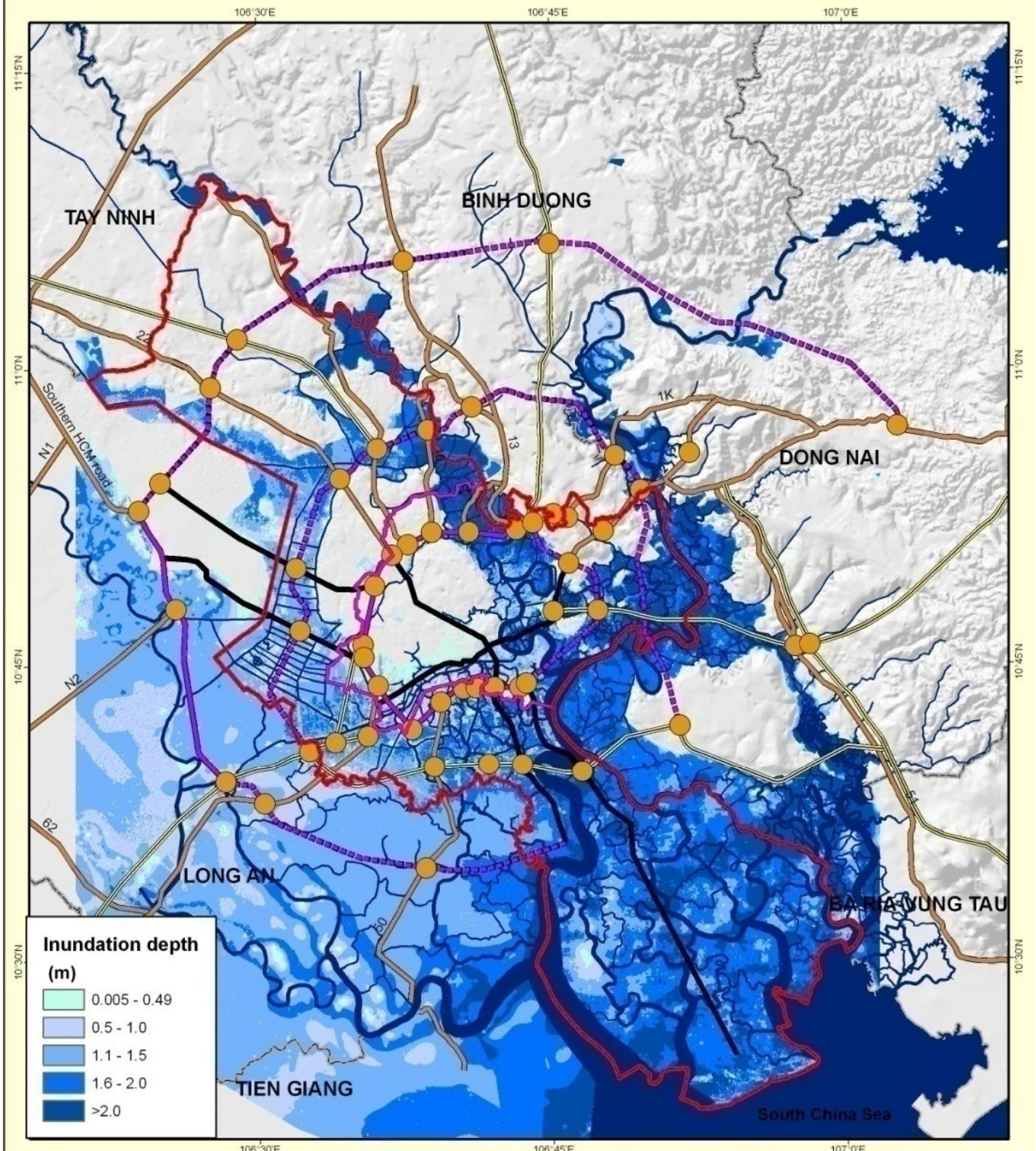
			Extreme A2		Extreme A2 with dyke	
District	Area (Ha)	Population 2050	People affected	Percent area affected	People affected	Percent area affected
2	5236.54	1,492,000	1,410,089	94.51	1,160,179	77.76
4	407.65	125,000	124,988	99.99	80,550	64.44
6	712.97	216,000	193,363	89.52	25,553	11.83
7	3146.06	1,071,000	1,070,572	99.96	691,009	64.52
8	1968.57	575,000	573,735	99.78	170,718	29.69
9	11979.2	3,420,000	2,321,838	67.89	2,310,894	67.57
Binh Thanh	2094.44	623,000	510,922	82.01	502,263	80.62
Nha Be	10413.5	437,000	436,956	99.99	368,915	84.42
Can Gio	61284.5	393,000	393,000	100	393,000	100
Binh Chanh	25433.3	1,483,000	1,342,560	90.53	1,232,521	83.11
Total/ average		**9,835,000**	**8,378,023**	**92.42**	**6,935,602**	**66.40**
Total/ average HCMC		**19,345,000**	**11,914,687**	**57.99**	**10,178,751**	**43.33**



Transport master plan - roads



Transport master plan – rail, ports and airport

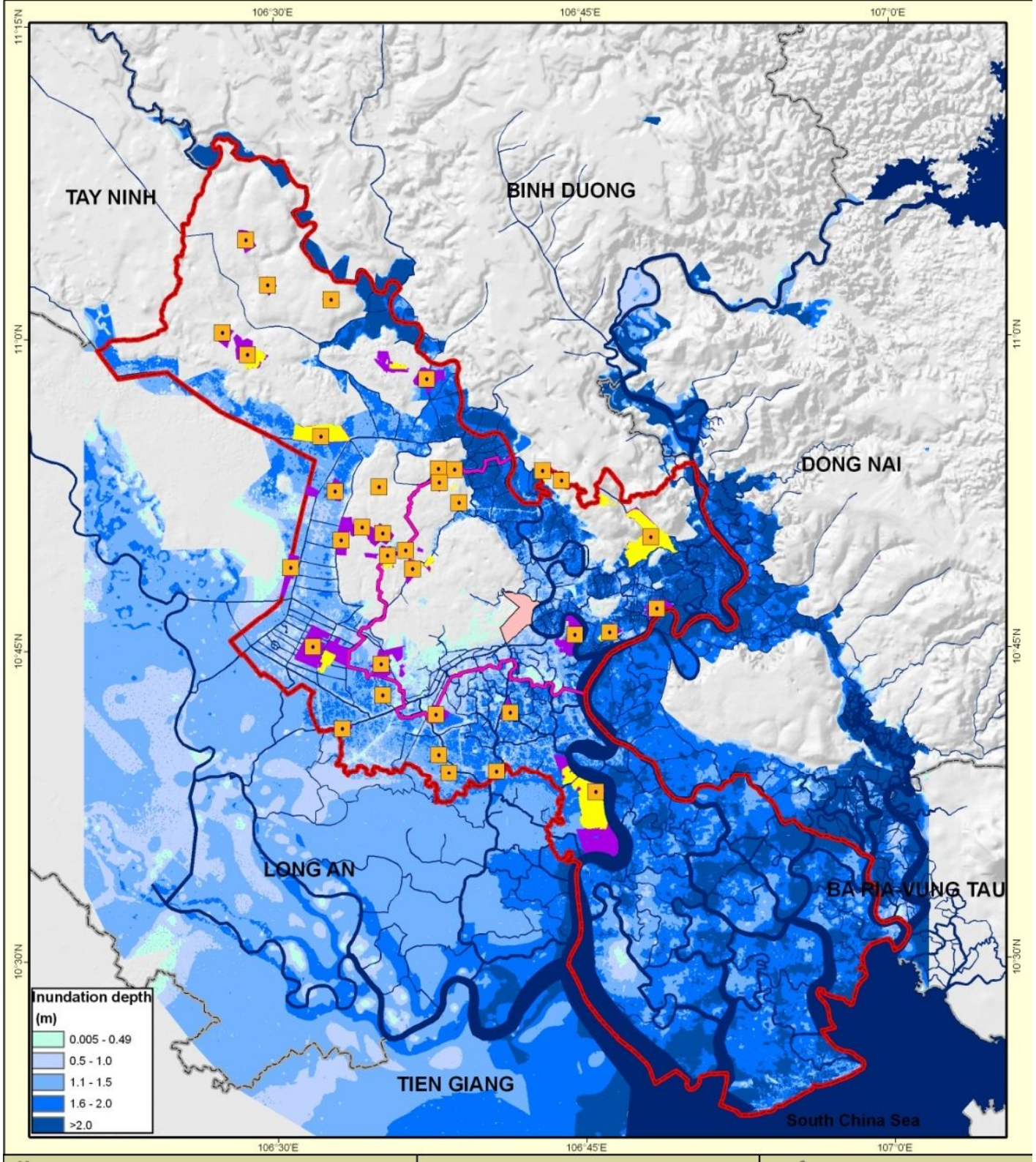


Transport master plan and 2050 extreme flood

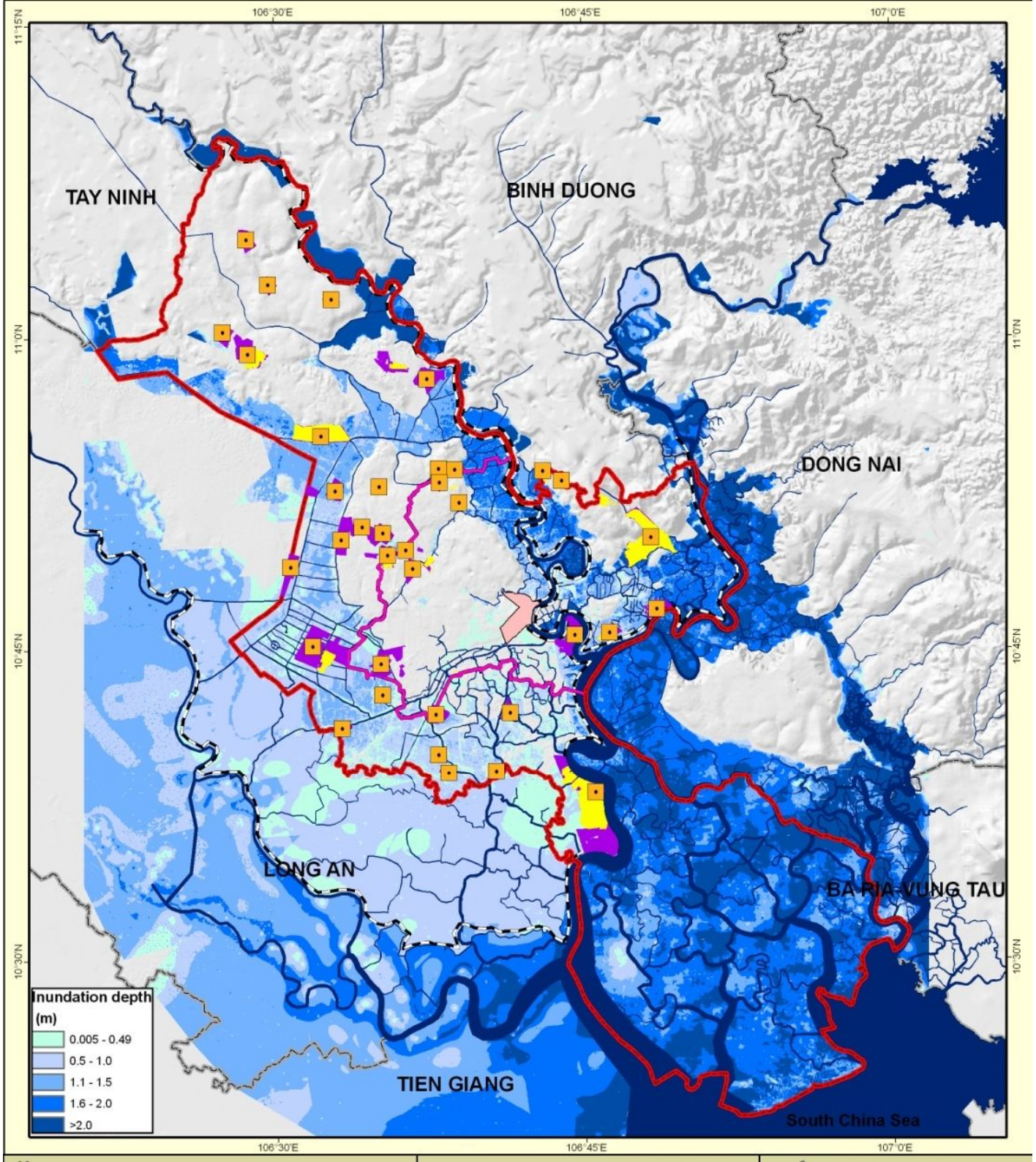
Risk indicator
0 km: Inundated
<1 km: Very high risk
<5 km: High risk
<10km: Medium risk
>10km: Low risk

2050 planned major road intersections at risk with and without the planned dyke system

Main intersections	Distance from flooded area (km)	
	Extreme A2	Extreme A2 with dyke
National road no. 13 (Binh Phuoc intersection)	0.00	0.00
Provincial road no. 12 - Nga Tu Ga	0.00	0.00
Provincial road no. 16	0.00	0.00
Provincial road no. 15 (Quang Trung inersection)	0.48	0.48
National road no. 22 (An Suong intersection)	1.27	1.27
South-Western new road	1.28	1.28
Tan Tao - Cho Dem highway	0.75	1.06
Provincial road no. 10	0.00	0.37
Hung Vuong (An Lac intersection)	0.00	0.83
Nguyen Van Linh	0.00	0.00
National road no. 50	0.00	0.09
Chanh Hung	0.00	0.00
Nguyen Van Cu	0.00	0.09
North-South Axis	0.00	0.26
Intersection of A Area	0.00	0.11
Inter-Provincial road no. 15	0.00	0.00
Inter-Provincial road no. 25	0.17	0.17
Hanoi highway (Binh Thai intersection)	0.10	0.10
Saigon-Long Thanh-Dau Giay highway	0.00	0.00
Saigon-Long Thanh-Dau Giay highway	2.41	2.41
Tan Van intersection	0.08	0.08
National road no. 1K	0.32	0.32
National road no. 13 (Thu Dau Mot)	2.77	2.17
Provincial road no. 15	0.00	0.00
National road no. 22	0.00	0.00
Provincial road no. 14	0.00	0.00
Provincial road no. 10	0.00	0.00
Saigon-Trung Luong highway	0.00	0.00
National road no. 50	0.00	0.00
National road no. 1A (Ben Luc town, Long An)	0.00	0.00
Saigon-Trung Luong highway	0.00	0.00
New road (Provincial road no. 14 near Duc Hoa town	0.01	0.01
National road no. 22	0.76	0.56
HCMC-Moc Bai highway	5.87	3.38
National road no13	3.30	3.30
National road no. 1A (Trang Bom), km 1845	3.04	3.04
National road no. 50	0.00	0.00
Ring road no. 3 (Nhon Trach)	0.00	0.34
North-South Axis	0.00	0.00
Ring road no. 3 (Nhon Trach)	0.00	0.00
Provincial road no. 16	0.00	0.00



Existing and planned industrial zones in extreme 2050 flood without dyke system

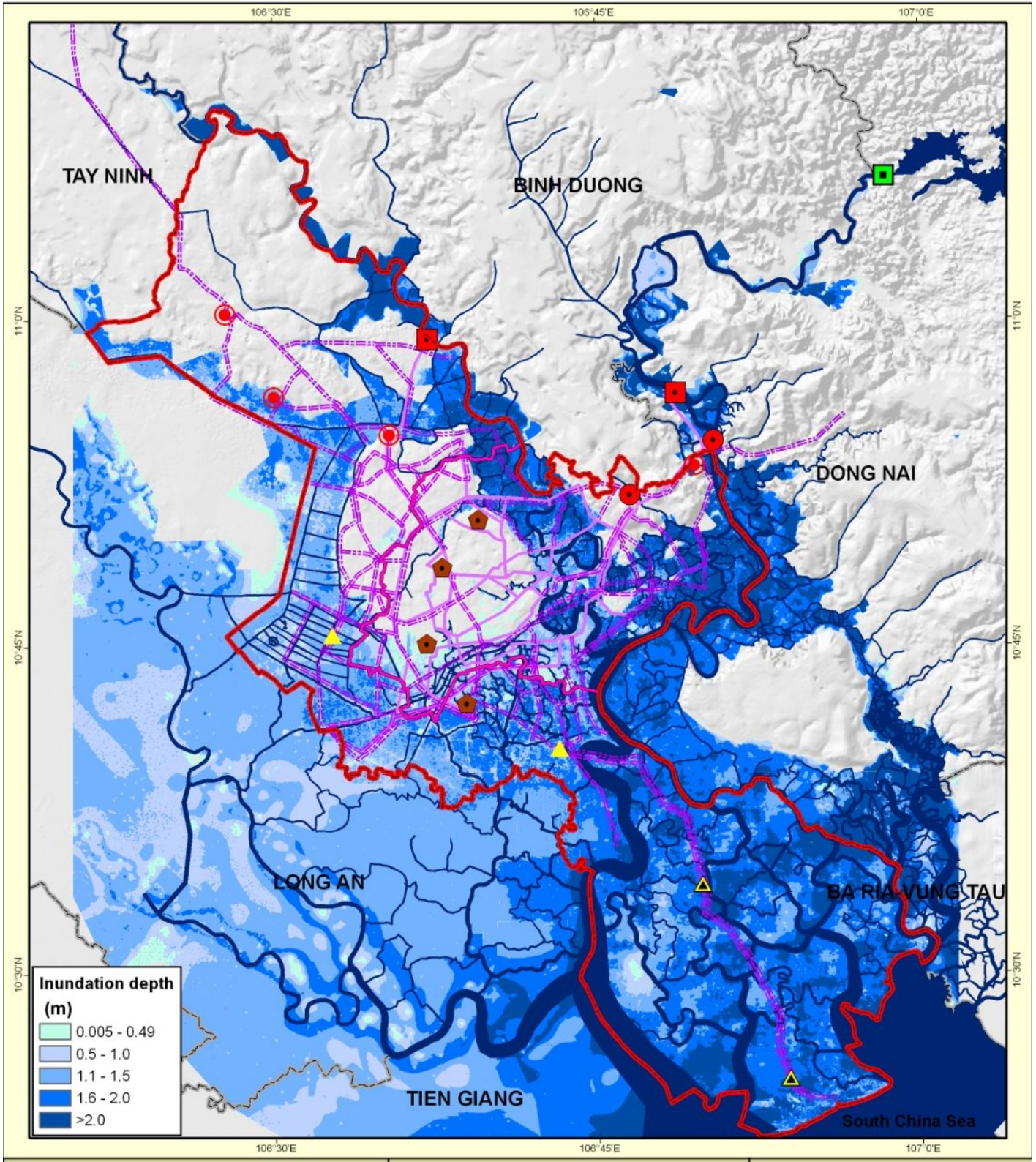


Existing and planned industrial zones in extreme 2050 flood with dyke system

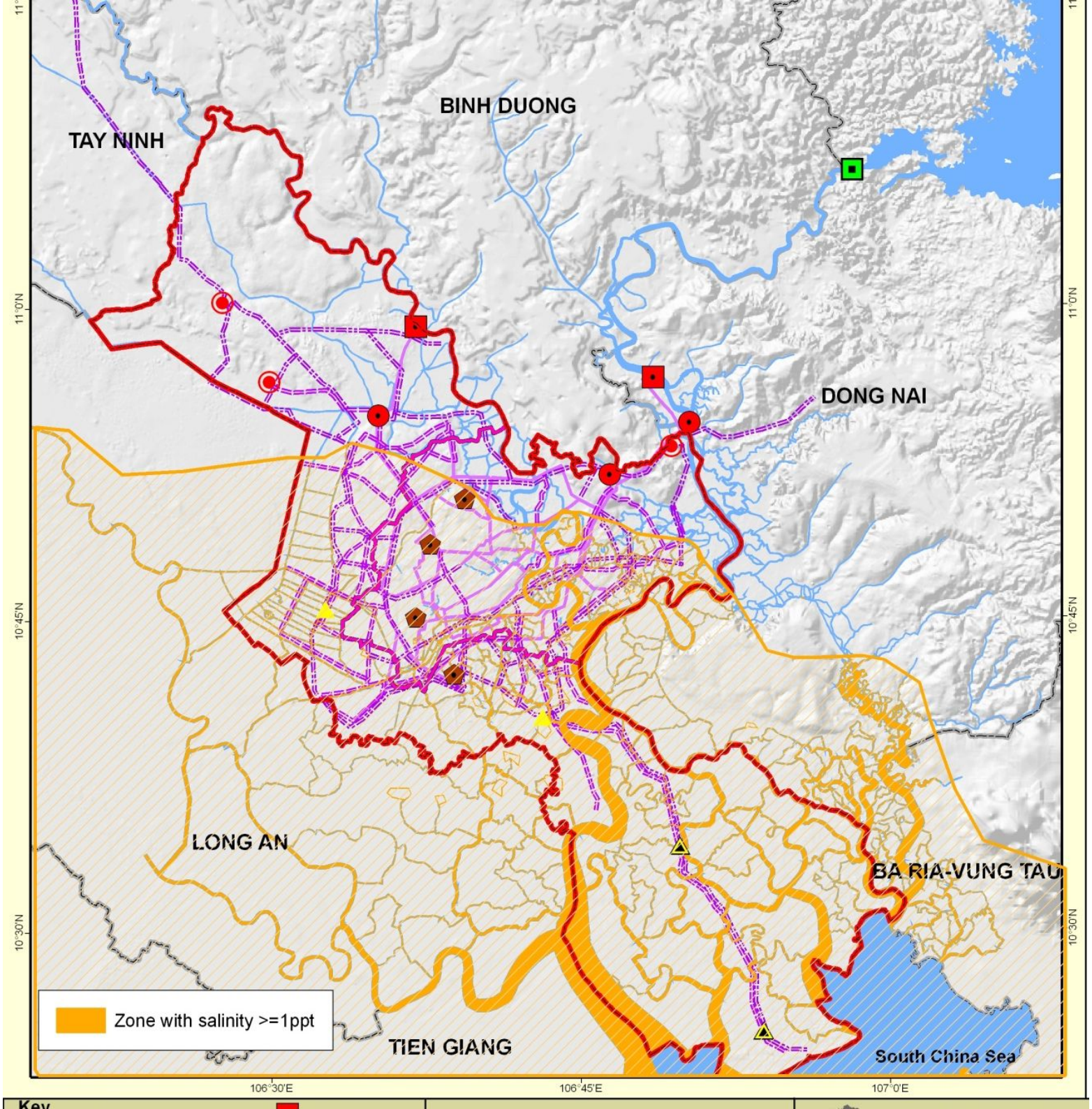
Risk indicator
0 km: Inundated
<1 km: Very high risk
<5 km: High risk
<10km: Medium risk
>10km: Low risk

2050 existing and planned industrial zones in extreme flood (i) without and (ii) with dyke system

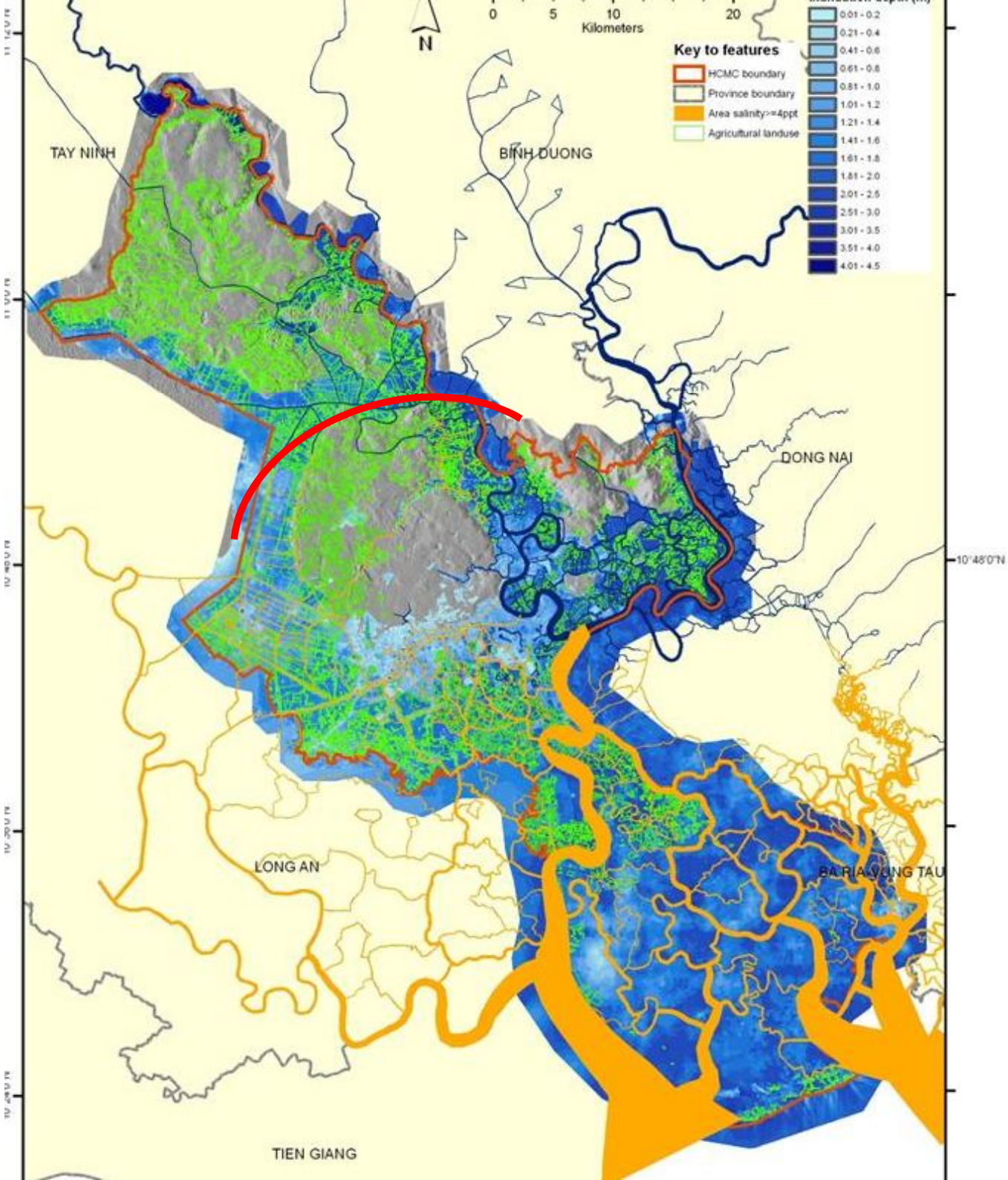
Name Izs and IPZs	Type	Distance from flooded area	
		Extreme A2	Extreme A2 with dyke
Hoc Mon	Group	2.45	2.45
Hiep Thanh IZ	IZ	0.00	0.00
Tan Thoi Nhat	Group	0.35	0.35
Tan Binh IZ	IZ	1.88	1.88
Vinh Loc I IZ	IZ	0.15	0.15
Tan Tao IZ	IZ	0.00	0.00
De Bo Metro	Group	0.00	0.00
Le Minh Xuan IZ	IZ	0.00	0.00
Xuan Thoi Son	Group	0.00	0.00
Xuan Thoi Thuong IZ	IZ	1.95	1.95
Vinh Loc II IZ	IZ	0.40	0.40
Nhat Thanh	Group	0.00	0.65
Thoi An	Group	0.55	0.55
Ba Diem	Group	0.46	0.46
Dong Thanh IZ	IZ	1.07	1.07
Bau Dung IZ	IZ	4.70	4.70
West-North Cu Chi IZ	IZ	2.00	0.78
Tan Phu Trung IZ	IZ	0.00	0.00
Bau Tran IZ	Group	4.34	4.34
Phan Van Coi IZ	Group	1.81	1.81
Phuoc Hiep IZ	Group	2.99	0.00
Tan Quy IZ	Group	0.00	0.00
Tan Tuc	Group	0.00	0.00
Phong Phu IZ	IZ	0.00	0.00
Tan Thuan IPZ	IPZ	0.00	0.00
Hiep Phuoc IZ	IZ	0.00	0.00
Quy Duc	Group	0.00	0.00
Hung Long	Group	0.00	0.00
Small enterprisez	Group	0.00	0.16
Cat Lai IZ	IZ	0.00	0.00
SaiGon Hi-Tech Park	IZ	0.00	0.00
Phu Huu	IZ	0.00	0.00
Linh Trung II	IPZ	0.48	0.48
Binh Chieu IZ	IZ	1.18	1.18
Da Phuoc	Group	0.00	0.00
Tan Thoi Hiep IZ`	IZ	1.60	1.60



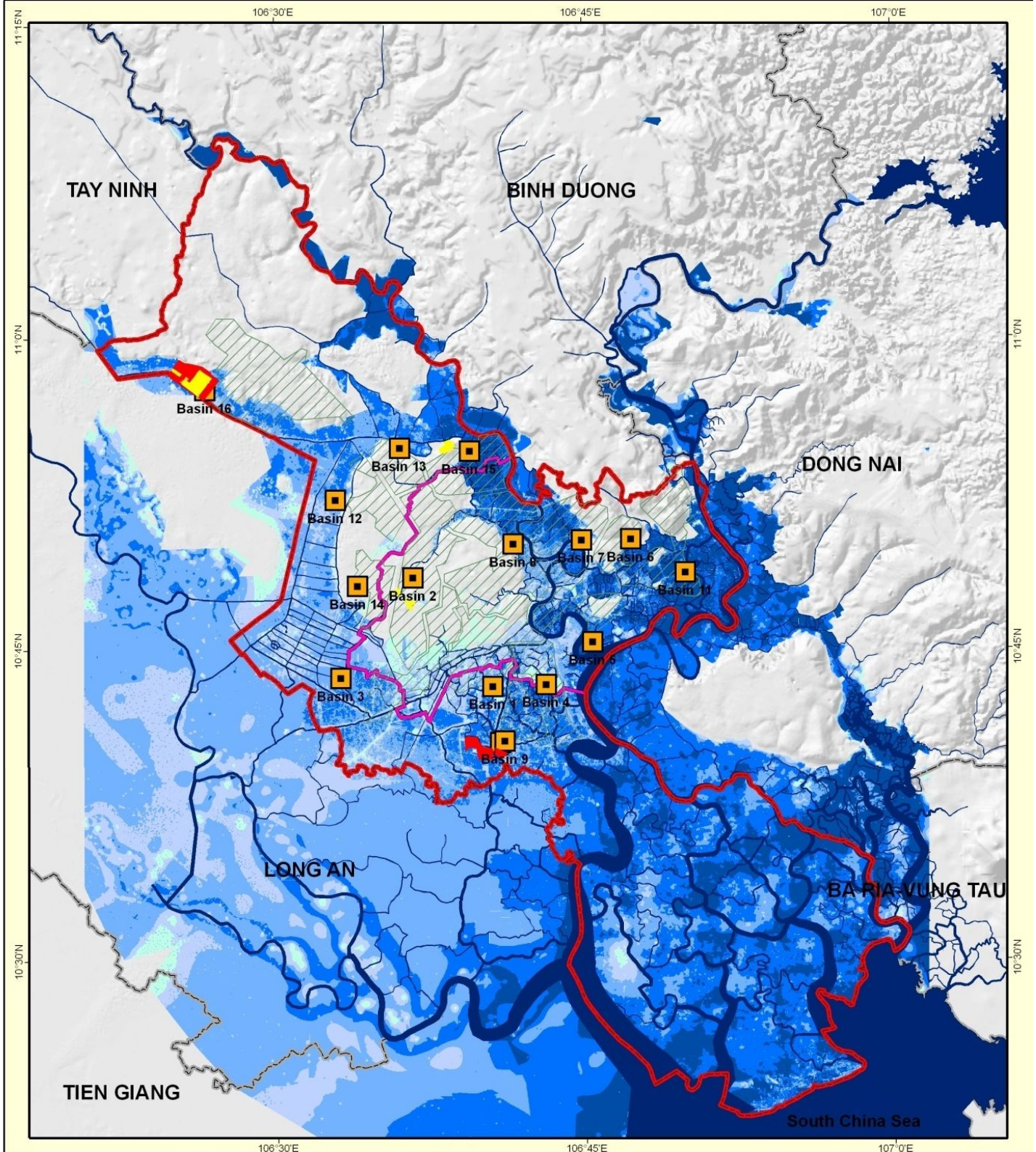
Water supply infrastructure - impact of 2050 flood



Water supply infrastructure - impact of 2050 drought and saline intrusion



Agriculture and 4ppt saline intrusion during 2050 regular flood without dykes



Water treatment infrastructure and land fill sites

Risk indicator
0 km: Inundated
<1 km: Very high risk
<5 km: High risk
<10km: Medium risk
>10km: Low risk

2050 Planned water treatment plants at risk with and without the dyke system

Waste water treatment plants	Area (ha)	Capacity (m3/day)	Distance from flood area(km)		
			Regular flood A2	Extreme flood A2	Extreme flood A2 with control flood system
Basin 1, THBNDT	50	512000	0	0	0
Basin 2, West HCMC	11	170000	0.0	1.9	1.9
Basin 3,THLG	73	260000	2.3	0.0	0.0
Basin 4, South HCMC	20	210000	0.0	0.0	0.0
Basin 5, East HCMC	35	350000	0.0	0.0	0.0
Basin 6 North HCMC II	6	54000	0.6	0.3	0.3
Basin 7 North HCMC I	15	151000	0.0	0.0	0.0
Basin 8, Go Vap and Binh Thanh	20	210000	0.0	0.0	0.0
Basin 9, NLTN	40	430000	0.3	0.0	0.0
Basin 10, Nha Be	5	45000	0.0	0.0	0.0
Basin 11, Tac river, dist 9	6	54000	0.0	0.0	0.0
Basin 12, Ba Diem, Nga Ba Dong	5	41000	1.7	0.0	0.0
Basin 13, canal Hoc Mon, dist Hoc Mon	5	41000	5.1	0.0	0.0
Basin 14, Binh Tan and Binh Chanh	5	43000	0.0	1.3	1.7
Basin 15, canal Cau Dua, dist Hoc Mon	10	82000	0.0	0.0	0.0
Basin 16, Cu Chi	10	81000	0.0	0.0	0.0

Some key potential risks

- The impact of 2050 extreme and regular climate and hydrodynamic conditions on infrastructure could be extensive and far reaching in its effects on the City's economy.
- The transport master plan is committed to (i) major ring road construction, (ii) arterial interprovincial and national roads, and (iii) new ports and rail/metro systems. By 2050, some 30-70% of these new systems are at risk of flooding.
- Close to 70% of the City's remaining agriculture are at risk of salinity concentrations $\geq$ 4ppt
- Some 50% of the City's surface and ground water treatment plants are at risk of flooding and salinity of concentrations of $\leq$ 1ppt.
- 60% of the City's waste water treatment plants and 90% of land fill sites are at risk of flooding

Adaptation options

The aim – to increase resilience in vulnerable communities, development sectors and areas

- Engineering options (eg dykes and drainage systems)
- Traditional local strategies
- Social responses (including resettlement and "autonomous" actions)
- Land use planning (eg zoning and development controls)
- Economic instruments (eg subsidies and tax incentives)
- Natural systems management (eg rehabilitation, enhancement)
- Sector specific adaptation practices (eg agriculture - species, regimes)

Definition of associated institutional and administrative innovations

Integration of adaptation options

1. Integration into overarching socio-economic and spatial and plans eg
   - Socio-economic plan (DPI)
   - Land use plan (DONRE)
   - Urban Master Plan (DUPA)
   - Construction plan (DOC)
2. Integration with sector development plans - Sector-wide adaptation policies and plans
3. Integration with Building Code and sector design standards and guidelines
4. Integrating through area specific adaptation guidelines and development controls

Guiding principles for HCMC adaptation

1. Build on experience in natural disaster response
2. Rehabilitate and maintain and natural flexibility and resilience in City design
3. Promote autonomous responses amongst communities and sectors
4. Maintain and enhance natural systems
5. Maintain and enhance biodiversity for greater stability and resilience
6. Keep rivers and canals free flowing and clean
7. Ensure the poor are not worse off with climate change
8. Locate strategic infrastructure away from vulnerable areas
9. Locate sensitive industrial and commercial functions away from vulnerable areas
10. Facilitate adaptation at every level of government

Four approaches to integrating adaptation in development

1. Adaptation auditing and retrofitting in existing and approved developments beginning with those in vulnerable areas
2. Integration of adaptation into future development planning for areas and sectors (requires guidance on adaptation options and hotspot profiling and assessments)
3. Assessing development plans and project proposals as they come through the planning pipeline against adaptation screening tools as part of Strategic Environmental Assessment and EIA
4. Monitoring and evaluation of implementation of adaptation measures and the opportunity and authority to require remedial and additional actions.

The example of water supply – engineering retrofitting

- All infrastructure is designed on current climate and sea level
- The key issues are flood levels and salinity intrusion
- Actions required on existing water supply infrastructure
  1. Raising dry and wet well walls
  2. Raising electricity control panels
  3. Raising access roads
  4. Raising reservoir walls
  5. Move intakes upstream
  6. Review and modify dykes systems in vicinity of infrastructure
- It is not “if” but when and by how much such retrofitting will be needed

Natural system adaptation

- The flood protection dyke system phases - an opportunity to learn and adapt (exploring natural system options)
- The rehabilitation and extension of mangroves as a first line of defense from seaward climate
- River and canal bank rehabilitation – the 40 m rule
- Reforestation and enhancement of City watersheds.
- The cleaning up of canals and rivers
- The protection and rehabilitation of urban wetlands.
- Promote different crops and trees for areas at risk of saline intrusion.

Actions required of HCMC PC

- reform the existing natural disaster management committee into a climate change adaptation and mitigation committee
- prepare a HCMC climate change adaptation plan
- establish a climate change adaptation and mitigation fund
- provide special budgetary allocation for adaptation over a five year period to support
  - key sectors to conduct audits of existing facilities

Actions required of DONRE

- prepare the land use plan as a key instrument for promoting and implementing adaptation
- apply adaptation screening guidance for the review of sector and spatial plans, and
- introduce screening and assessment tools to the SEA and EIA process as another force for integration of adaptation in development planning.

Actions required of sectors

- auditing existing infrastructure and development plans and orientations
- retrofitting adaptation measures in existing infrastructure,
- defining sector specific adaptation options
- reviewing and upgrading sector design standards (most prepared in the early 1990's)
- Integrating adaptation measures into strategies and plans for the next development period, and
- introducing a system of monitoring, auditing and reporting on sector adaptation performance.

Lessons from experience

- Adaptation needs to be placed in the context of development planning cycles
- Adaptation needs to be given a spatial planning context (eg local areas, provinces, catchments)
- Adaptation occurs at different levels – regional, national and, in particular, the local level
- Adaptation occurs in sectors, communities and areas
- Local experience should be linked with national policy-making
- There is rich past experience in adaption to natural disasters to draw from