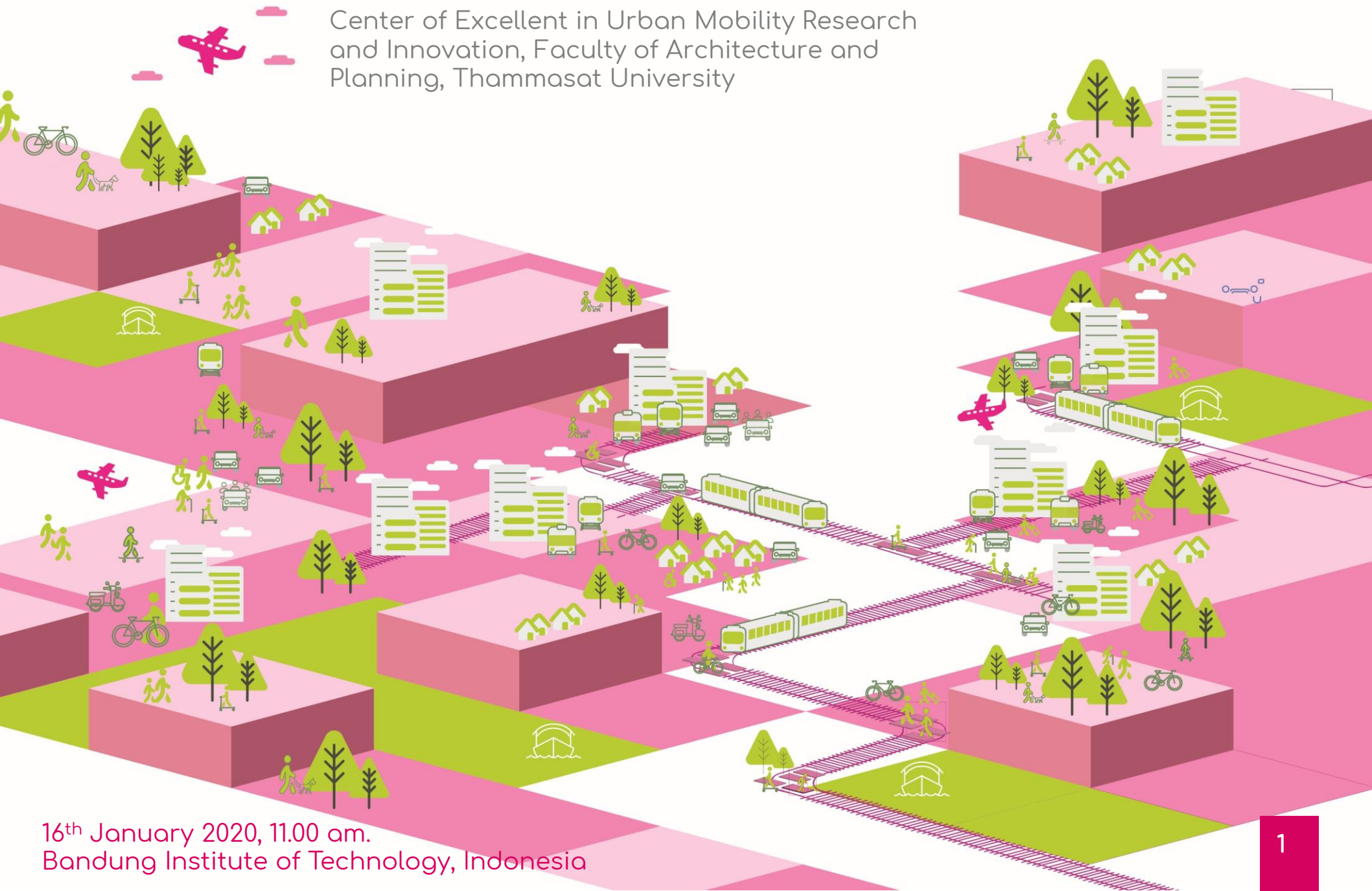


TOD and Its Sustainability



Associate Dr. Pawinee IAMTRAKUL
Center of Excellent in Urban Mobility Research
and Innovation, Faculty of Architecture and
Planning, Thammasat University

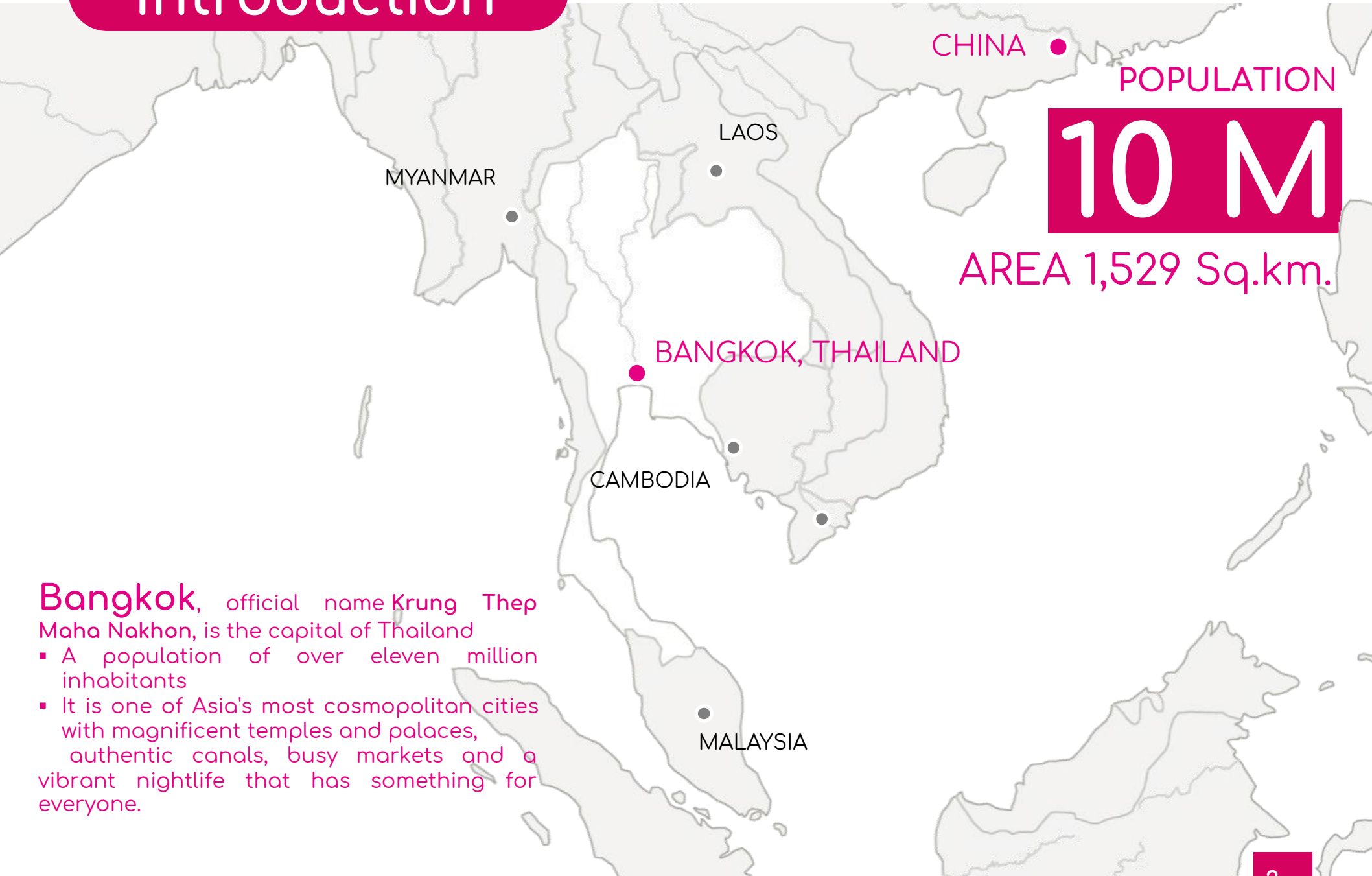


16th January 2020, 11.00 am.
Bandung Institute of Technology, Indonesia

Contents

- Development of Transportation System In Bangkok
 - Evolution & Identity
 - Transportation System In Bangkok
 - Land Use Development
 - Transportation Planning
 - Current Problems Situation
 - Megacities & Urban Problems
- Solutions for Better CONNECTIVITIES
 - TOD Solutions
 - TOD Solution to SDGs
 - TOD Solution: Approach
 - TOD Solution: How ?
 - Case Study: Klong “Lat Phrao”

Introduction



POPULATION
10 M

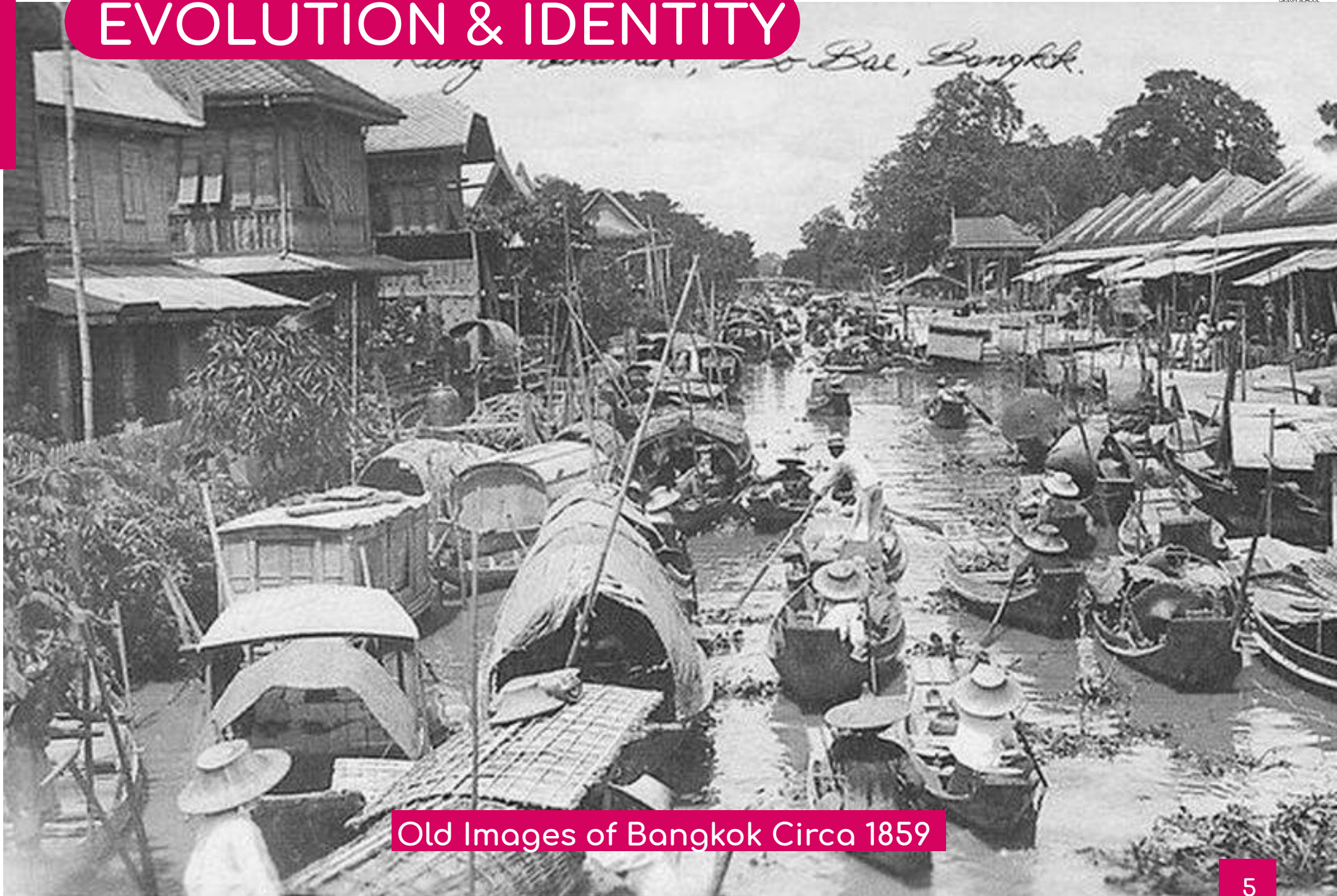
AREA 1,529 Sq.km.

Bangkok, official name Krung Thep Maha Nakhon, is the capital of Thailand

- A population of over eleven million inhabitants
- It is one of Asia's most cosmopolitan cities with magnificent temples and palaces, authentic canals, busy markets and a vibrant nightlife that has something for everyone.

The Past

EVOLUTION & IDENTITY

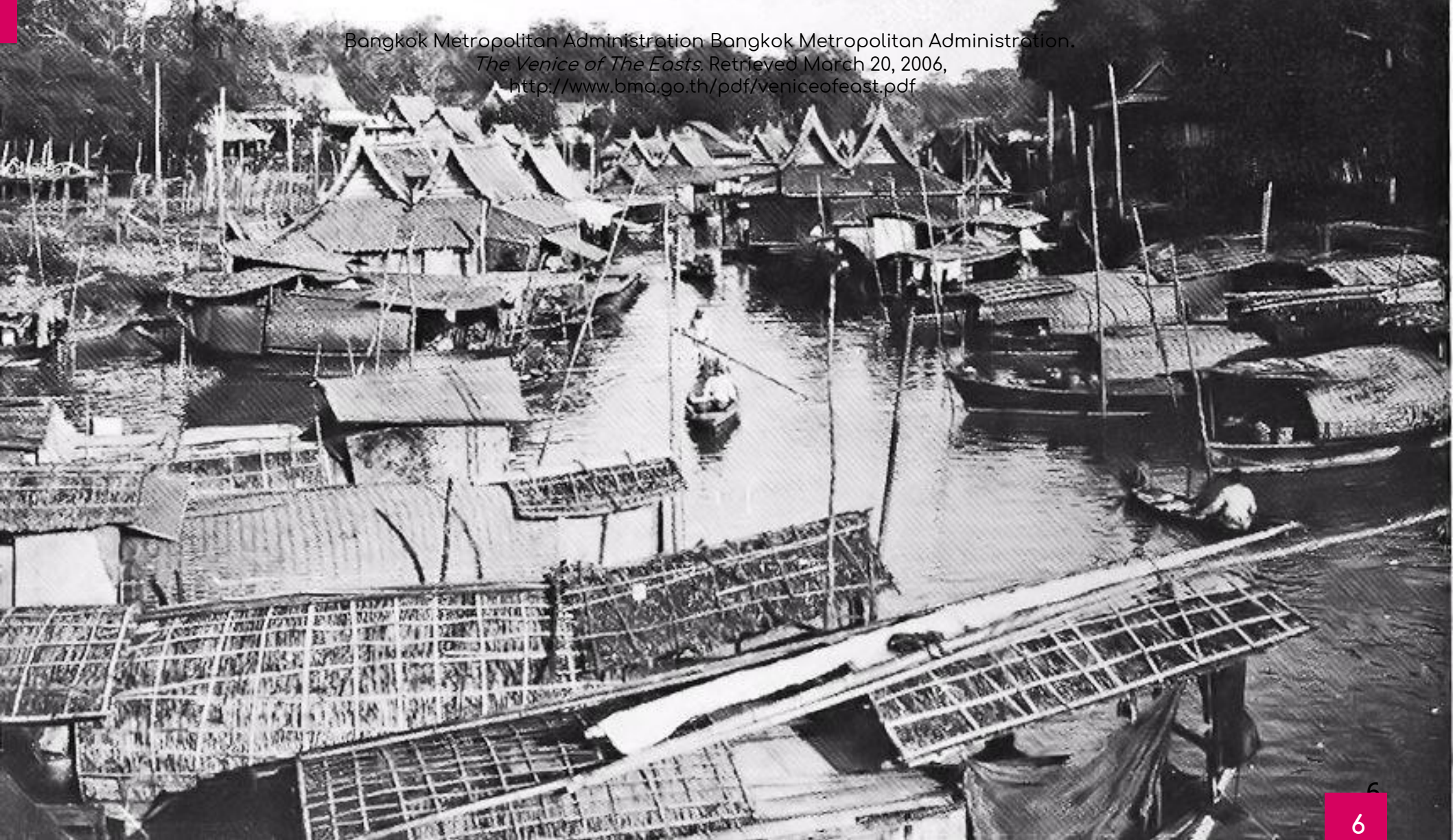


Old Images of Bangkok Circa 1859

EVOLUTION & IDENTITY

Floating Houses in Bangkok

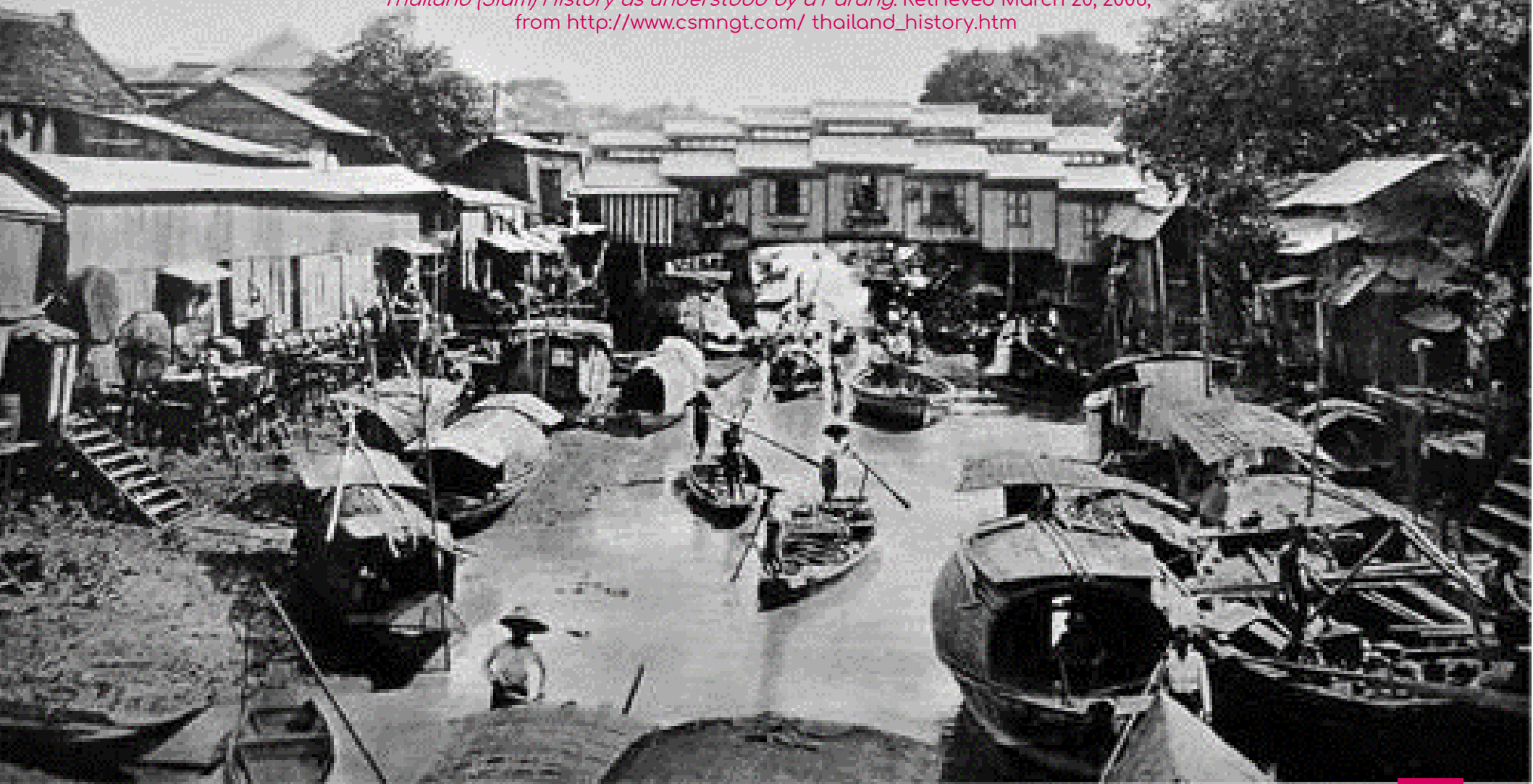
Bangkok Metropolitan Administration Bangkok Metropolitan Administration,
The Venice of The East. Retrieved March 20, 2006,
<http://www.bma.go.th/pdf/veniceofeast.pdf>



EVOLUTION & IDENTITY

Living Along the Watercourse in Bangkok

Thailand (Siam) History as understood by a Farang. Retrieved March 20, 2006,
from http://www.csmngt.com/thailand_history.htm



#VENICE OF THE EAST

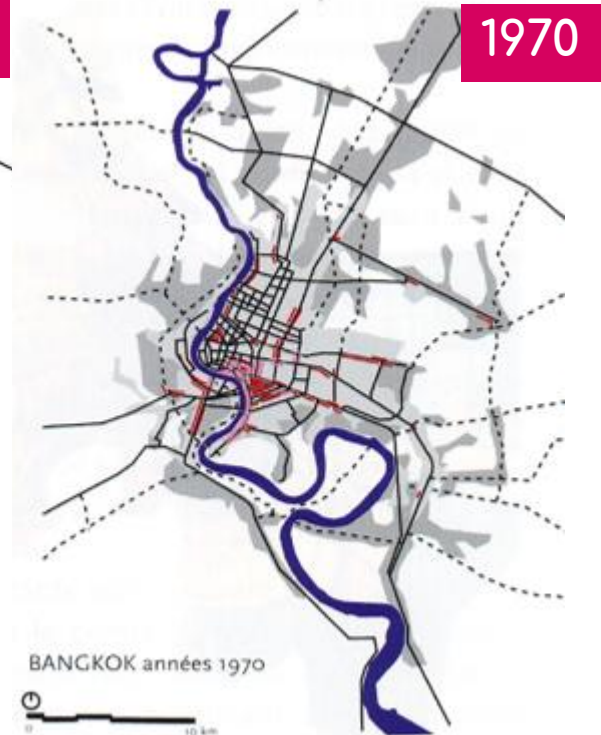
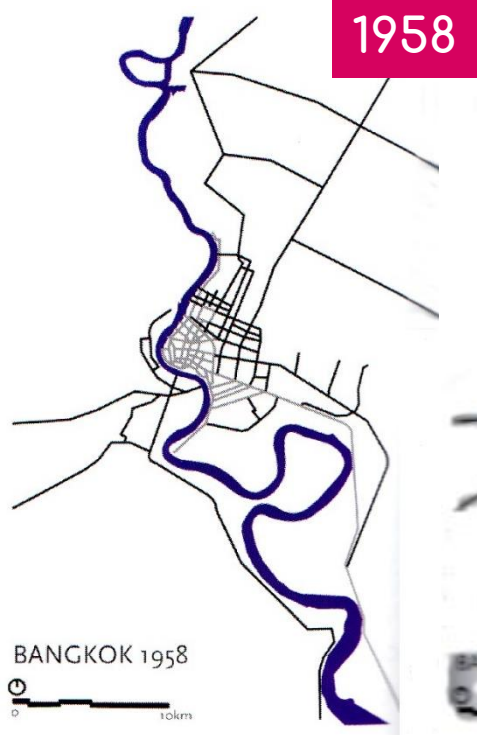
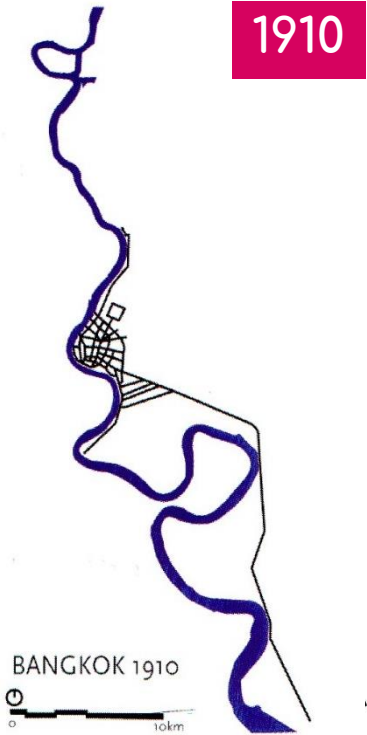


EVOLUTION & IDENTITY



The first creative district of THAILAND
Center of Economic, Culture and Social District.

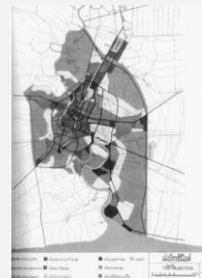
EVOLUTION & IDENTITY



1941: The 2nd world war
1952, The national government approves a City and Town Planning act



1962: The automobile industry was established as part of the government's import substitution policy

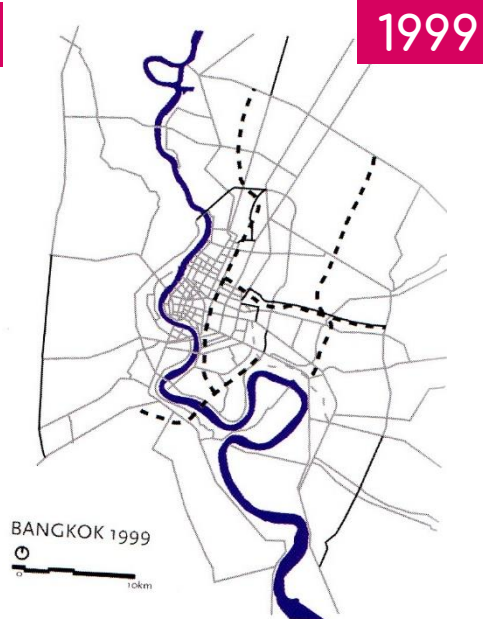
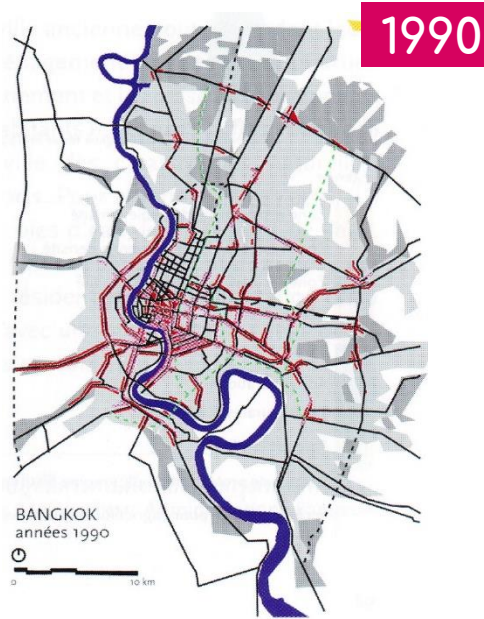
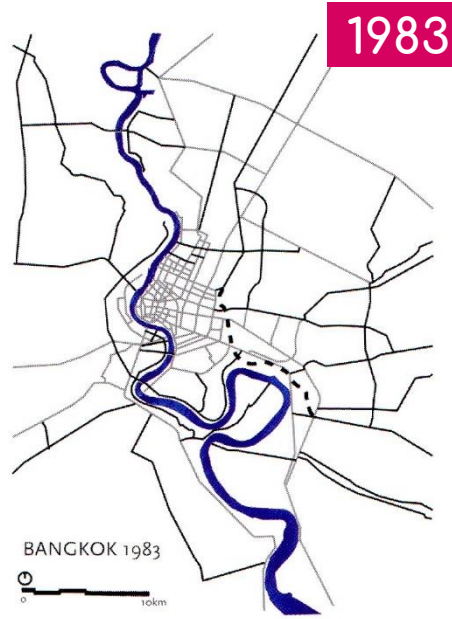
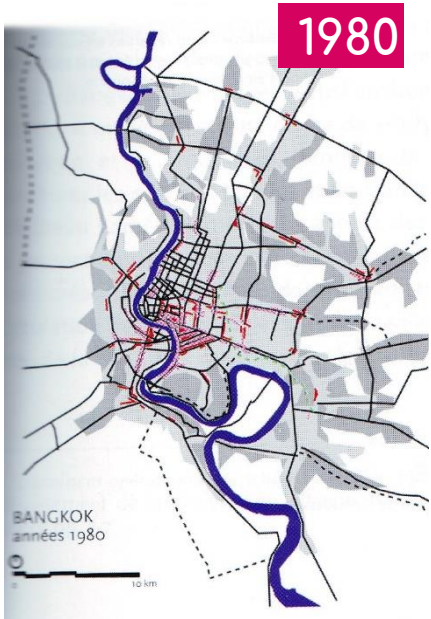


1960: Thai government who hired Litchfield Whiting Bowne & Associates from the United States to carry out the Greater Bangkok Plan 2533, "Litchfield Plan"



1972: The expressway and rapid transit authority (ERTA) was established The Lavalin project was propose for the 3 electric mass transit system

EVOLUTION & IDENTITY



1967: The 2nd National Economic Development Plan continually emphasized the development of infrastructure (1967-1971) /3/4



1977: The 1st Bangkok Metropolis Development Plan (1977-1981)
1981: The 1st stage of the city' expressway system was constructed, completed in 1987 of 27.1 km.



1992: Hopewell elevated railway project run by private company developed mass transit project and it was commenced and constructed



1999: BTS (1st private mass transit concession) was operated for green line 23.5km.

EVOLUTION & IDENTITY

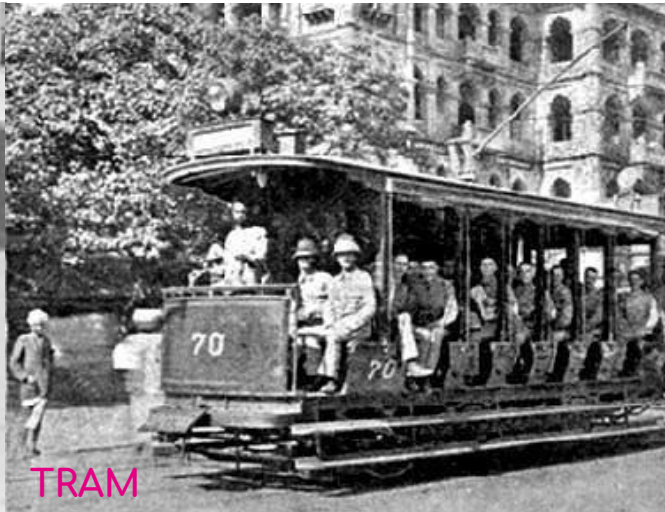
ROAD-BASED TRANSPORT SYSTEM

1864



CARRIAGE

1887



TRAM

1907



BUS

1933



ROD SAM LOR

1968



TRAM

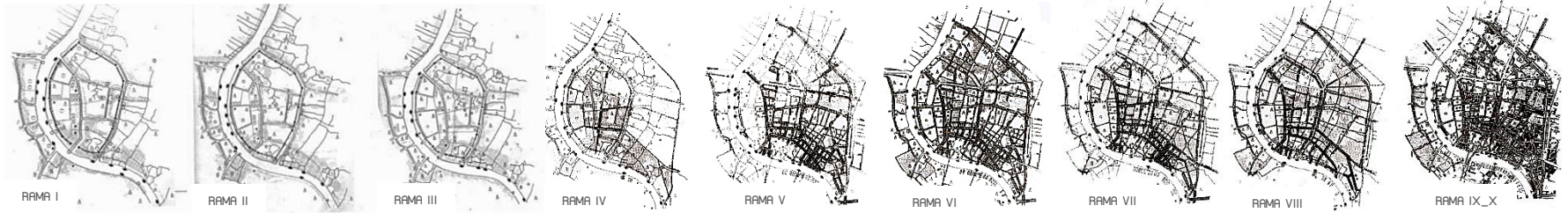
1975



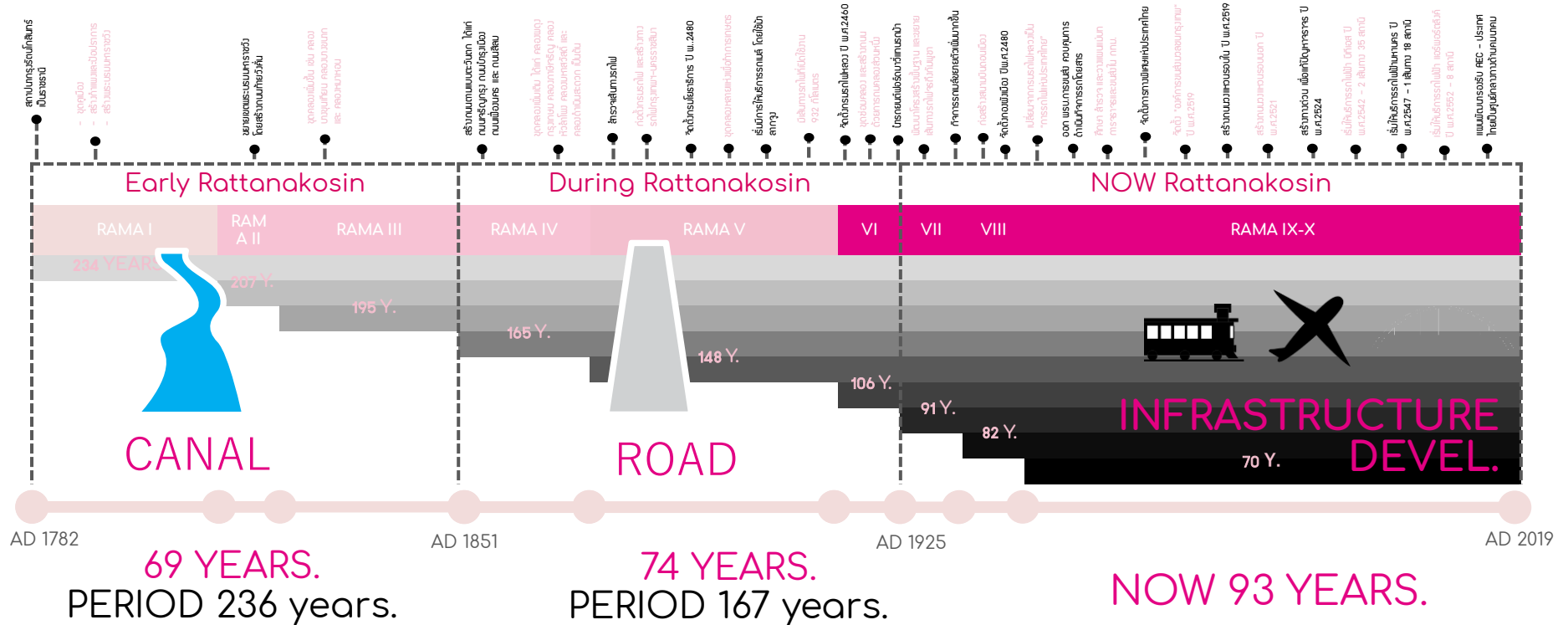
BUS

Transportation System in Bangkok 1910-2020

1782 1809 1824 1851 1868 1910 1925 1910 1934 1946 2020



From : Physical Features of Rattanakosin, 1985



Culture



Charming



Charming



©artography1976/Shutterstock

Attraction



The
Past

&

Present

The Rich of Culture, Charming, Attractions

CITY OF ROYAL PALACES



© Travel mania/shutterstock

BEAUTIFUL NIGHTLIFE



SEAT OF THE KING



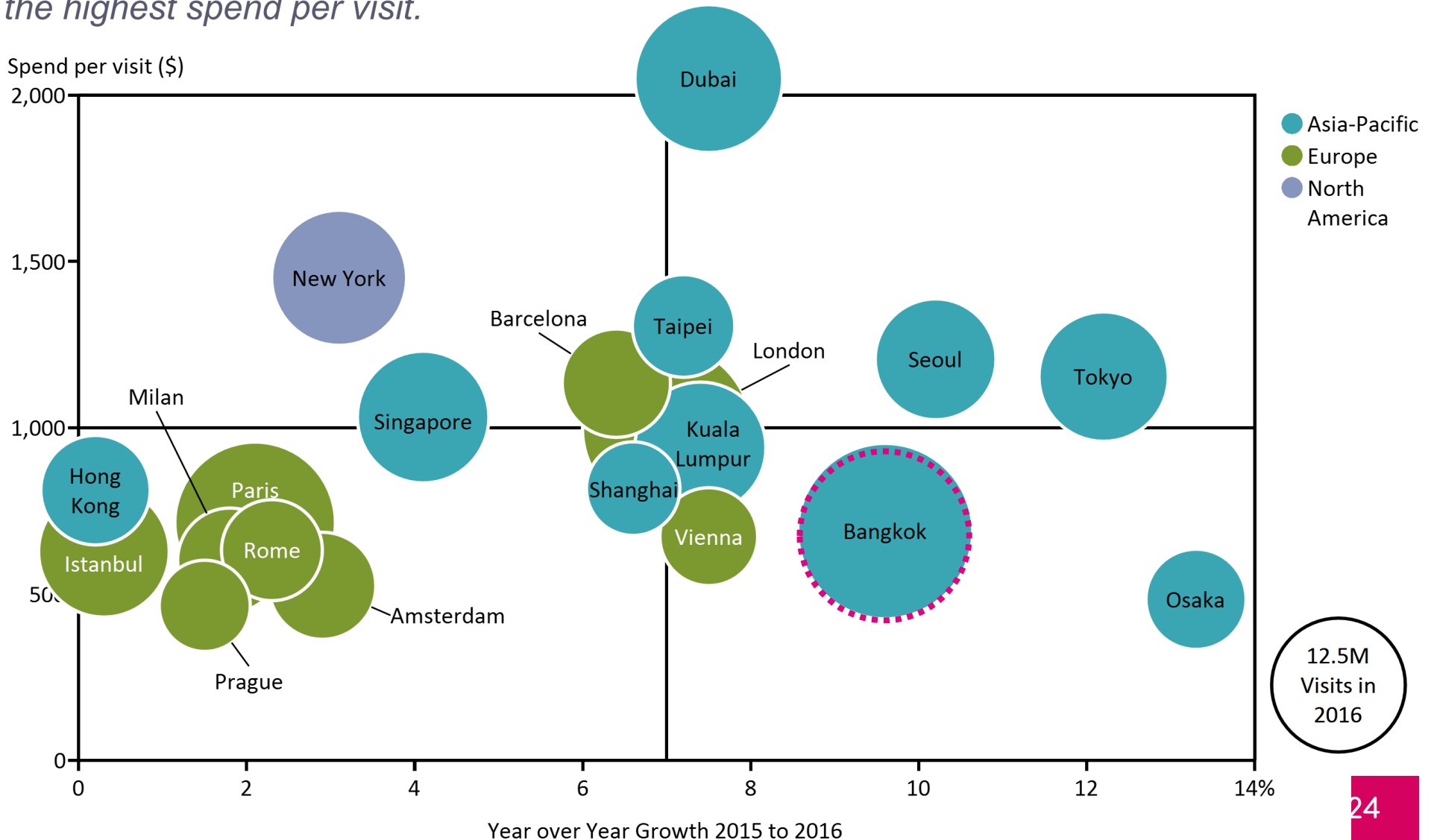
THE KING OF STREET FOOD



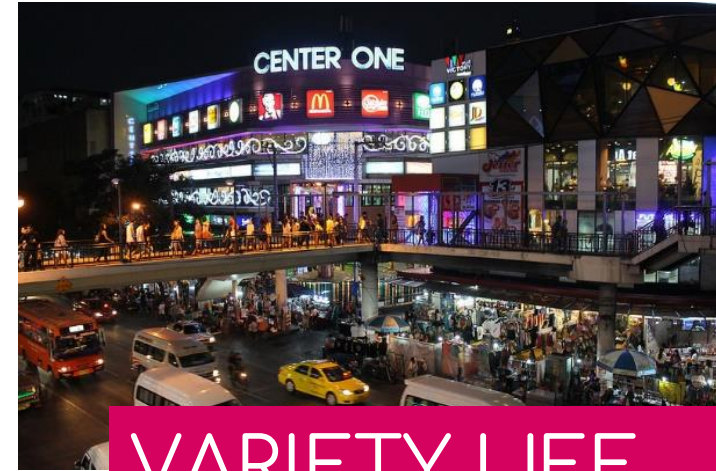
NODE&ATTRACTION

Global Top 20 Travel Destination Cities

Asian cities experienced higher growth than European ones. Dubai and New York had the highest spend per visit.



NODEs & ATTRACTIONS



VARIETY LIFE



Megacities &

Urban

Problems

Current Problems Situation

Bangkok

Influence of Primate City

Primate City is a city which is greater than two times the next largest city in a nation (or contains over one-third of a nation's population) — (Mark Jefferson), 1939

AVERAGE INCOME IN BANGKOK IS

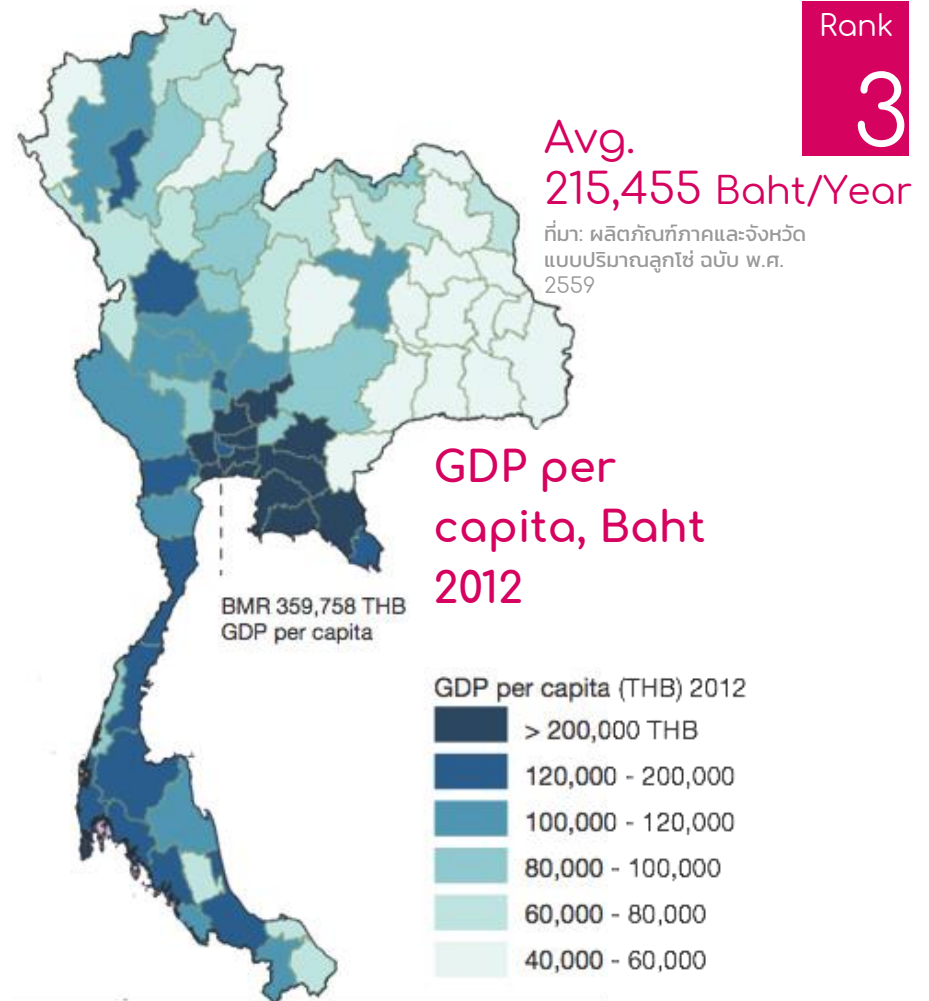
2 times

AS MUCH AS THE REST OF THAILAND

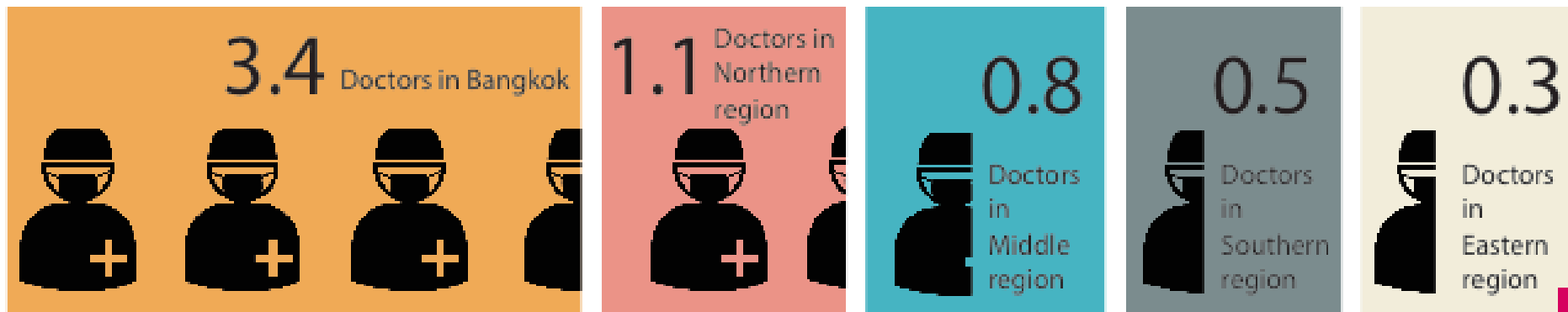
more than

3 times

HIGHER RATIO OF DOCTORS/PATIENTS



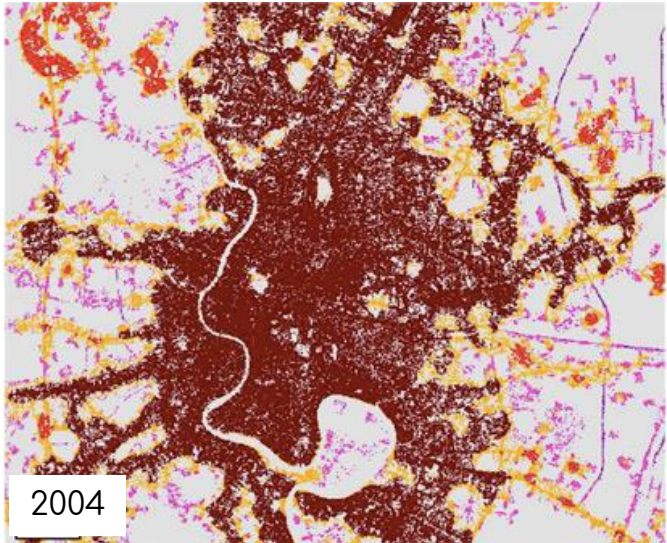
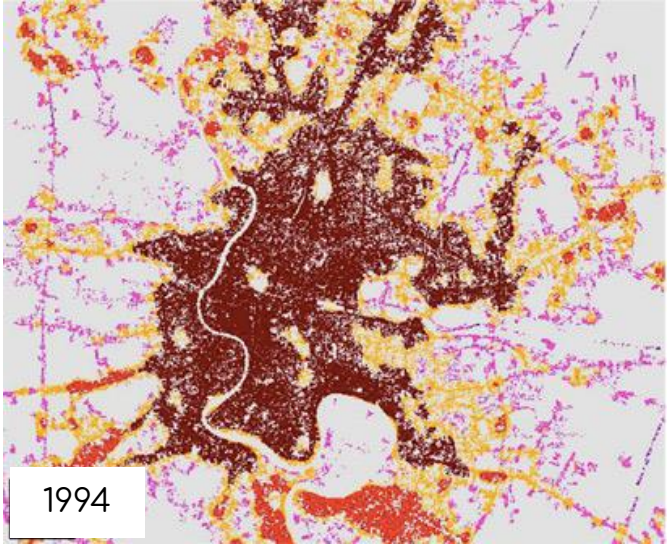
Ratio of 1 doctors per 1,000 patients in Thailand, 2016



(GIS Health, 2016)

URBAN SPRAWL

Mono centric and Development along Transportation Networks



- OLD TOWN
- SUN URBAN
- CONNECTED URBAN
- ROAD NETWORK DEVELOPMENT
- URBAN SPRAWL

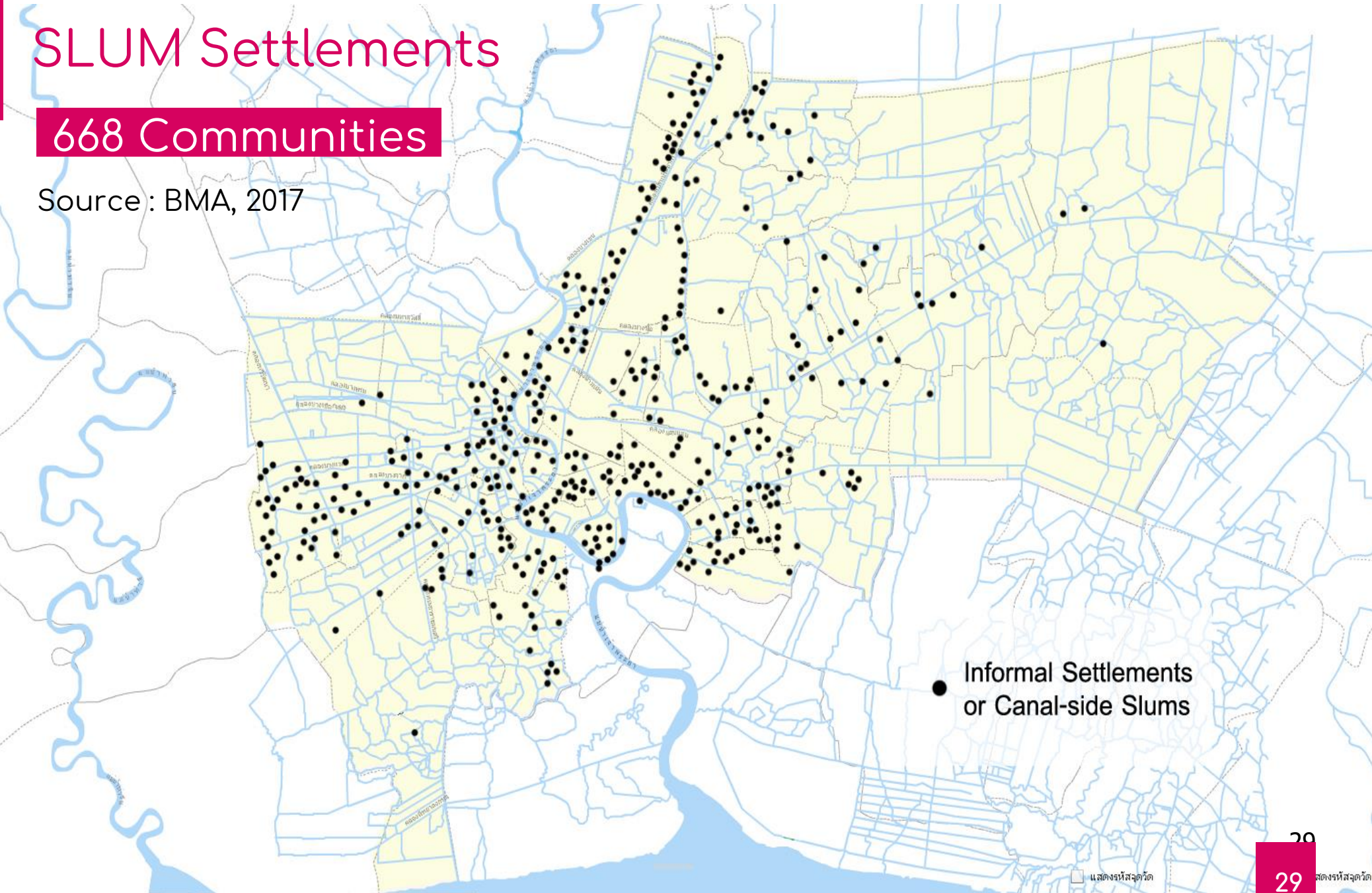


URBAN SPRAWL

SLUM Settlements

668 Communities

Source: BMA, 2017



Current Problems Situation

Urban Sprawl



SLUM Settlements

Current Problems Situation

Traffic Congestion



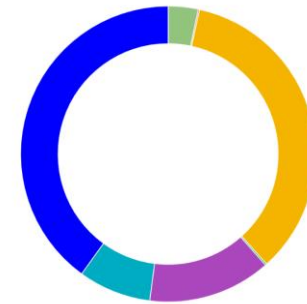
Average Travel Speed

15 km./hr.

TOMTOM, 2019
WHO, 2018
Global Wealth Report, 2016
Airvisaul.com, September 2019
Pollution Control Department, 2018
The government of Macau, 2019

Current Problems Situation

ENERGY CONSUMPTION



- Agriculture
- ore mine
- Industry
- Construction
- Residential
- Retail
- transportation

Transport Energy Consumption

40% of total energy consumption in Thailand

TOMTOM, 2019
WHO, 2018
Global Wealth Report , 2016
Airvisaul.com, September 2019
Pollution Control Department, 2018
The government of Macau , 2019

Current Problems Situation

Road Accident



3 people die every hour.

66 people fatal everyday from road accidents in Thailand

TOMTOM, 2019
WHO, 2018
Global Wealth Report , 2016
Airvisaul.com, September 2019
Pollution Control Department, 2018
The government of Macau , 2019

Current Problems Situation

Pollution & Health



Asthma rate reaches

15-20%

from 5% in 1980
PM 2.5 is 165 mg.
In 2019

TOMTOM, 2019
WHO, 2018
Global Wealth Report , 2016
Airvisaul.com, September 2019
Pollution Control Department, 2018
The government of Macau , 2019

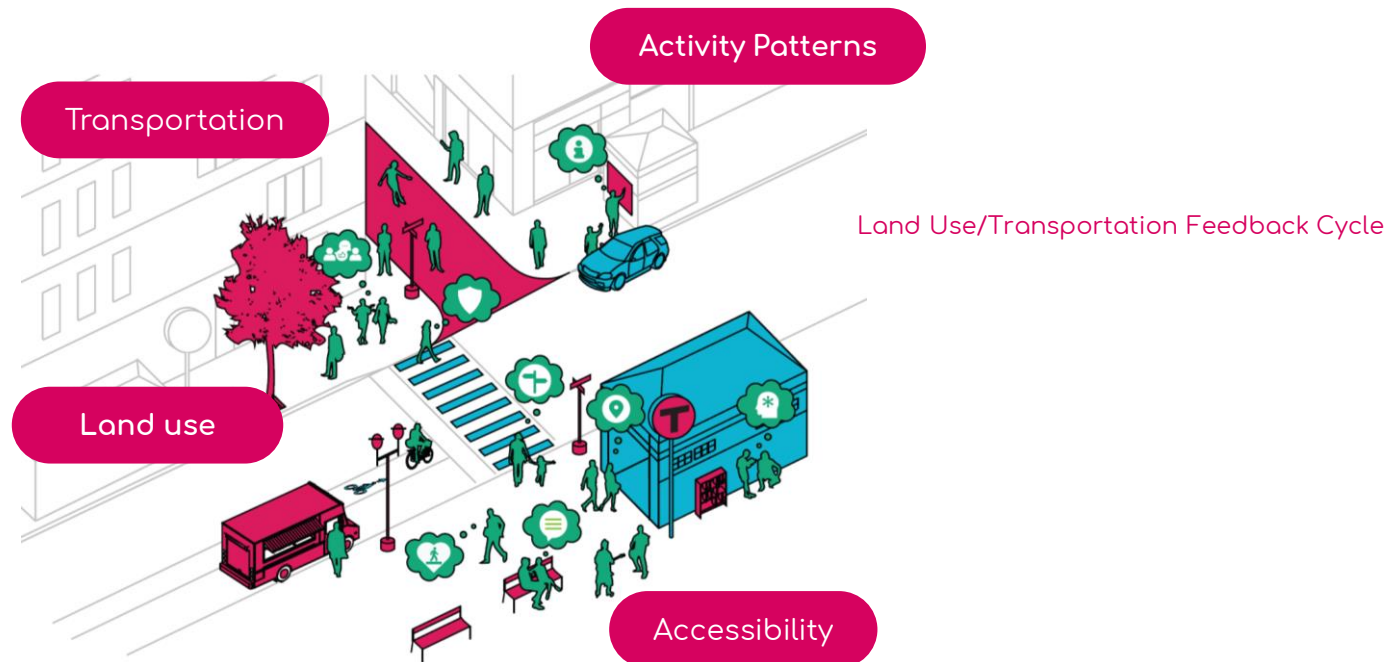
SOLUTIONs for Better CONNECTIVITIES

TOD SOLUTIONS

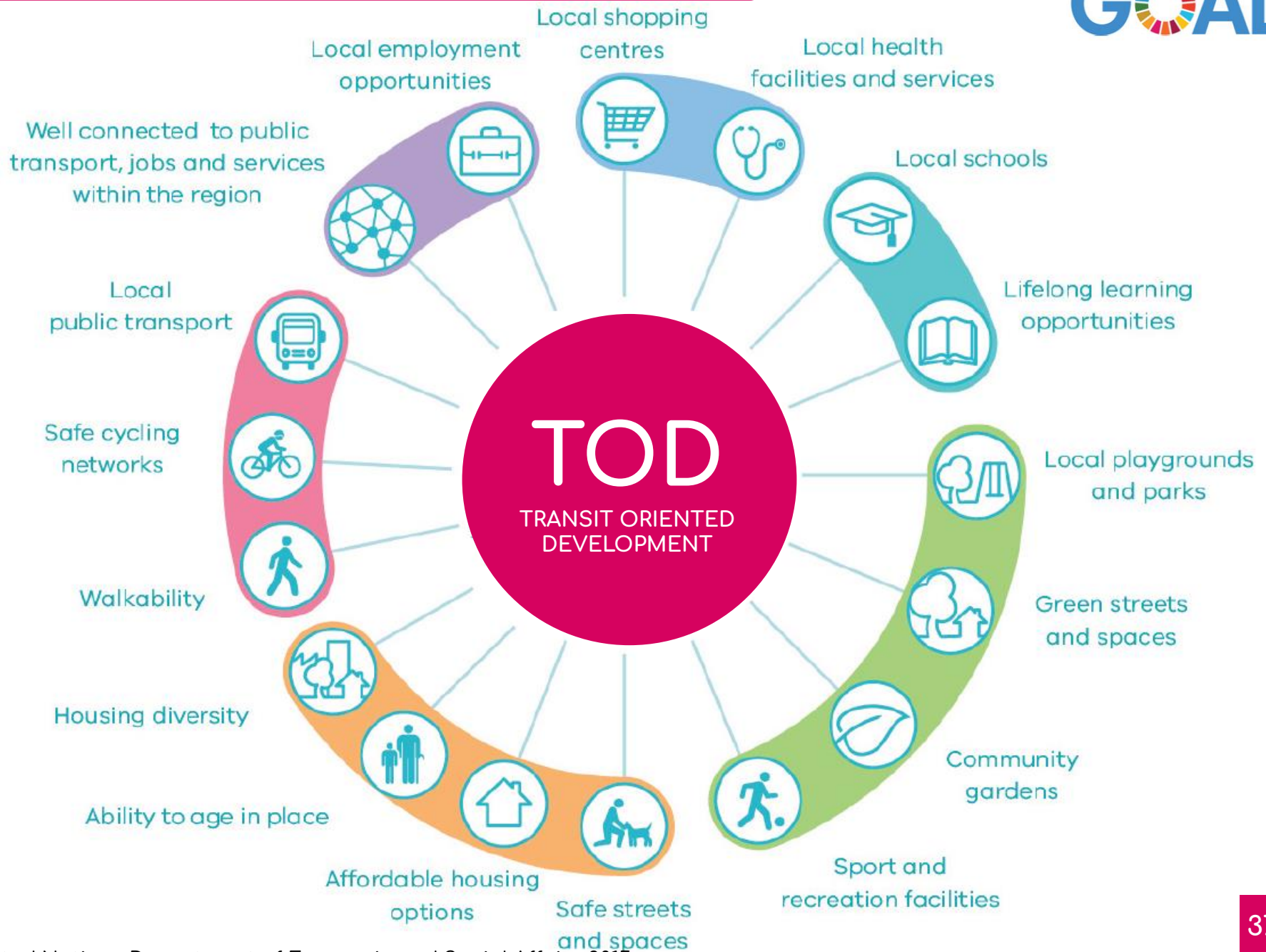
Transit, or public transport, oriented development (TOD)

puts public transport front and centre, with the aim to maximise access by public transport, encourage walking and cycling, and minimise the need to own and use private cars.

C40 Cities describe TOD as “an urban planning principle that promotes high-density, mixed use development integrated with a robust public transport system”.



TOD SOLUTION TO SDGs



TOD SOLUTION TO SDGs

SUSTAINABLE DEVELOPMENT GOALS



11 SUSTAINABLE CITIES AND COMMUNITIES



TOD SOLUTION TO SDGs



Sustainable cities and communities

Challenges

The **RAPID** and often **UNPLANNED URBANIZATION** witnessed worldwide has led to **INCREASED PRESSURE ON THE ENVIRONMENT**



Solutions

PROMOTE SOUND URBAN PLANNING, sustainable building, low-carbon transports, green spaces and sustainable lifestyles



Our cities account for up to **80% OF ENERGY CONSUMPTION** as well as **75% OF GLOBAL WASTE AND CARBON EMISSIONS**



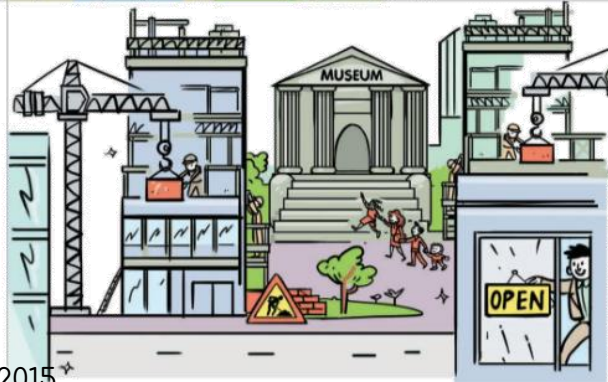
INVEST IN RENEWABLE ENERGY, waste management, sustainable and green infrastructure



Due to the high concentration of people, infrastructure, housing and economic activities, **CITIES ARE PARTICULARLY VULNERABLE** to climate change and natural disasters



PROTECT CITIES - which are important social, cultural and economic centres - from environmental and climate threats



Source: United Nations Department of Economic and Social Affairs 2015

TOD SOLUTION TO SDGs



SOCIAL

<p>TARGET 11-1</p> <p>SAFE AND AFFORDABLE HOUSING</p>	<p>TARGET 11-2</p> <p>AFFORDABLE AND SUSTAINABLE TRANSPORT SYSTEMS</p>
<p>TARGET 11-3</p> <p>INCLUSIVE AND SUSTAINABLE URBANIZATION</p>	<p>TARGET 11-7</p> <p>PROVIDE ACCESS TO SAFE AND INCLUSIVE GREEN AND PUBLIC SPACES</p>

ECONOMIC

<p>TARGET 11-C</p> <p>SUPPORT LEAST DEVELOPED COUNTRIES IN SUSTAINABLE AND RESILIENT BUILDING</p>	<p>TARGET 11-B</p> <p>IMPLEMENT POLICIES FOR INCLUSION, RESOURCE EFFICIENCY AND DISASTER RISK REDUCTION</p>
<p>TARGET 11-A</p> <p>STRONG NATIONAL AND REGIONAL DEVELOPMENT PLANNING</p>	

ENVIRONMENT

<p>TARGET 11-6</p> <p>REDUCE THE ENVIRONMENTAL IMPACT OF CITIES</p>	<p>TARGET 11-4</p> <p>PROTECT THE WORLD'S CULTURAL AND NATURAL HERITAGE</p>
<p>TARGET 11-5</p> <p>REDUCE THE ADVERSE EFFECTS OF NATURAL DISASTERS</p>	

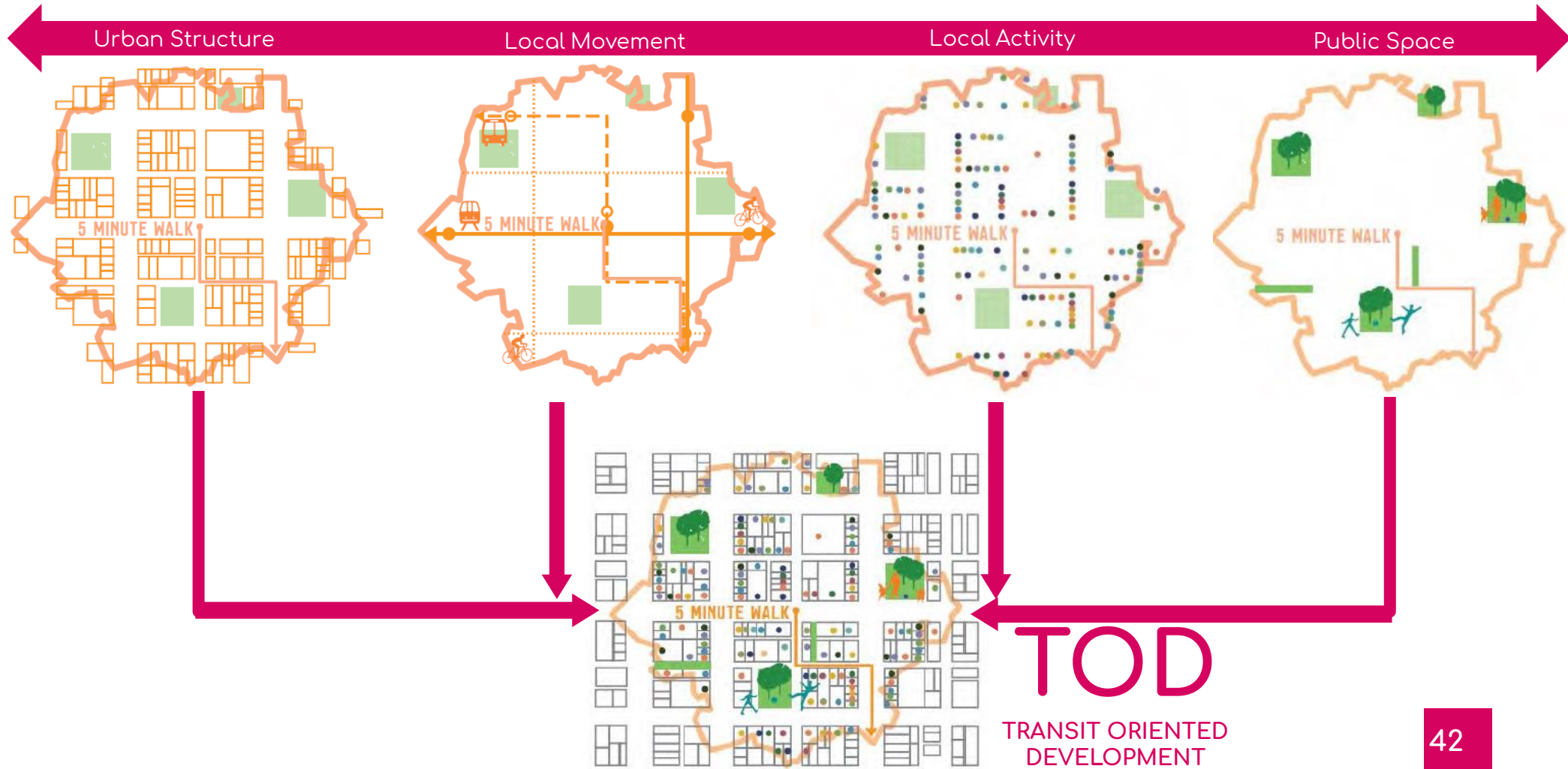
TOD SOLUTION TO SDGs



SOCIAL

ECONOMIC

ENVIRONMENT

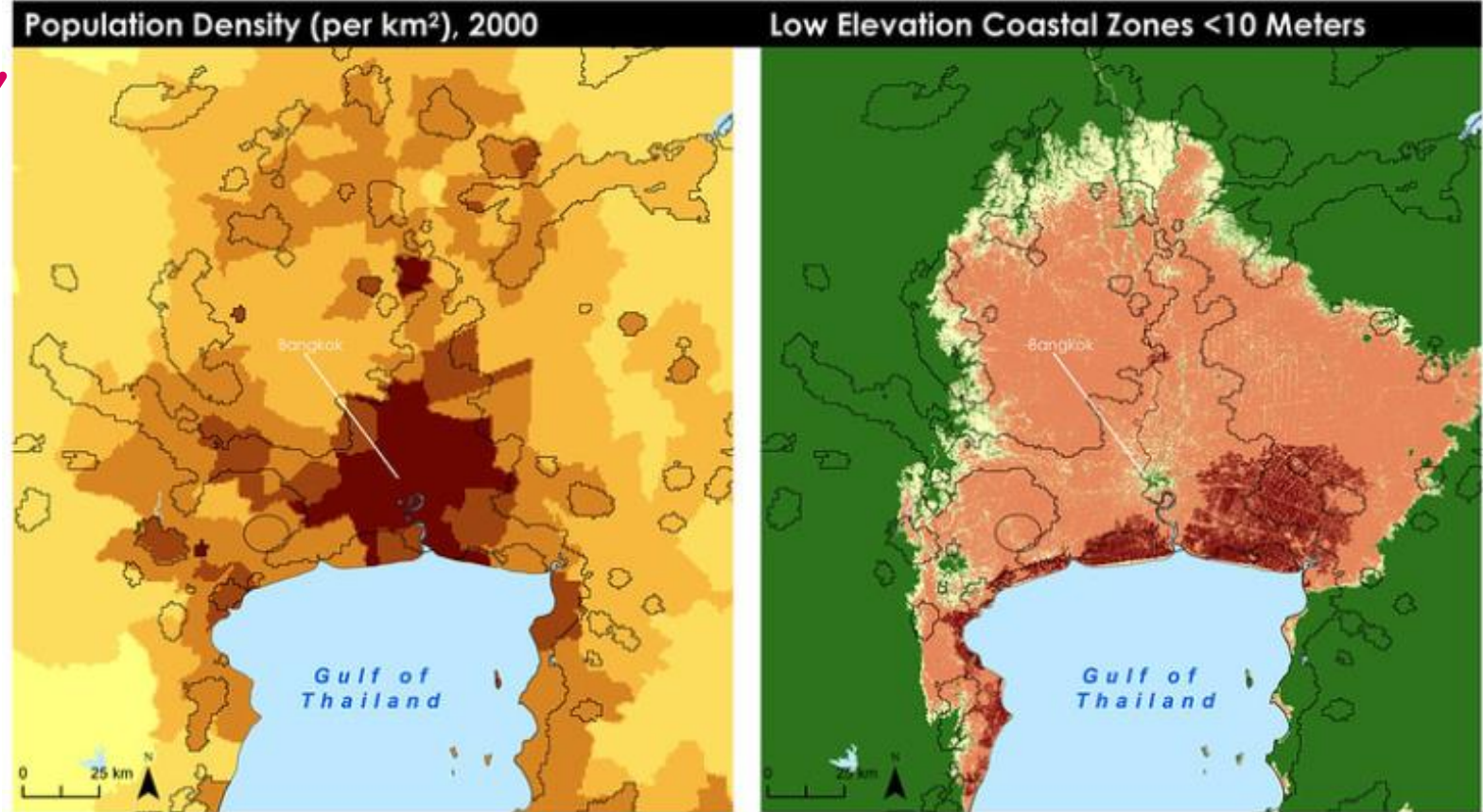


TOD SOLUTION: APPROACH : 6Ds

DENSITY

indicator such as dwellings, households, people and jobs. The main premise of high density development

THAILAND POPULATION DENSITY AND LOW ELEVATION COASTAL ZONES



Lambert Azimuthal Equal Area Projection



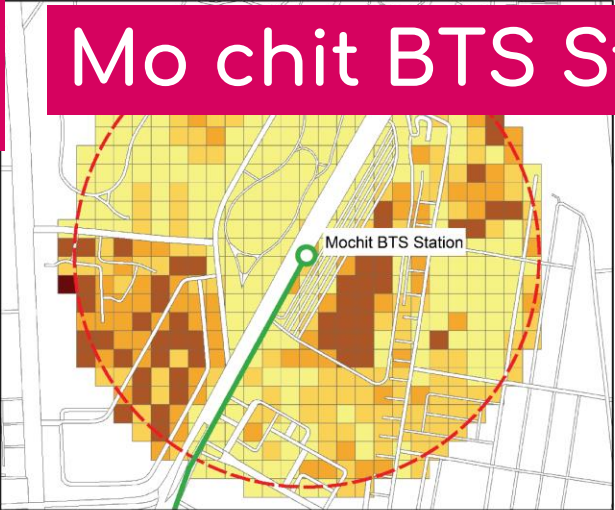
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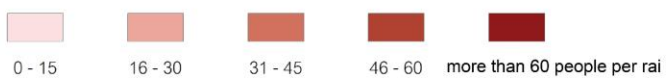
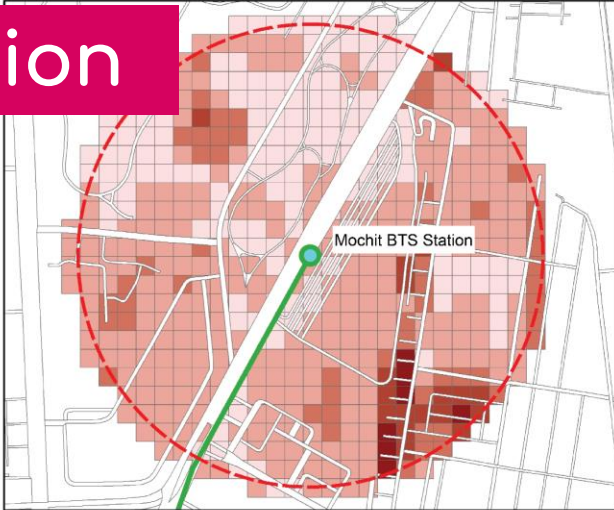
Copyright 2009, The Trustees of Columbia University in the City of New York. Source: Center for International Earth Science Information Network (CIESIN). Low Elevation Coastal Zone. <http://sedac.ciesin.columbia.edu/gpw/ecz.jsp>

TOD SOLUTION: APPROACH : 6Ds

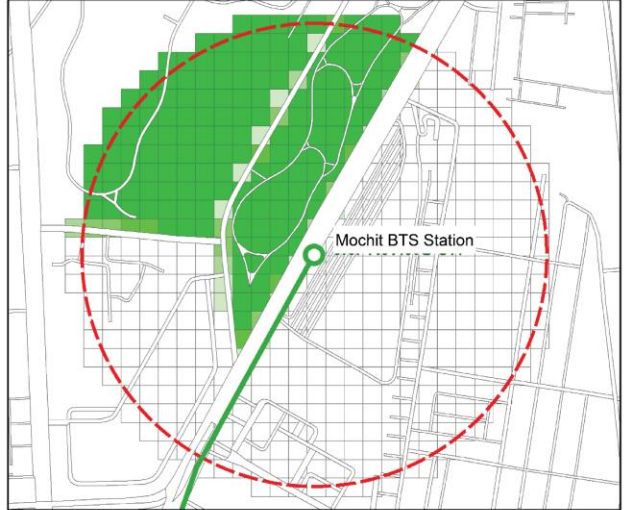
Mochit BTS Station



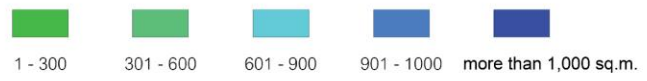
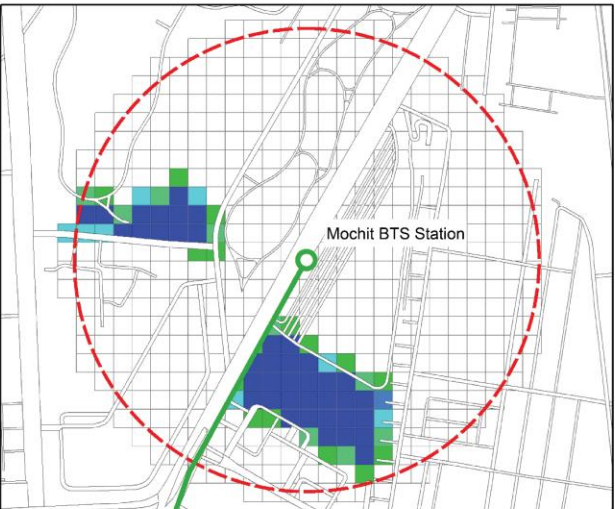
A. Building Density



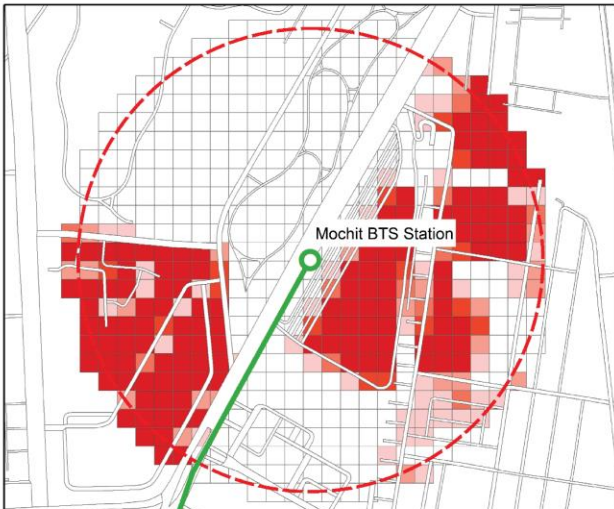
B. Population Density



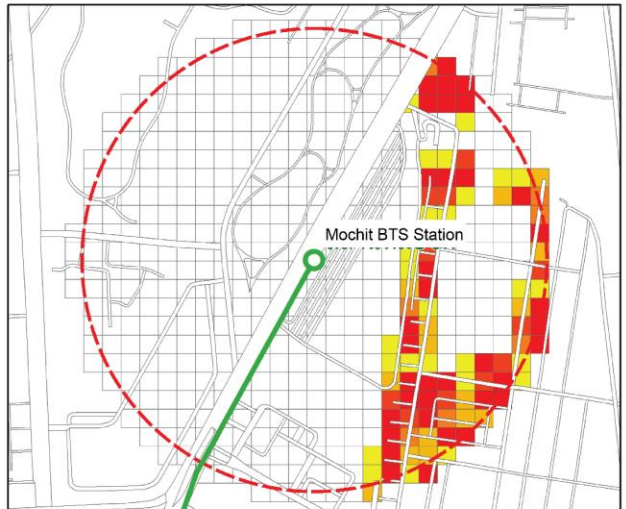
C. Recreation Space



D. Facility and Utility Space



E. Commercial Space



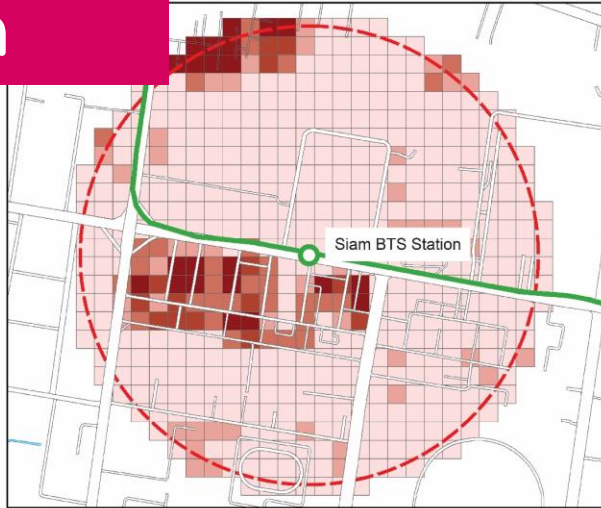
F. Residential Space

TOD SOLUTION: APPROACH : 6Ds

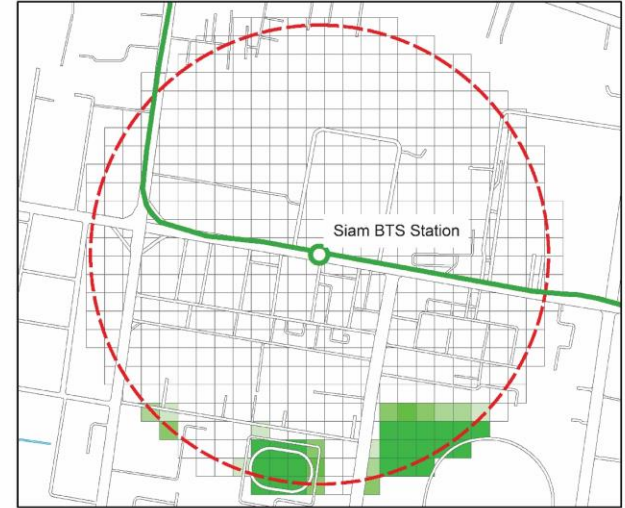
Siam BTS Station



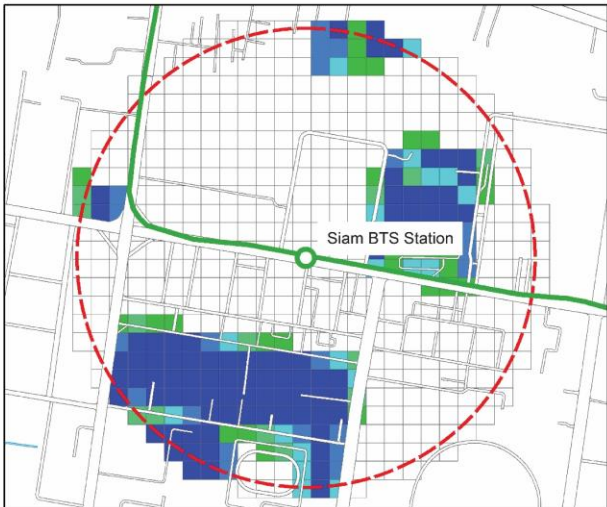
A. Building Density



B. Population Density



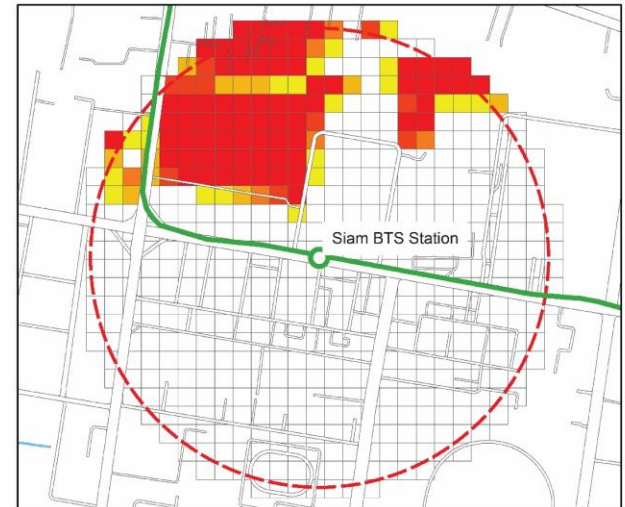
C. Recreation Space



D. Facility and Utility Space



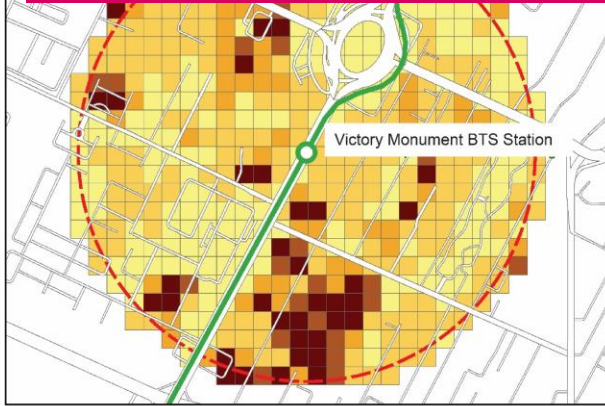
E. Commercial Space



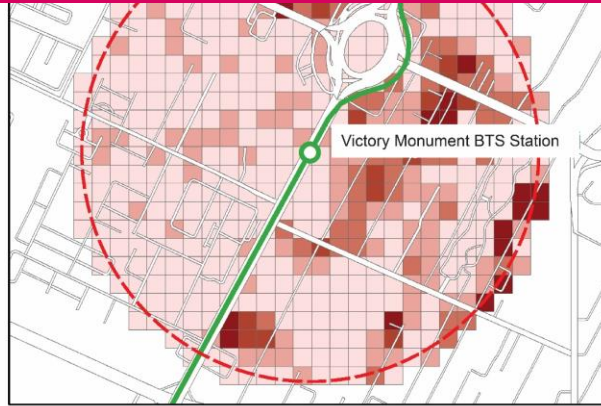
F. Residential Space

TOD SOLUTION: APPROACH : 6Ds

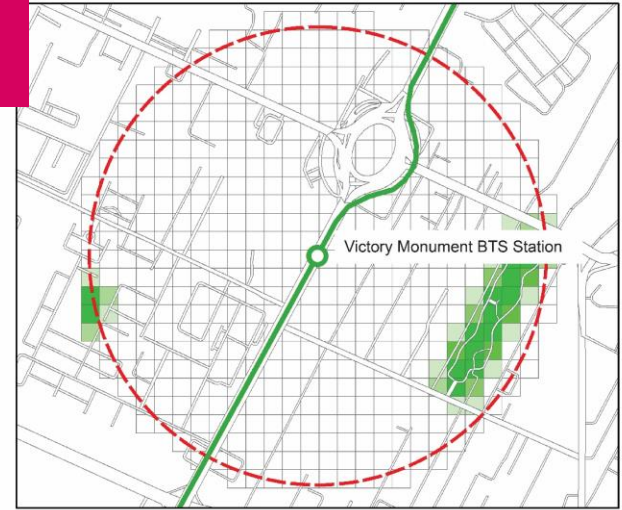
Victory Monument BTS Station



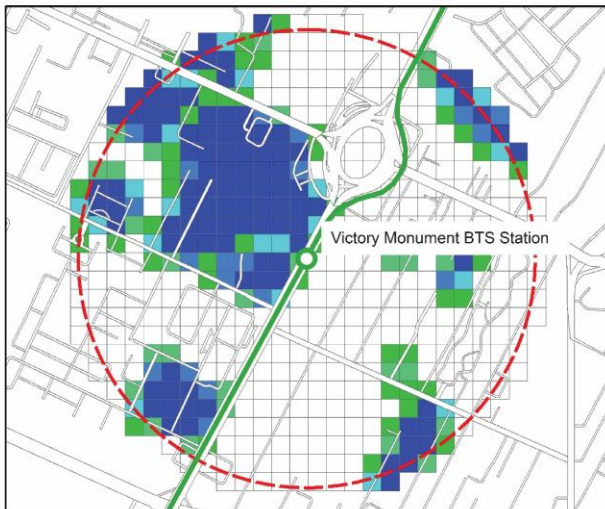
A. Building Density



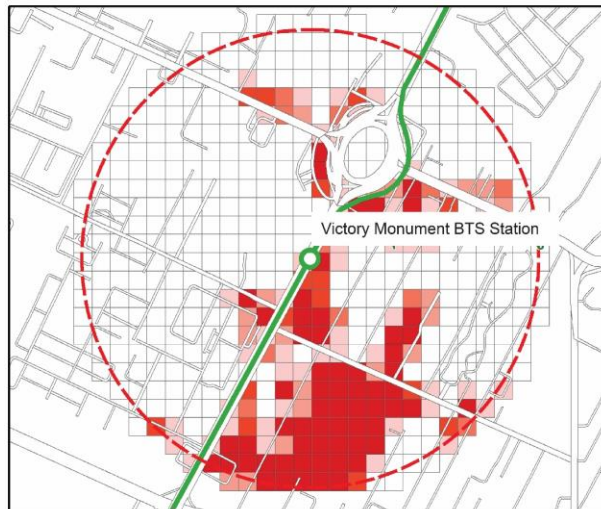
B. Population Density



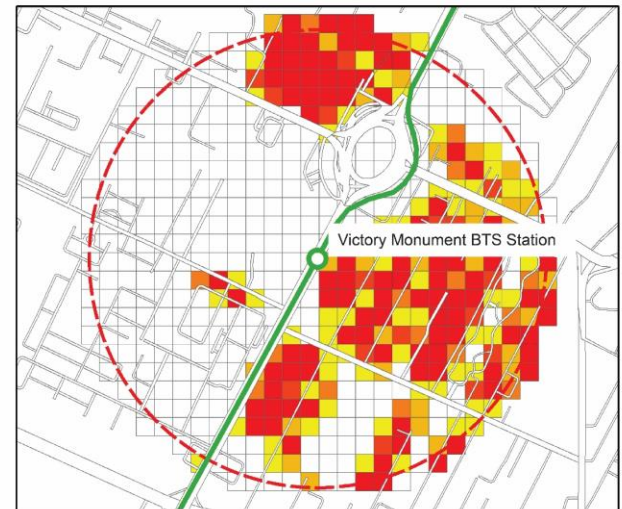
C. Recreation Space



D. Facility and Utility Space



E. Commercial Space

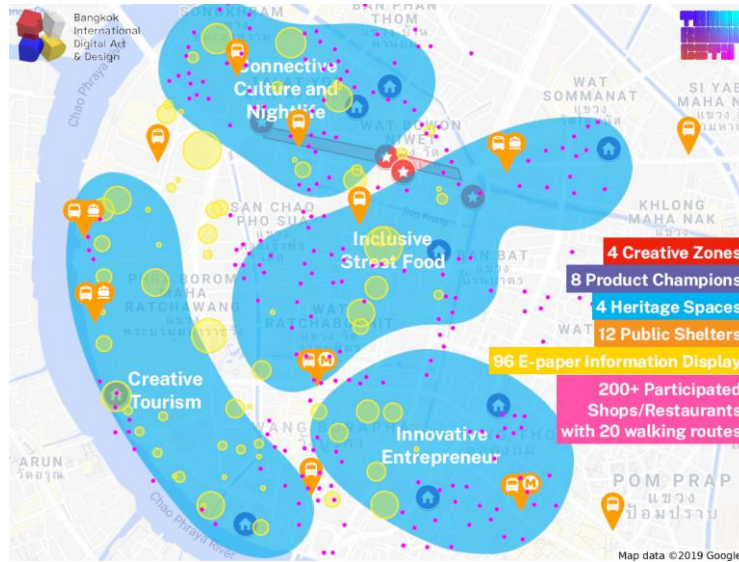


F. Residential Space

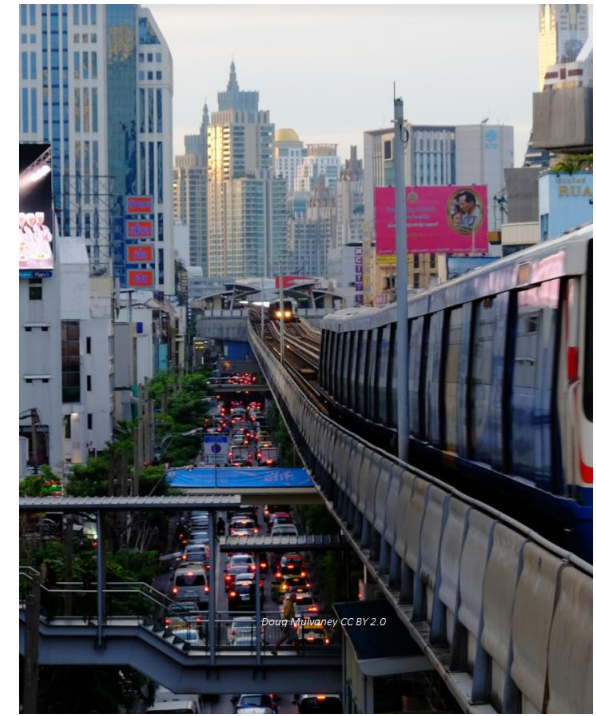
TOD SOLUTION: APPROACH : 6Ds

DESIGN

carefully articulated land-use mixtures; safe and smooth accessibility to transit stations



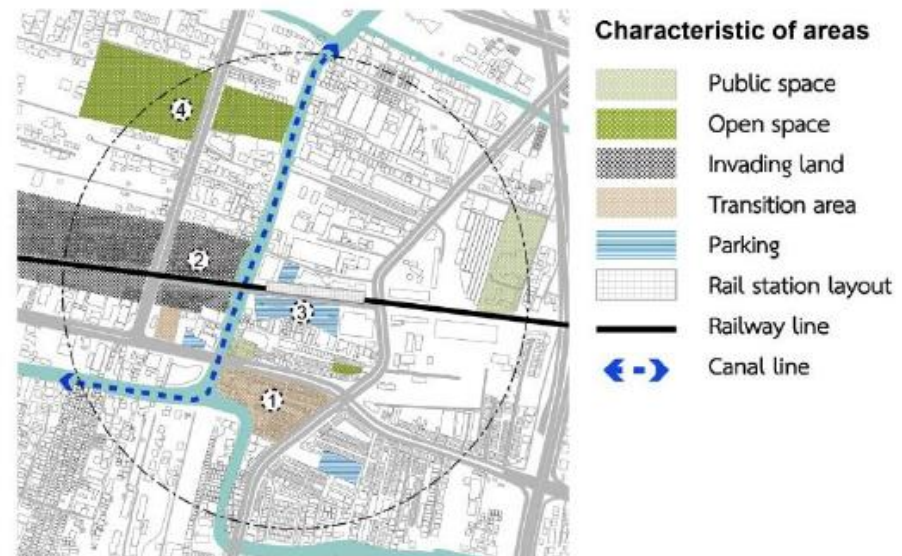
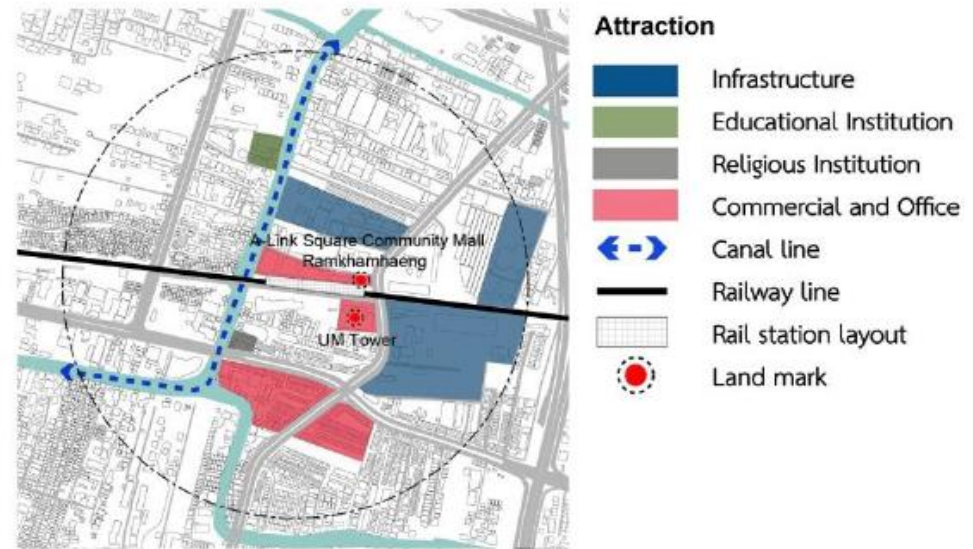
TOD SOLUTION: APPROCH : 6Ds



TOD SOLUTION: APPROACH : 6Ds

DISTANCE TO TRANSIT

- Evaluating existing **transit services, allocating transportation investments,** and making decisions on land development.
- **Land use factors, psycho-social and cultural factors,** habitual or automatic behavioural processes, and practical or instrumental reasoned factors.



TOD SOLUTION: APPROACH : 6Ds



TOD SOLUTION: APPROACH : 6Ds

DESTINATION ACCESSIBILITY

In this regard, transit systems need to be cast in manner that facilitates access to a wide variety of destinations such as work, service centres, recreation, and so forth



Accessibility

- Arterial road
- Collector road
- Local road
- Pedestrian
- Pedestrian overpass
- Canal line
- Railway line
- Rail station layout
- Rail station
- Pier
- Bus stop



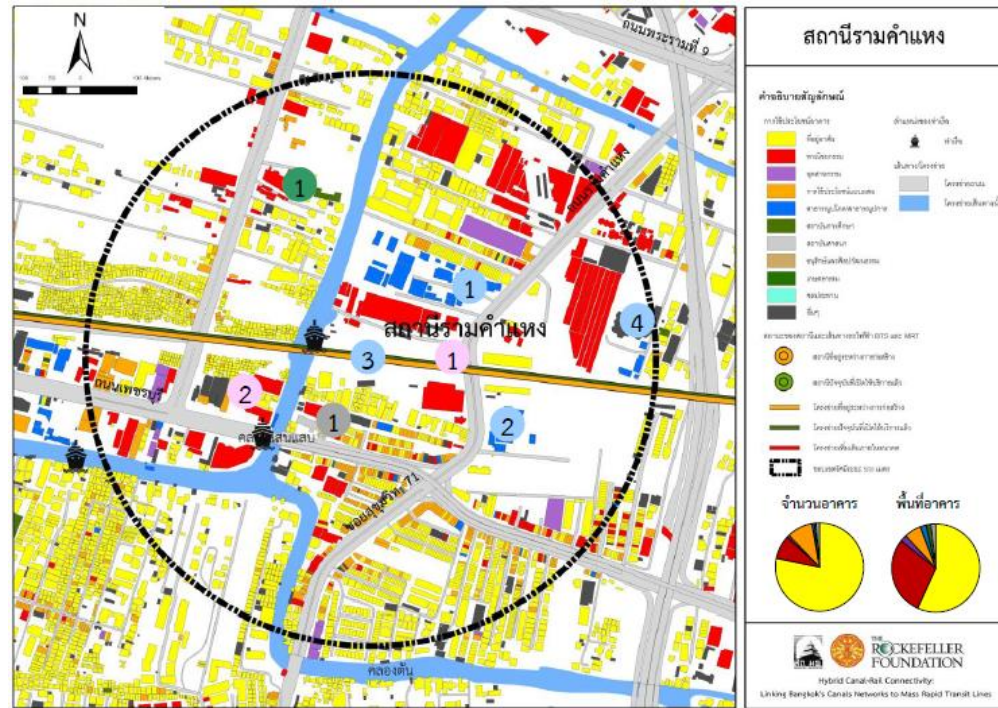
Built-up areas

- Building
- Rail station layout
- Railway line
- Canal line

TOD SOLUTION: APPROACH : 6Ds

DIVERSITY

highly mixed land use environment. cultural and institutionalized discrimination creates and sustains privileges for some while creating and sustaining.



TOD SOLUTION: APPROACH

: 6Ds

Cluster 1 Saphan Kwai Station



Cluster 2 Bang Wa Station



Cluster 3 National Stadium Station



Cluster 4 Ramkhamhaeng Station



Cluster 5 Siam Station



Cluster 6 Bang Na Station



Cluster 7 Saphan Taksin Station



Cluster 8 Bang Phai Station



Cluster 9 Phetchaburi Station



Cluster 10 Sanam Chai Station



Cluster 11 Victory Monument Station



Cluster 12 Hua Lamphong Station



Cluster 13 11th Infantry Regiment King' Bodyguard Station



Cluster 14 Kamphaeng Phet Station



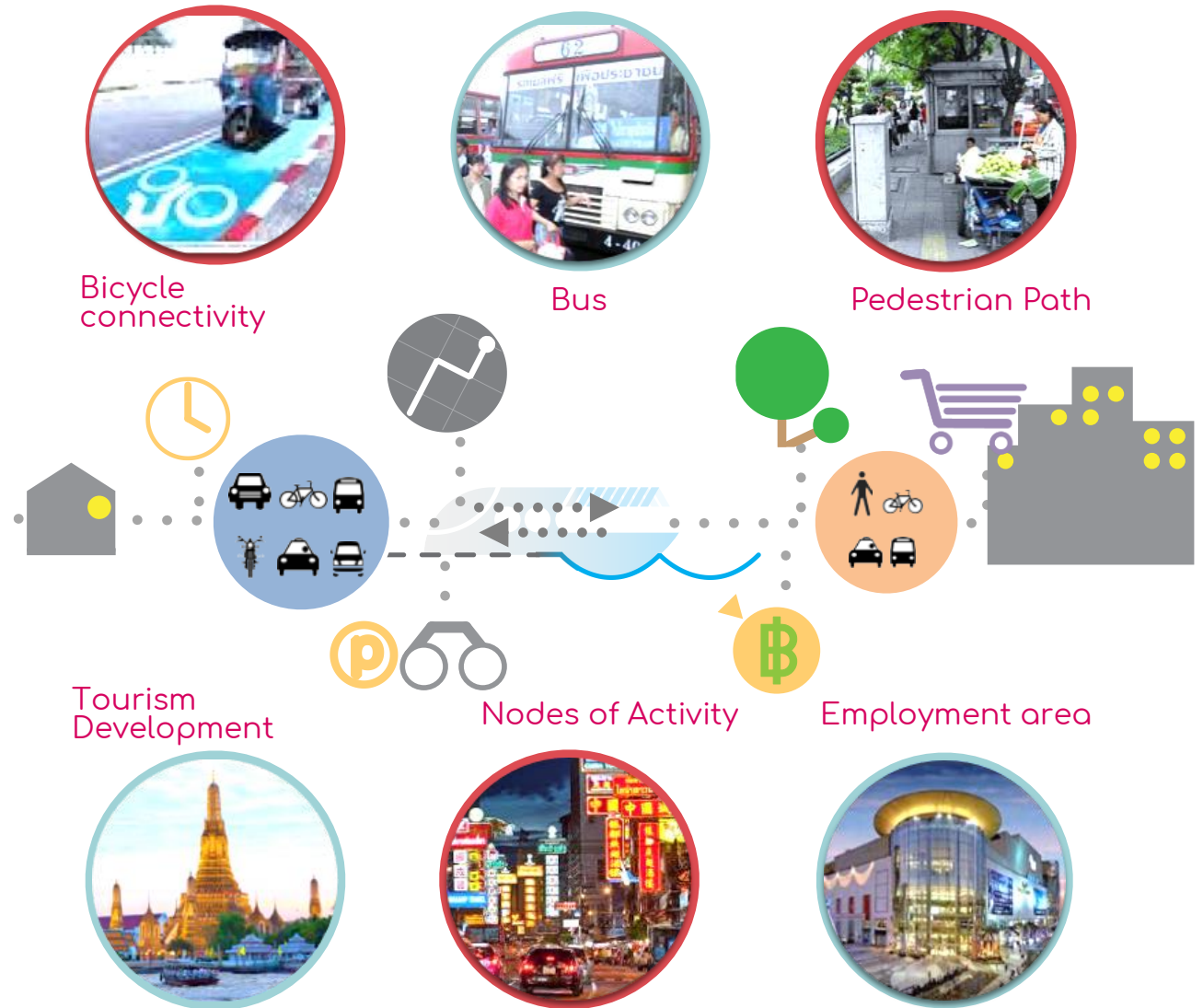
Legend

Other value	Greenline
BL_USE	Greenline
Others	BlueLine
Residential buildings	Station
Commercial buildings	Station
Industrial and cargo	Station
Mixed-use buildings	Station
Facilities	Station
Education buildings	Station
Religious buildings	Station
Utilities	Station
Hospital and medical care	Station
Institutional buildings	Station
Recreation	Station
Agriculture	Station
Port / Stage1	Station
Other value	Station
Phase	Station
Stage 1 of Development	Station
Yellow_line	Station
Red_line	Station
Purple_line	Station
Pink_line	Station
Orange_line	Station
Light_Red_Line	Station
Light_Green_Line	Station
Light_Blue_Line	Station

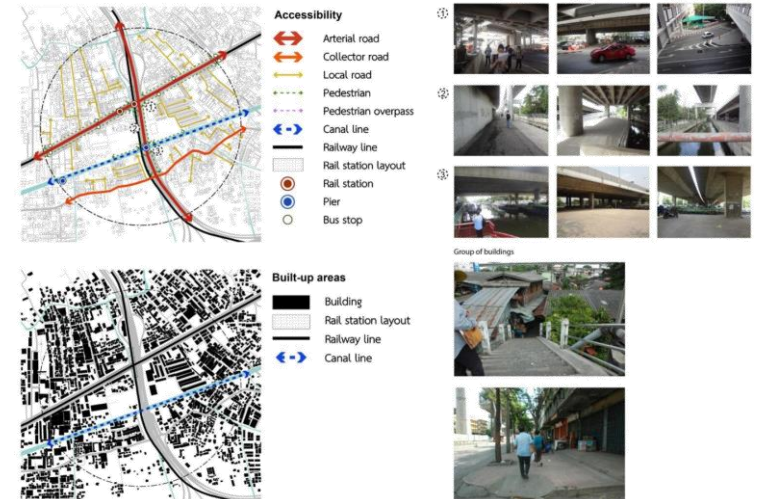
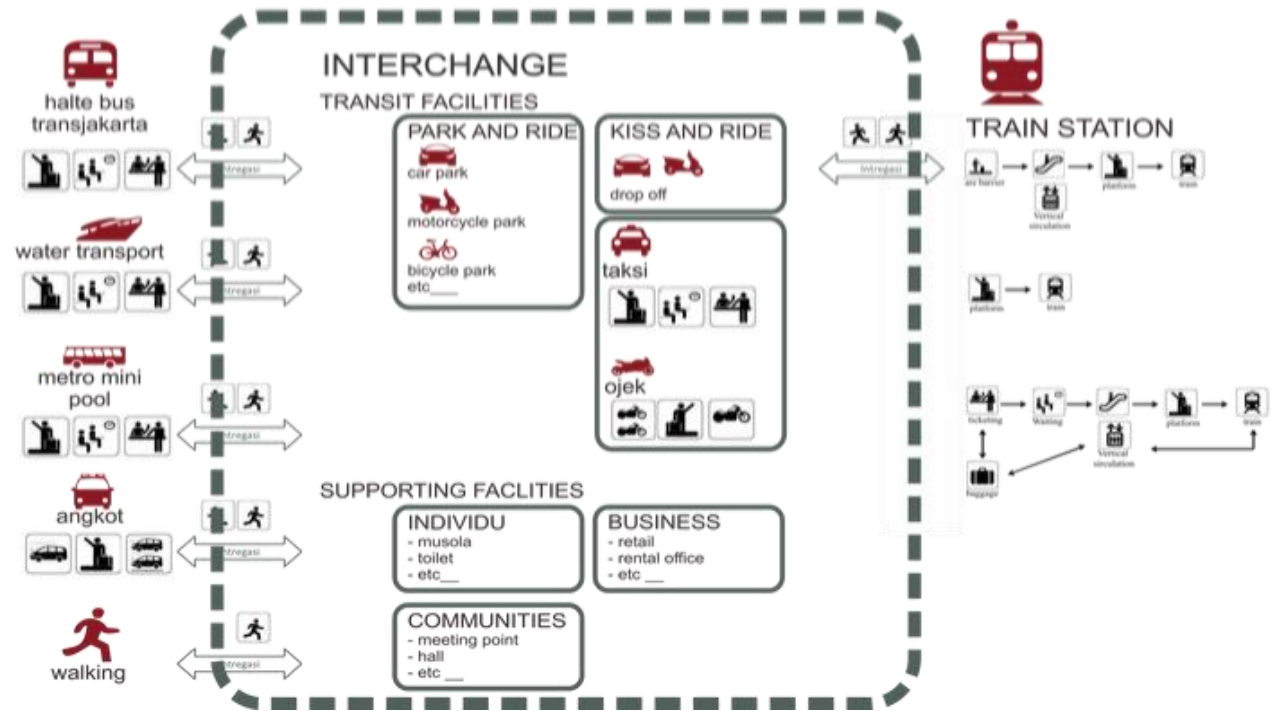
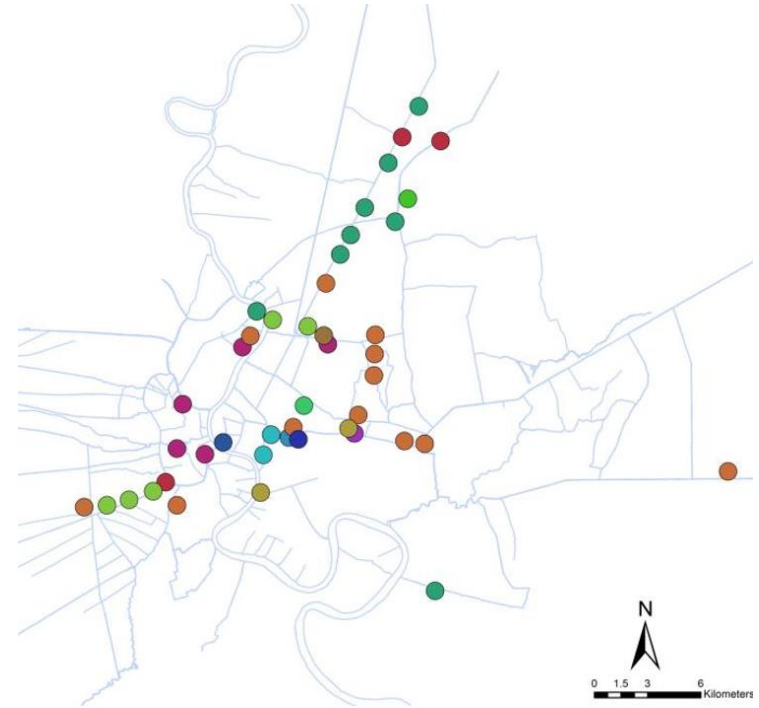
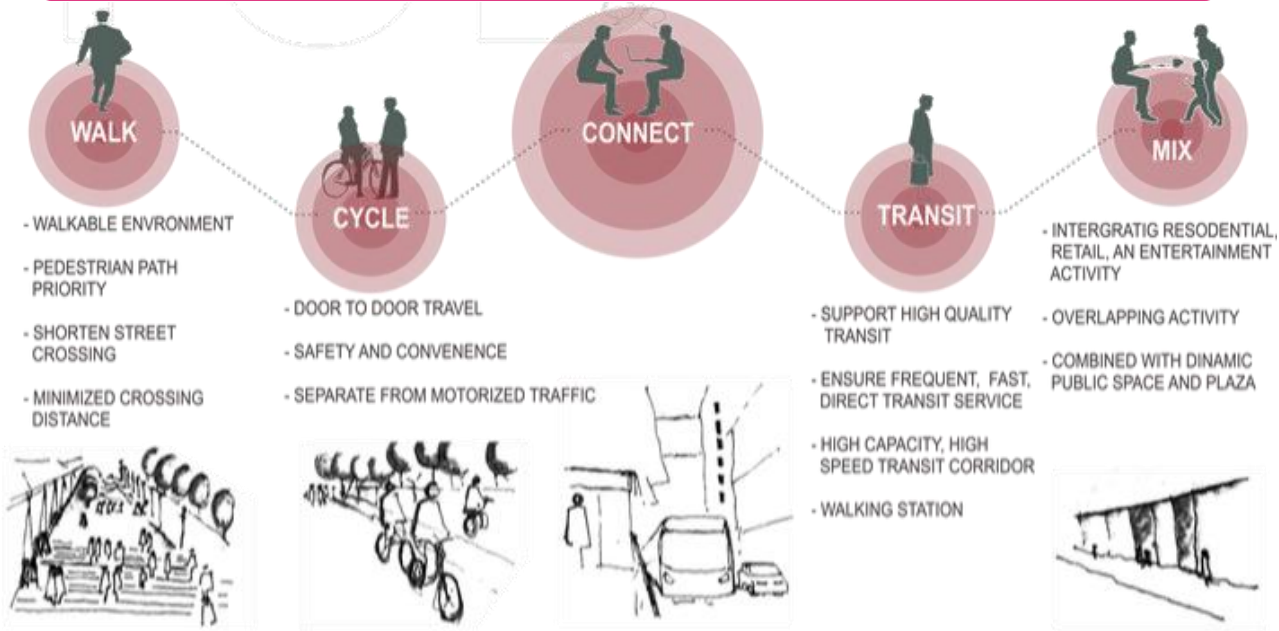
TOD SOLUTION: APPROACH : 6Ds

DEMAND MANAGEMENT

...any activity, method or program that reduces vehicle trips, resulting in more efficient use of transportation resources



TOD SOLUTION: APPROACH : 6Ds



TOD SOLUTION: HOW ?

CURRENT CANAL



Canal Network:
Existing
 Distance 67.49 km.
 300,000 Trip /day

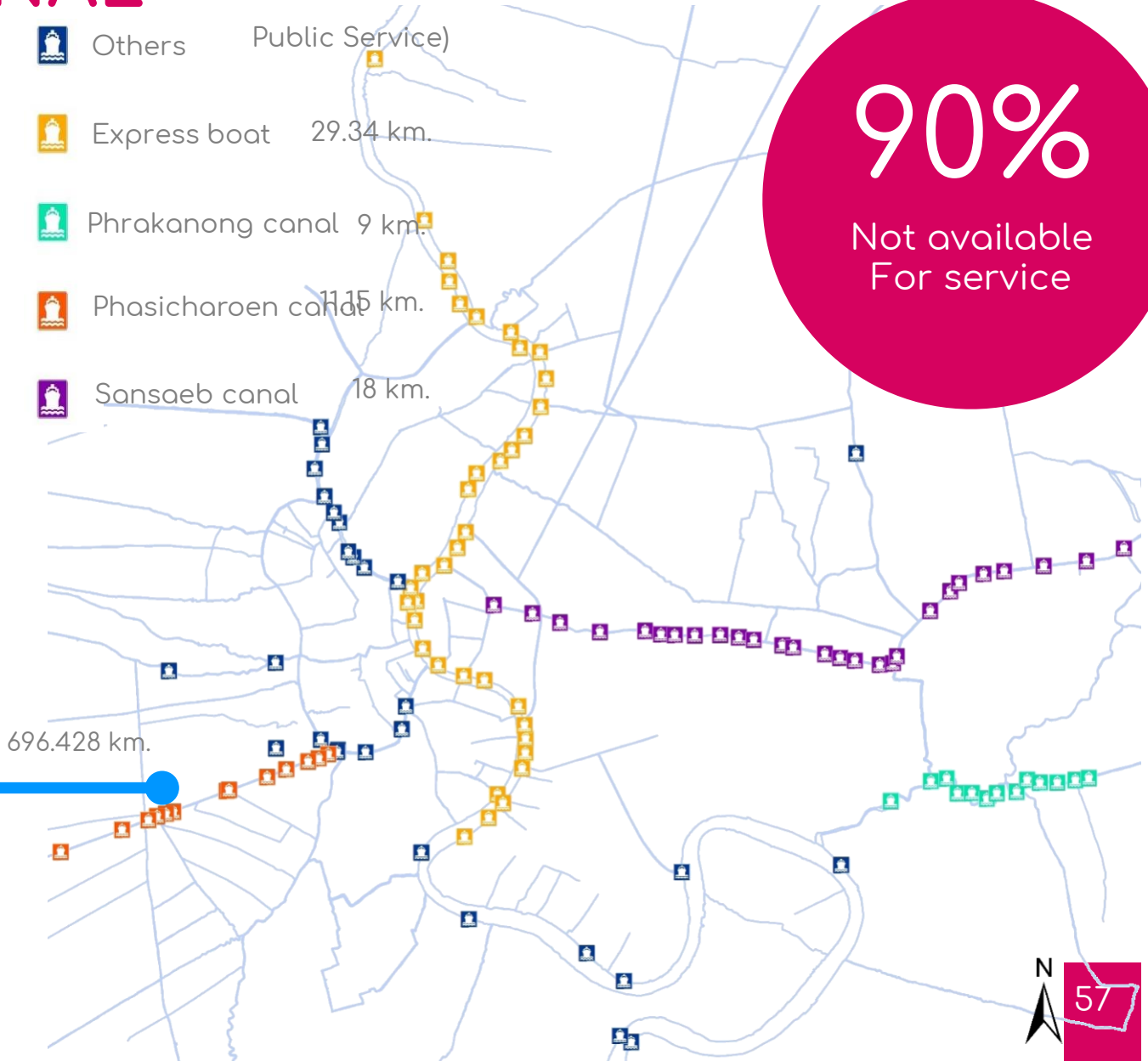
Canal Network in Service

67.49 km.

Potential Connectivity 696.428 km.

- Others (Public Service)
- Express boat 29.34 km.
- Phrakanong canal 9 km.
- Phasicharoen canal 11.15 km.
- Sansaeb canal 18 km.

90%
 Not available
 For service

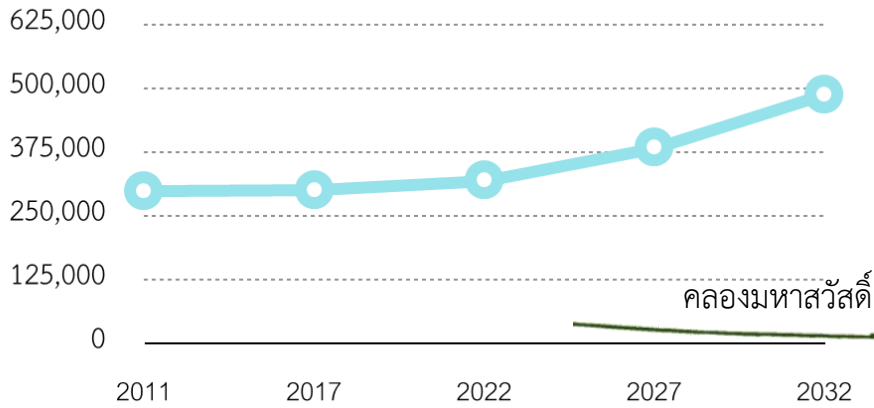


TOD SOLUTION: HOW ?

Water Transportation Demand in Next 20 Years



Number of Trips



คลองมหาสวัสดิ์

Ladphrao canal

Seanseap canal

Pasrichalearn canal

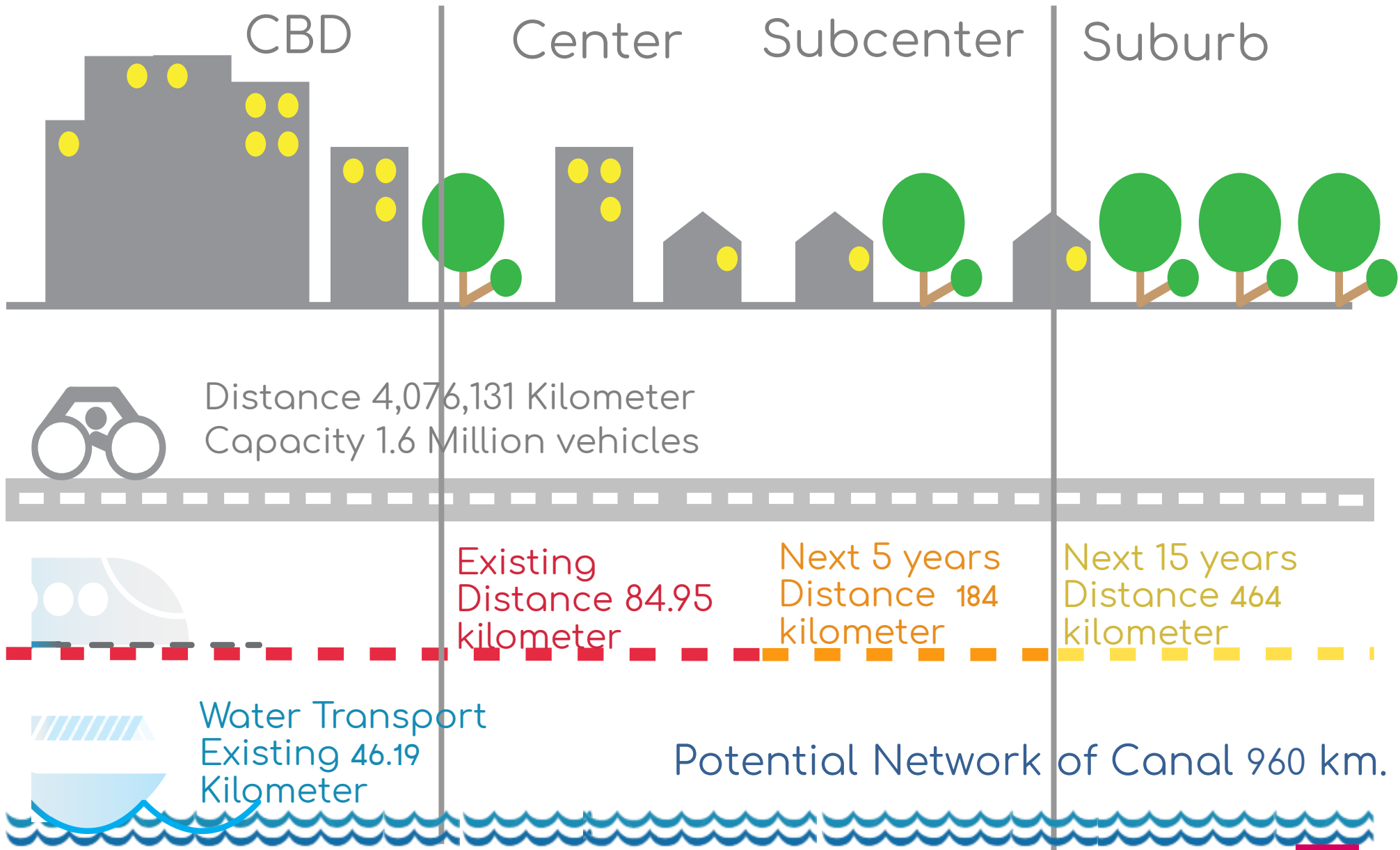
Prawetbureerom canal

คลองมหาชัย

Potential Canal Network for Service Distance 696.428 km.

Potential Canal Network for Service with Required Improvement Distance 265.110 km.

TOD SOLUTION: HOW ?



TOD SOLUTION: HOW ?

Existing Potential Development

Current Transit

Mass transit



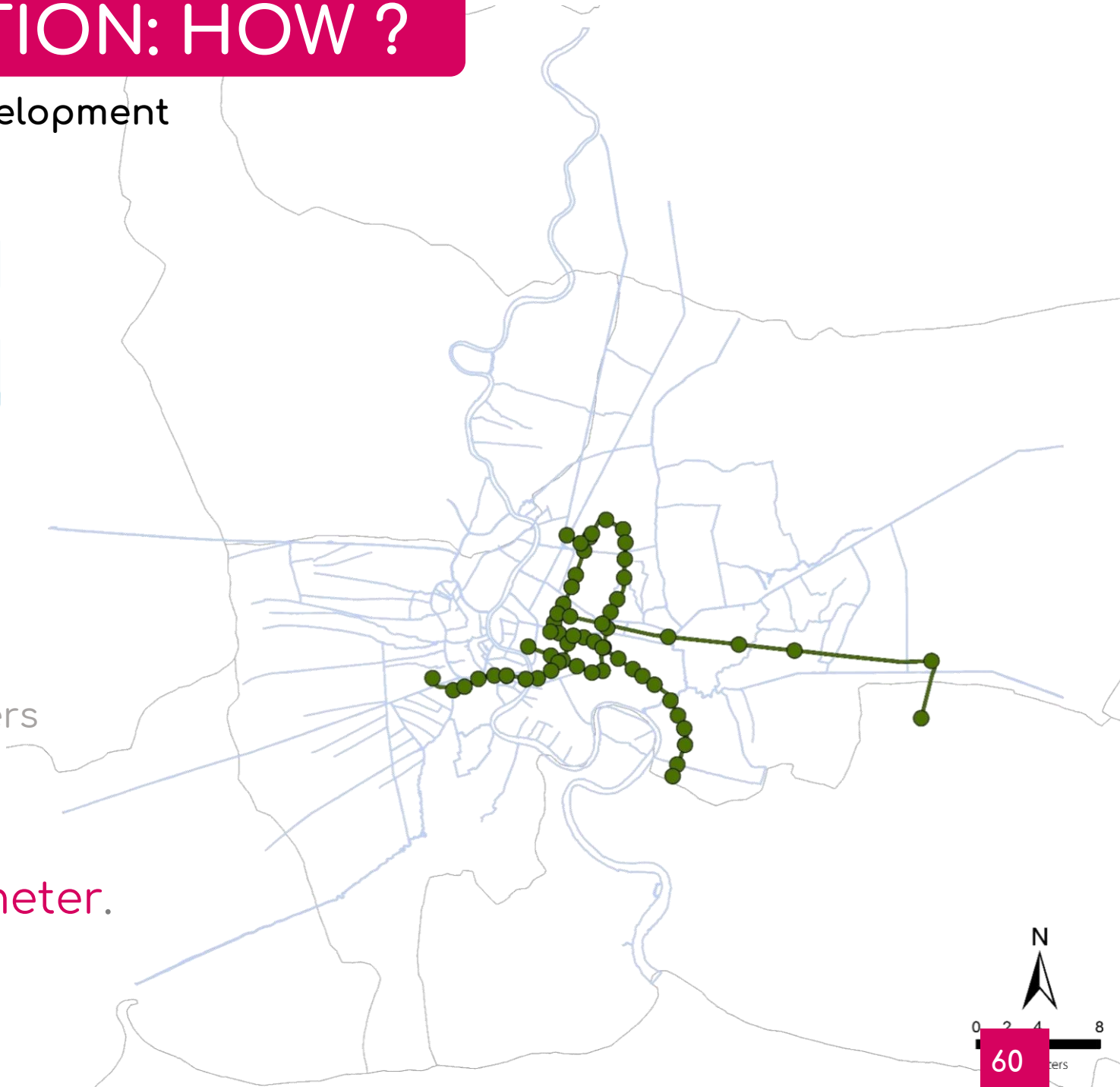
Design & Planning

Mass transit network:

Existing

Distance 84.95 kilometers
2,798,000 trips/ days

Existing
84.95 kilometer.



TOD SOLUTION: HOW ?

Existing Potential Development

Current Transit

Mass transit



Design & Planning

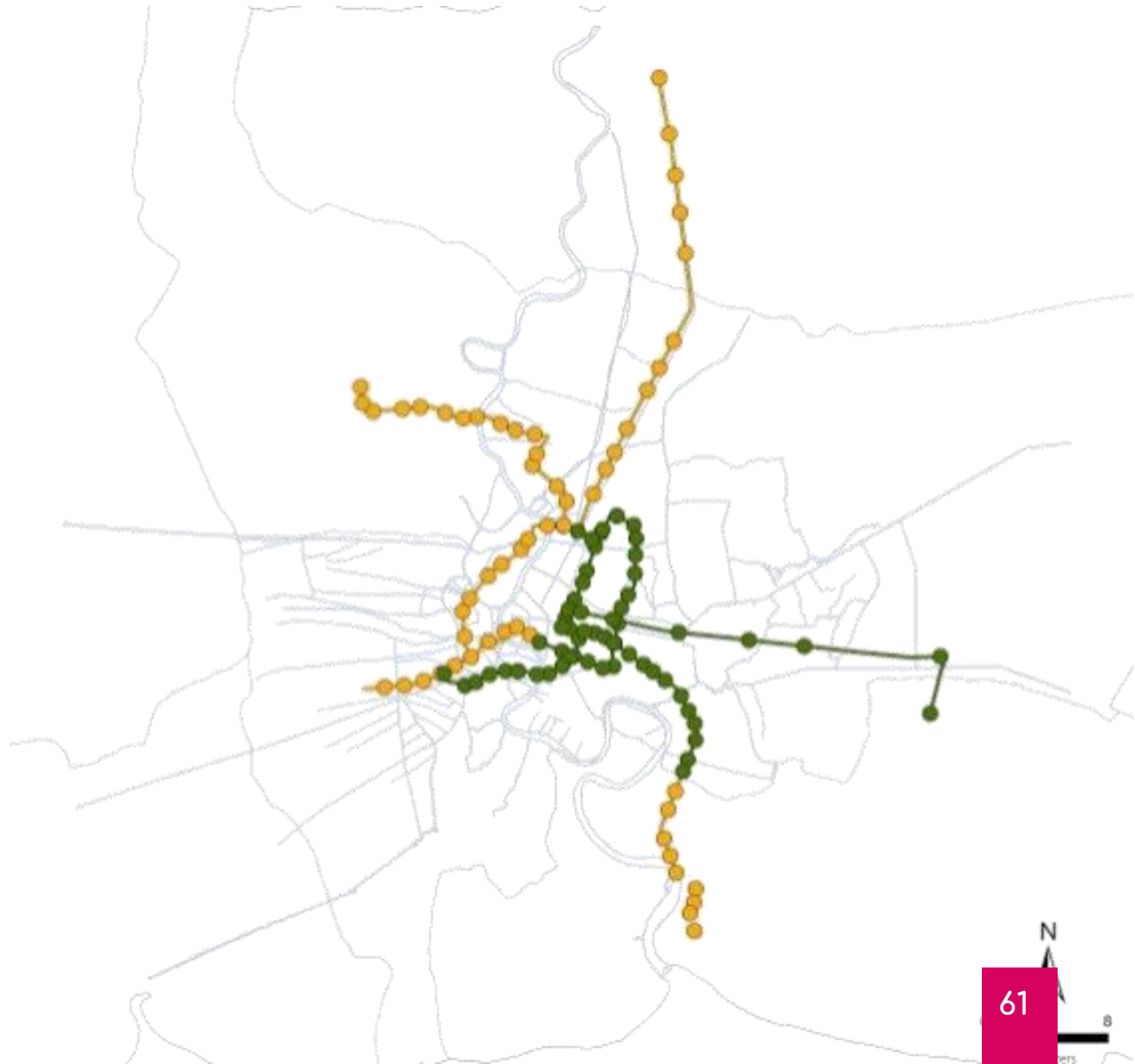
Mass transit network:

Next 5 years 2020

Distance 184 kilometer
5,611,000 trips/day



84.95 km.+ 84 km. = 184 km.



TOD SOLUTION: HOW ?

Existing Potential Development

Current Transit

Mass transit



Design & Planning

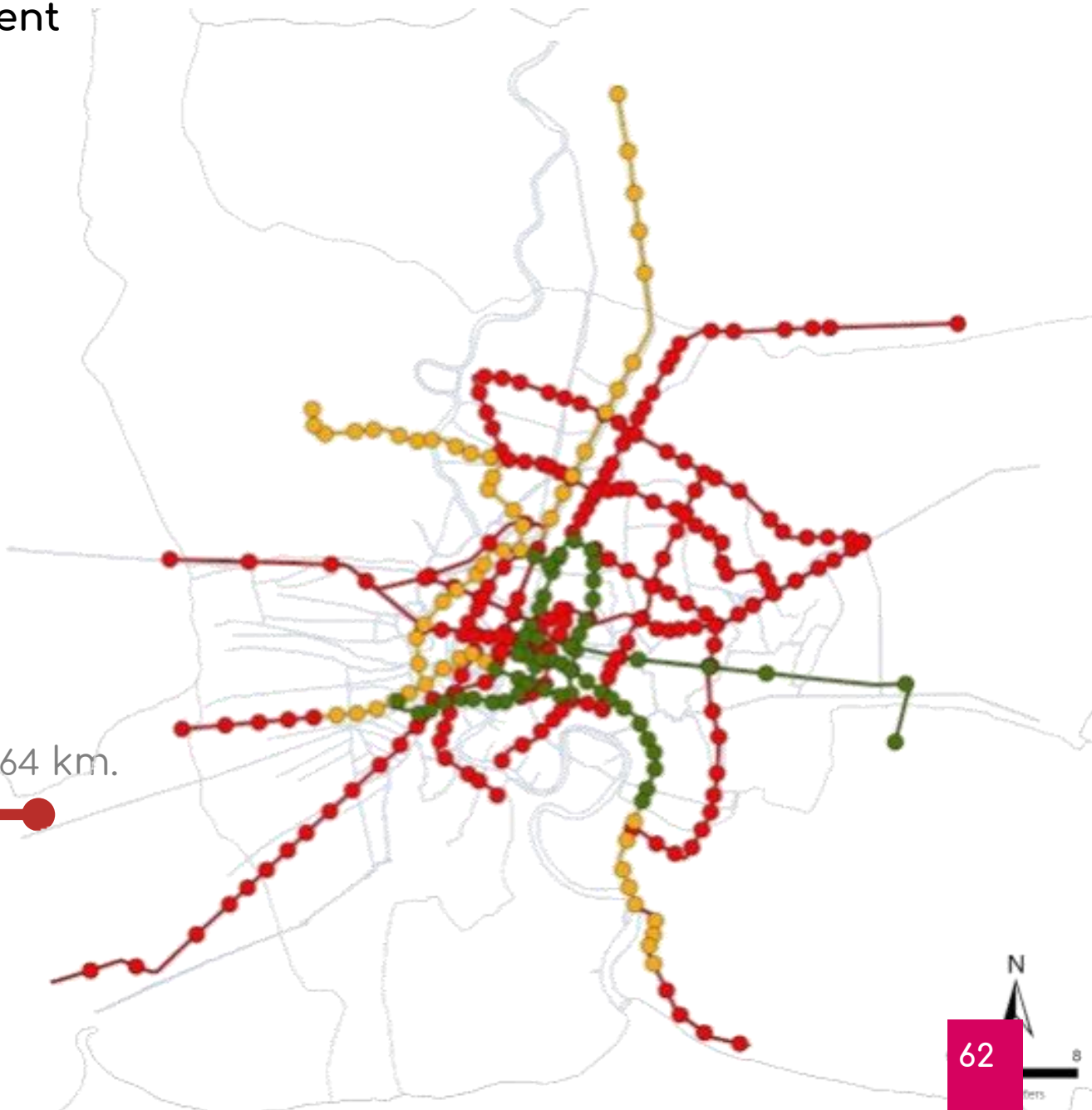
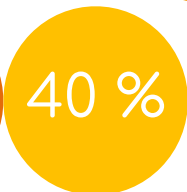
Mass transit network :

Next 15 years
2035

Distance 464 kilometers

10,309,000 Trip/day

84.95 km.+ 84 km. + 280 km. = 464 km.



Klong “Lad Phrao”

TOD SOLUTIONS

Klong "LadPhrao"



TOD SOLUTION: HOW ?

SOCIO-ECONOMICS

Social capital, safety and security to life and properties, community development potential.

Population

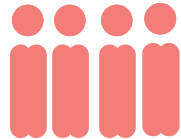


36,326 household

64,710 person

(กระทรวงมหาดไทย, 2558)

35,341 person Average



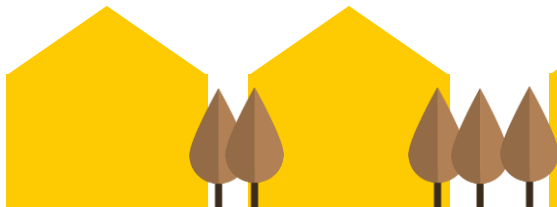
1.78

29,369 person

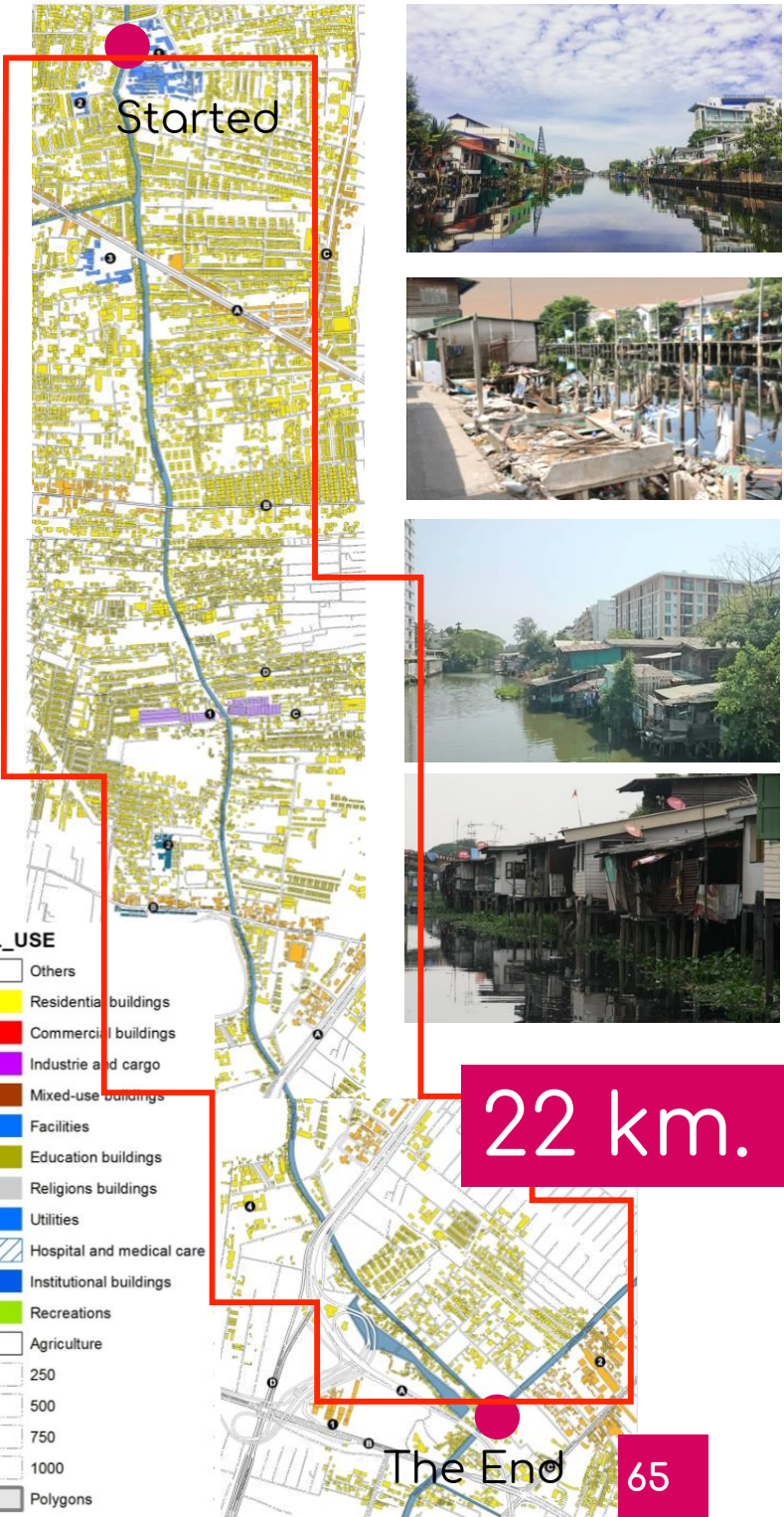


people/
household

Socio - economic



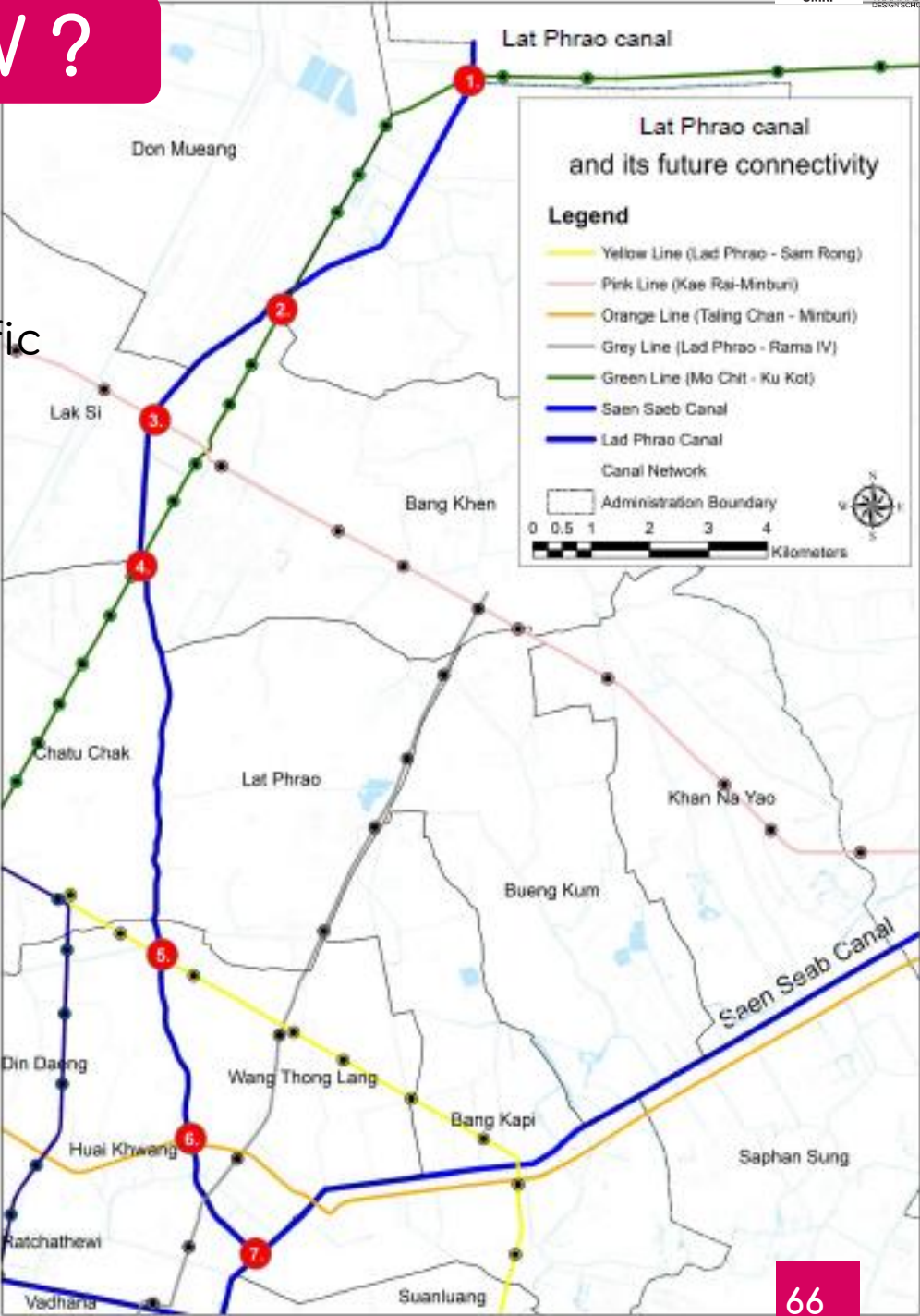
Residential
20 communities



TOD SOLUTION: HOW ?

TRANSPORTATION

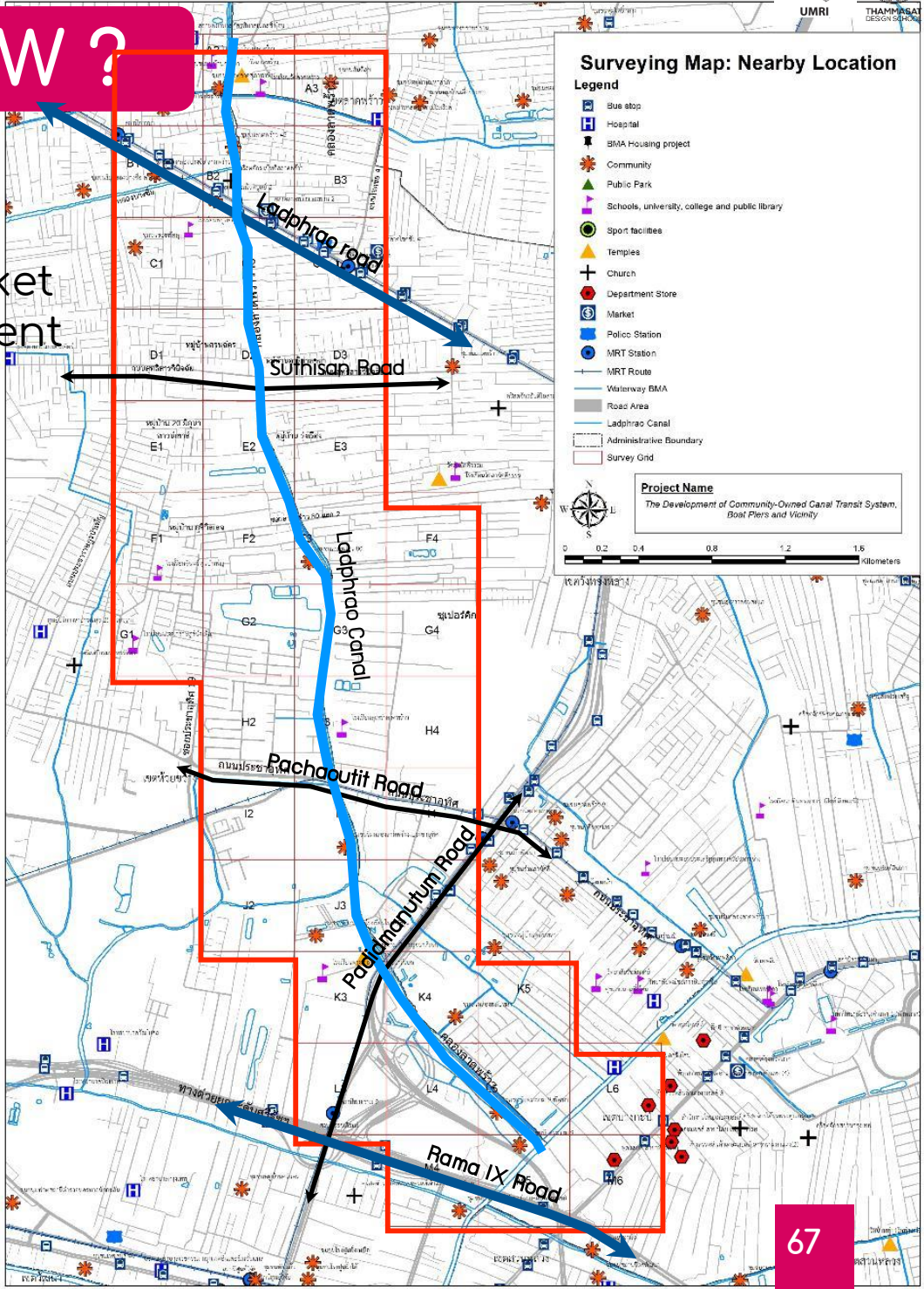
Pedestrian walkways, cycle lanes, road networks, parking, street amenities, traffic volume, intermodal travel patterns, rail stations located near canals.



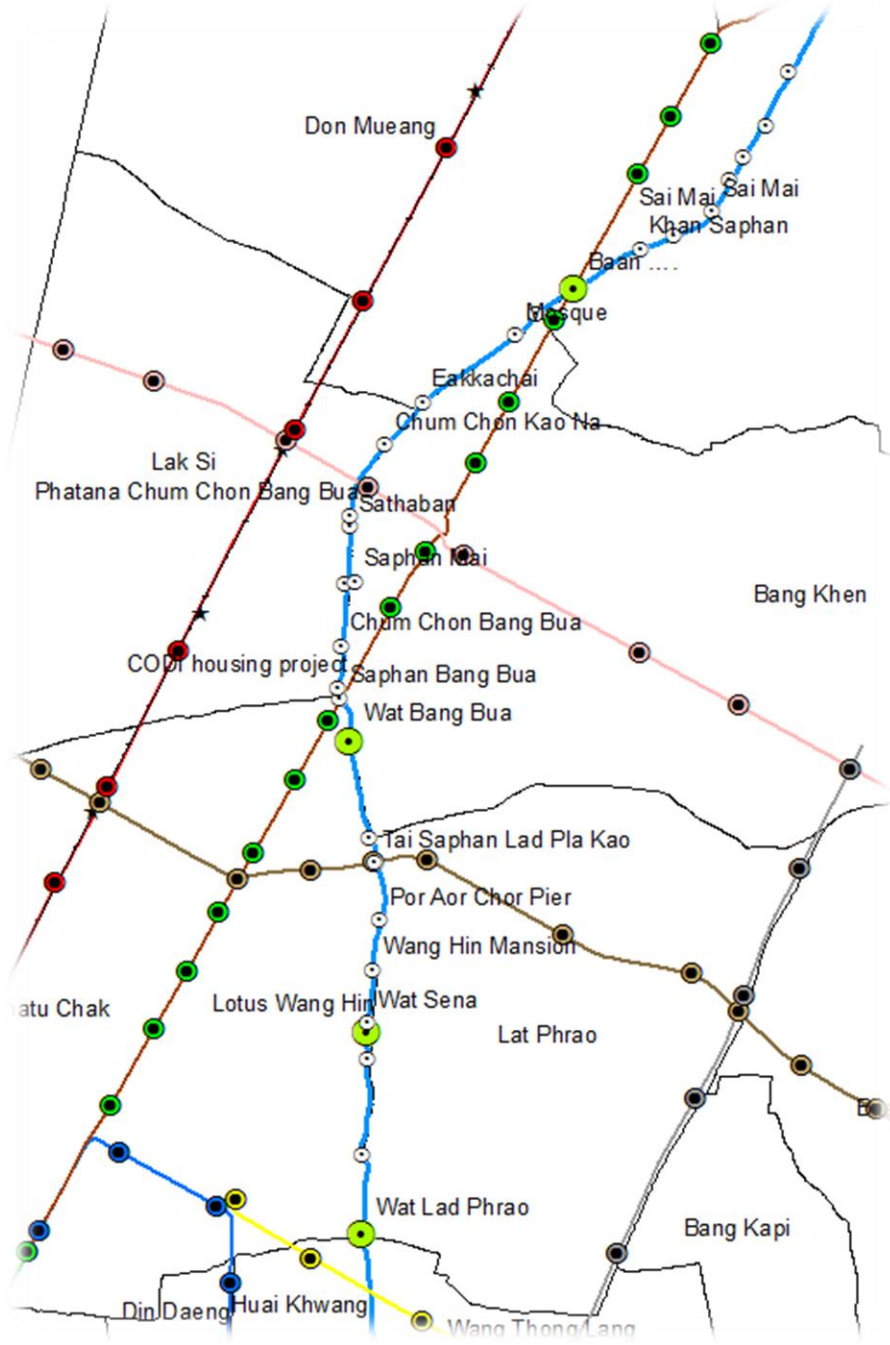
TOD SOLUTION: HOW ?

PUBLIC SERVICE

Land value and real estate price, market needs, market ideas, possible investment of real estate project and Location of security and Medical.



TOD SOLUTION: HOW ?



Data Collection : Site Survey (Pilot)

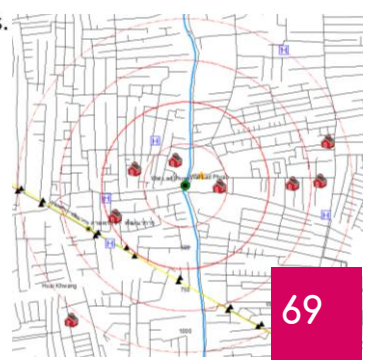
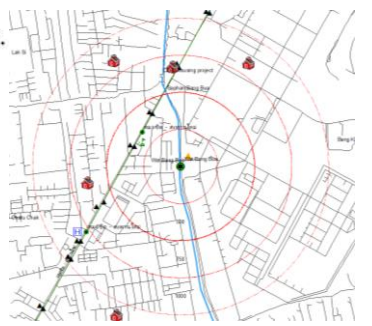
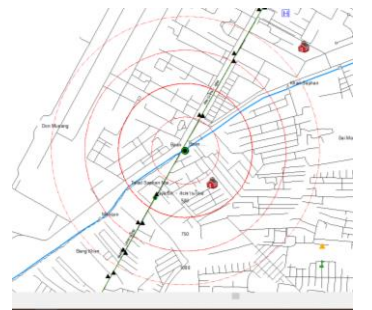
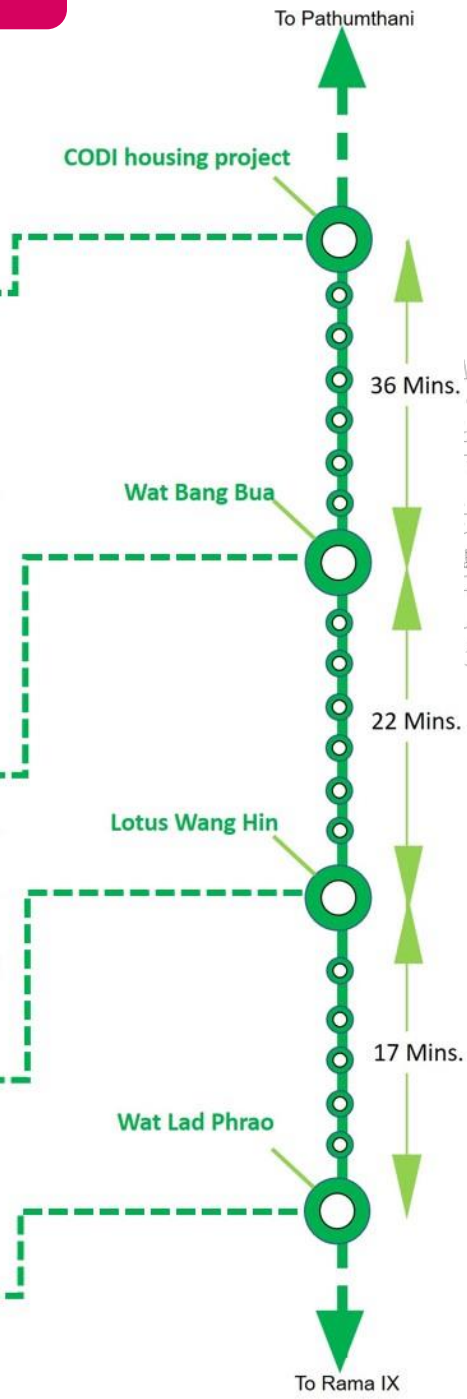
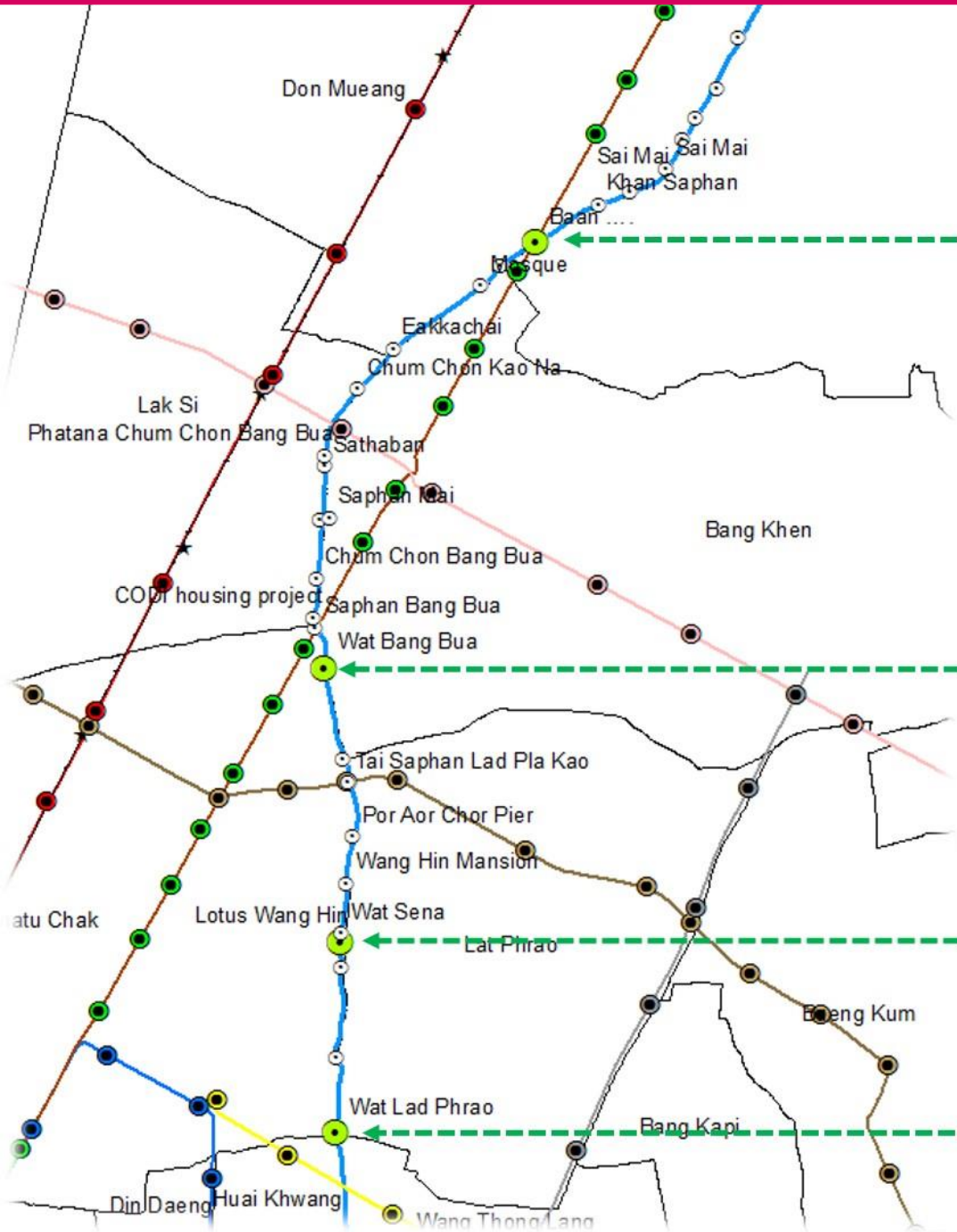
Vehicle type: Motor Boat
(Fiberglass)

Distant in total: Approx. 15.56
Kilometers

Starting time (Upward) From Wat
Lad Phrao pier, round trip

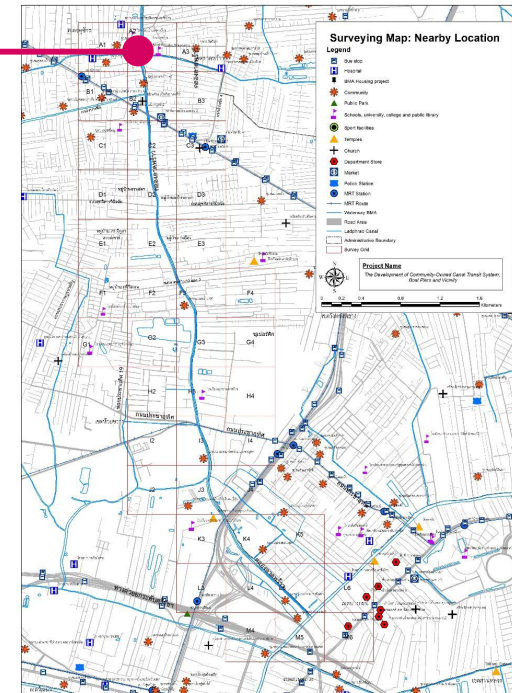
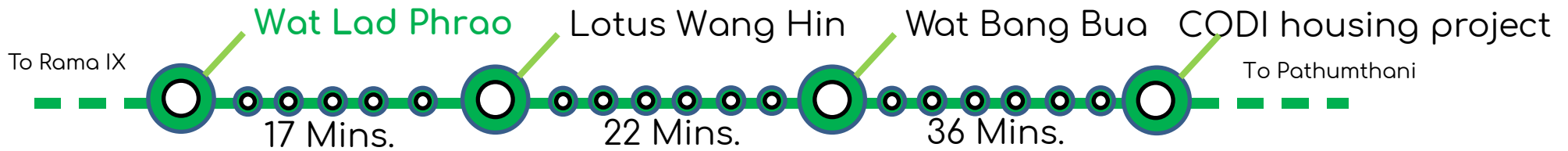
- Location (Lat, Long, Attitude)
- Piers name
- Piers Side
- Time (Time lab, Travel Time on the station)
- Building Density and Use
- Accessibility

TOD SOLUTION: HOW ?



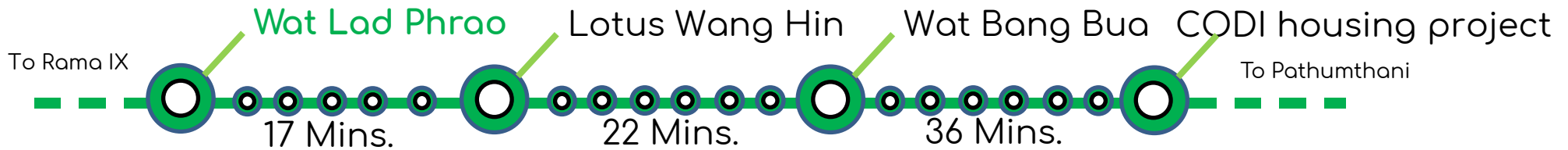
TOD SOLUTION: HOW ?

Survey route segment : Wat Lad Phrao

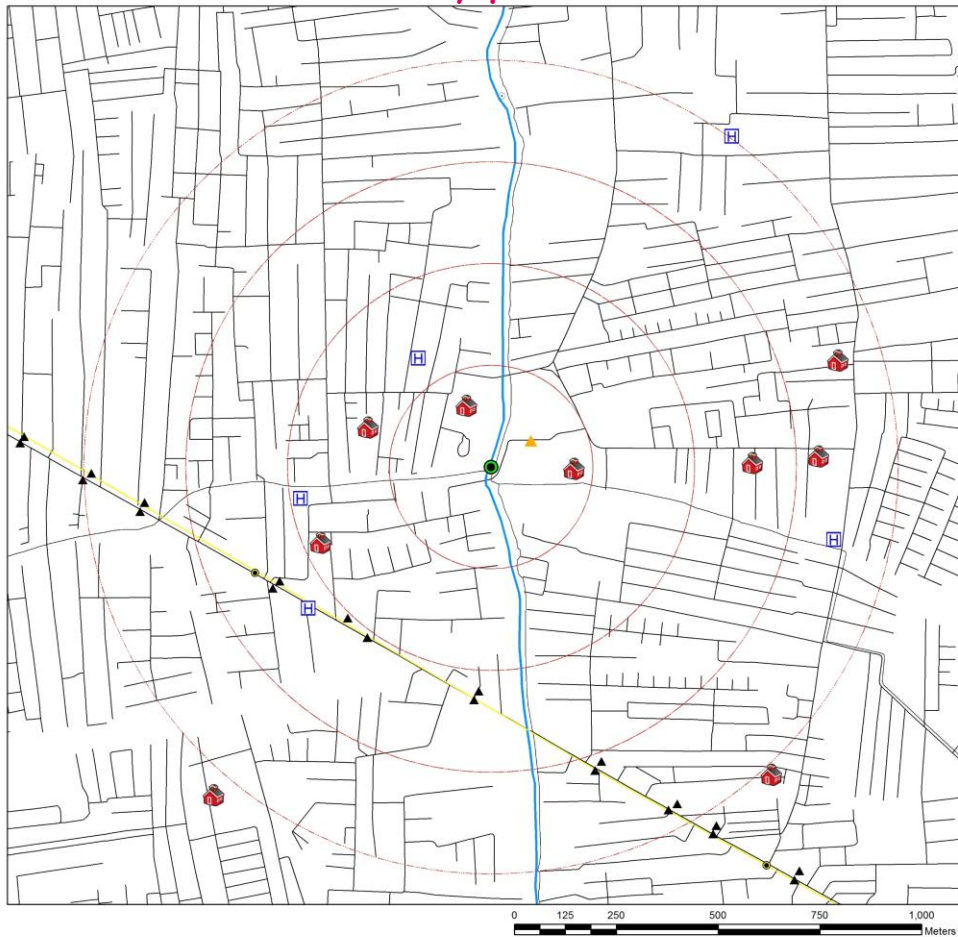


TOD SOLUTION: HOW ?

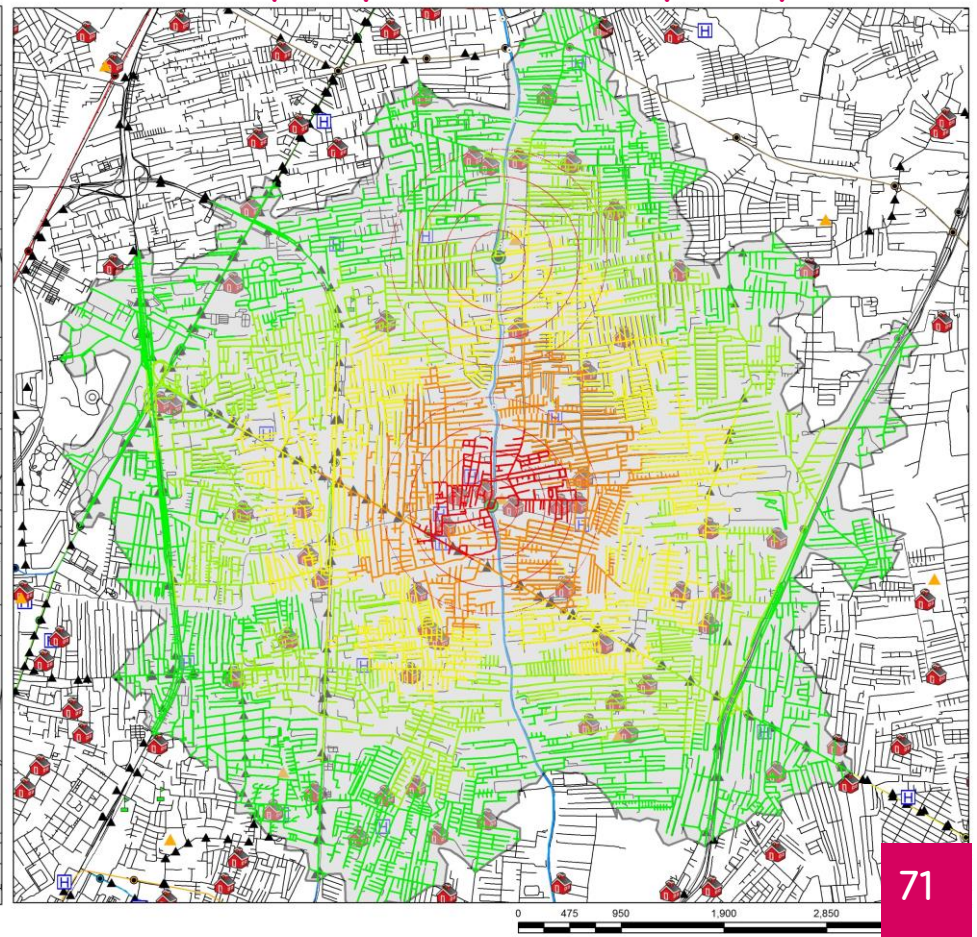
Survey route segment : Wat Lad Phrao



Location and nearby places

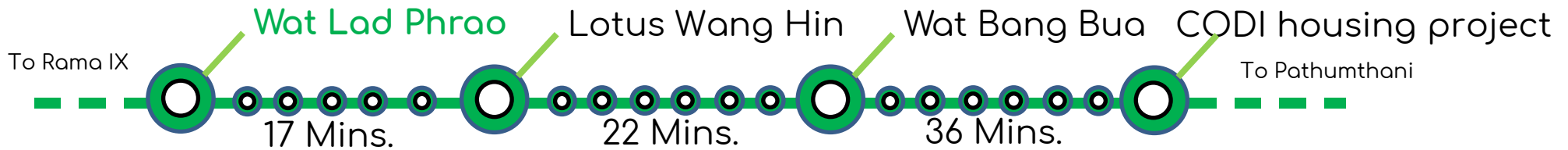


Reachability to pier location (5 Km)

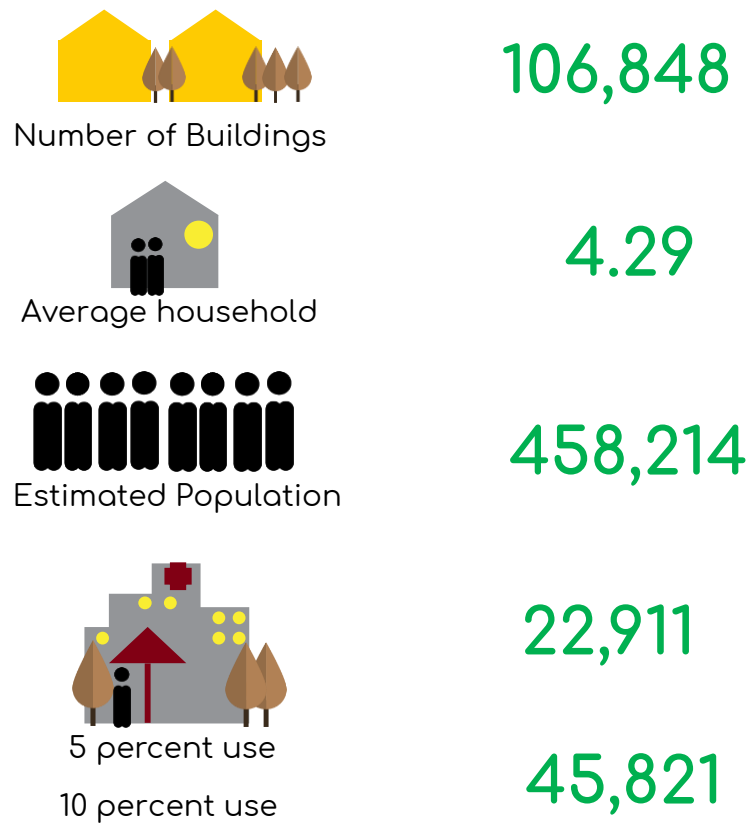
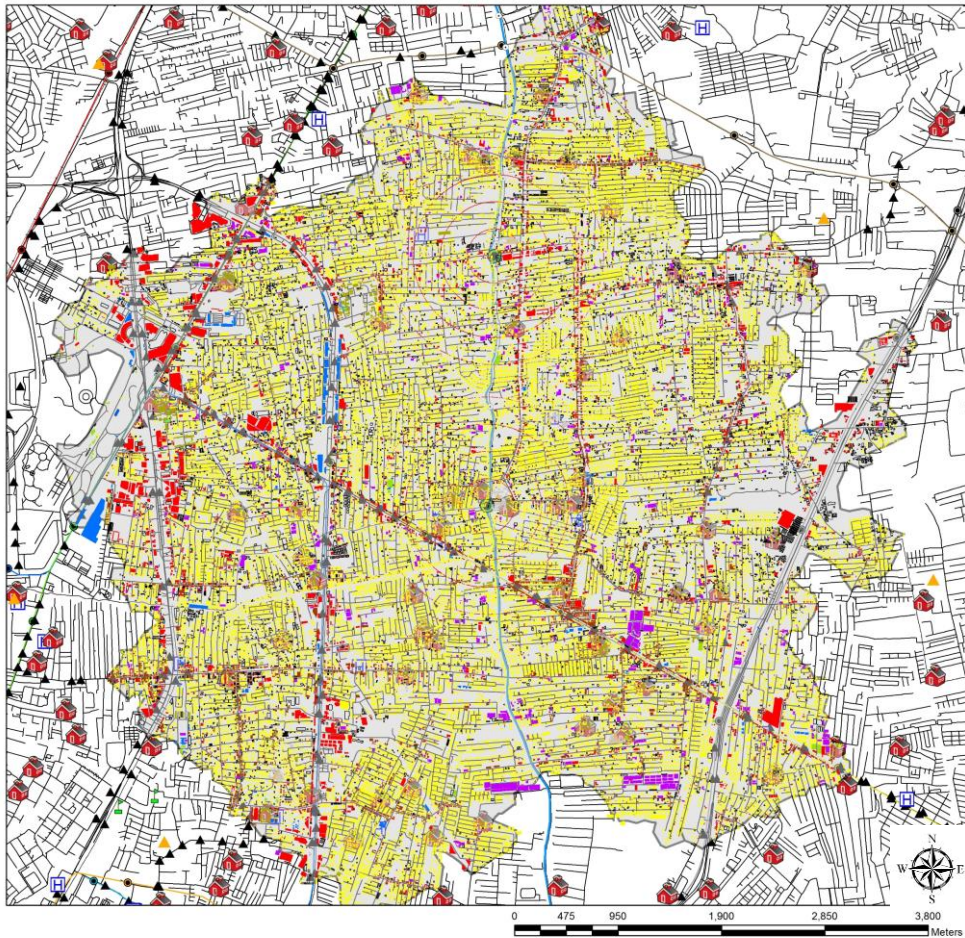


TOD SOLUTION: HOW ?

Survey route segment : Wat Lad Phrao

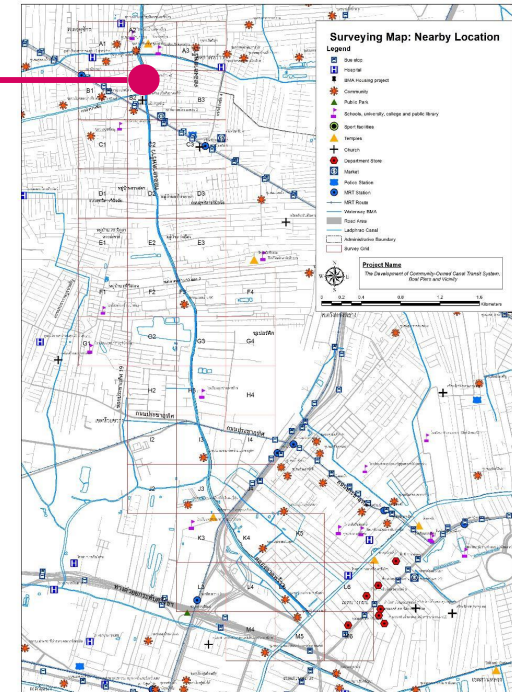


Building use condition



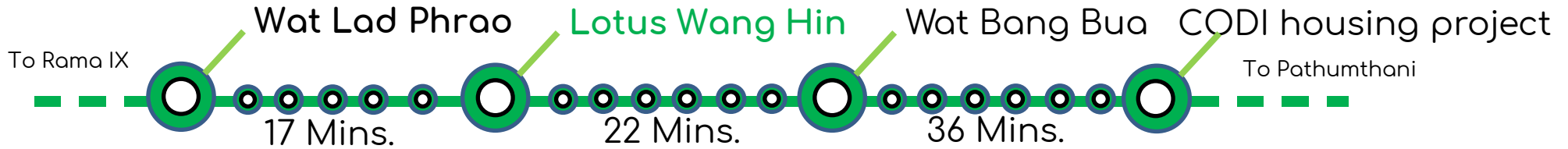
TOD SOLUTION: HOW ?

Survey route segment : Lotus Wang Hin

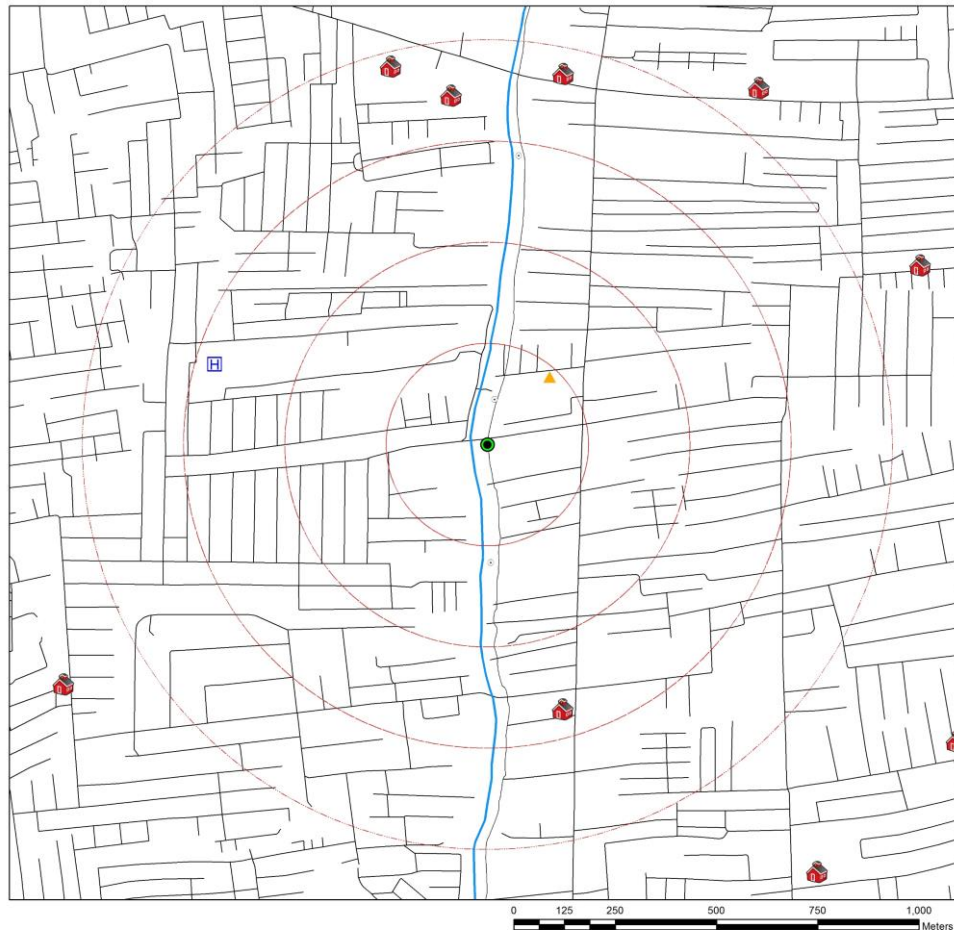


TOD SOLUTION: HOW ?

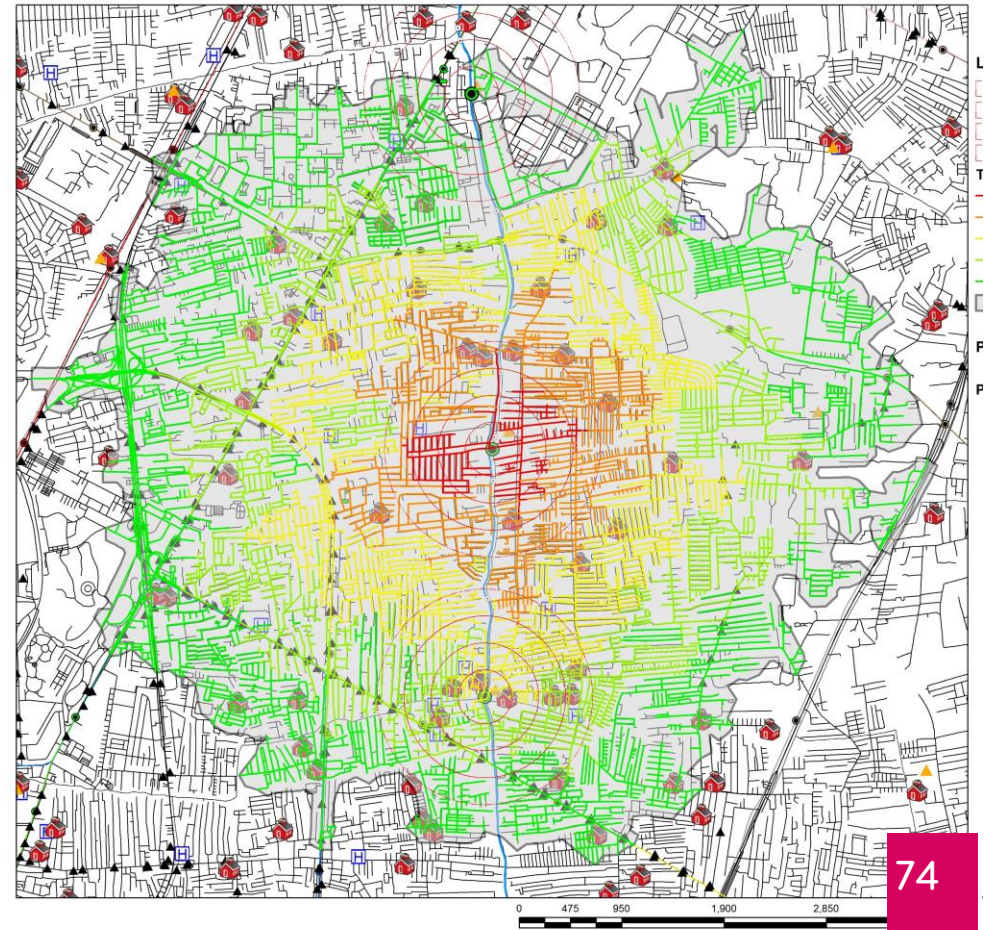
Survey route segment : Lotus Wang Hin



Location and nearby places



Reachability to pier location (5 Km)

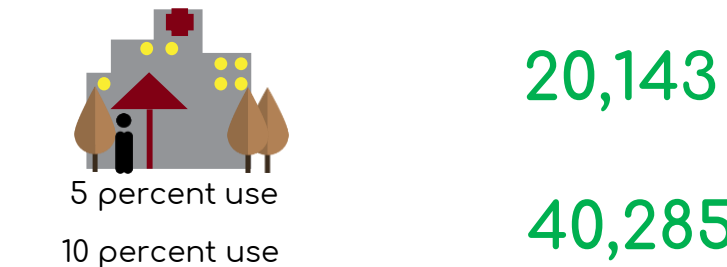
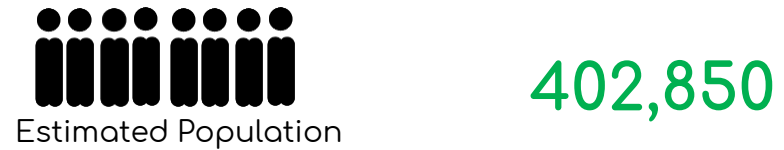
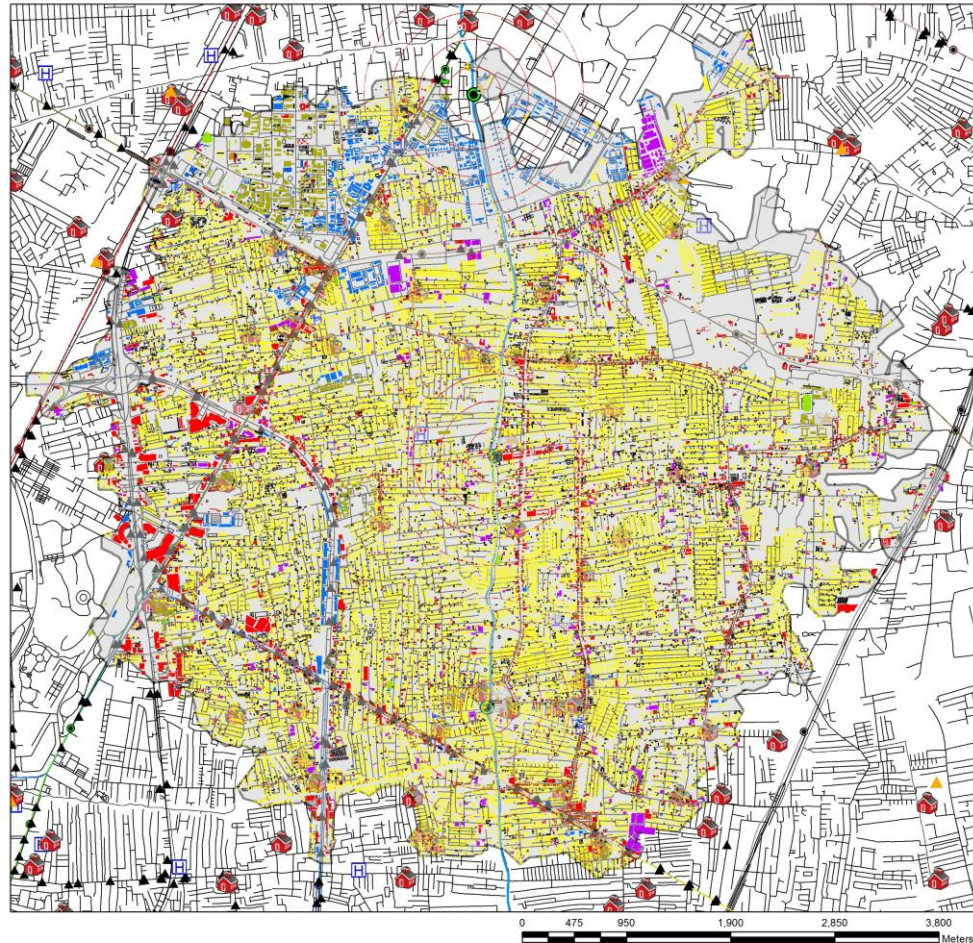


TOD SOLUTION: HOW ?

Survey route segment : Lotus Wang Hin

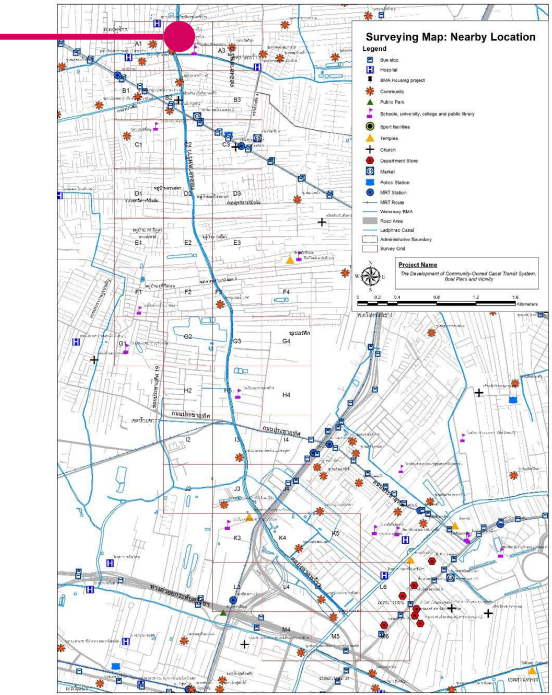
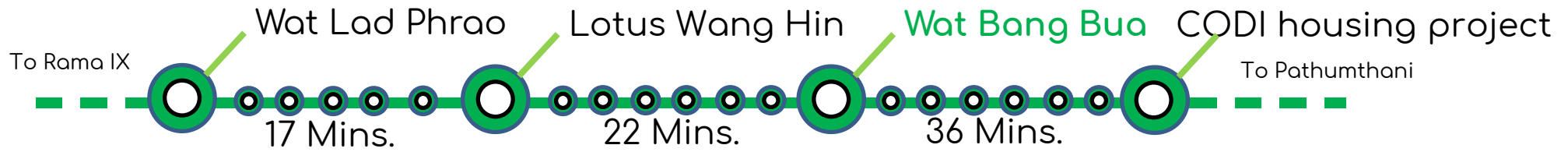


Building use condition



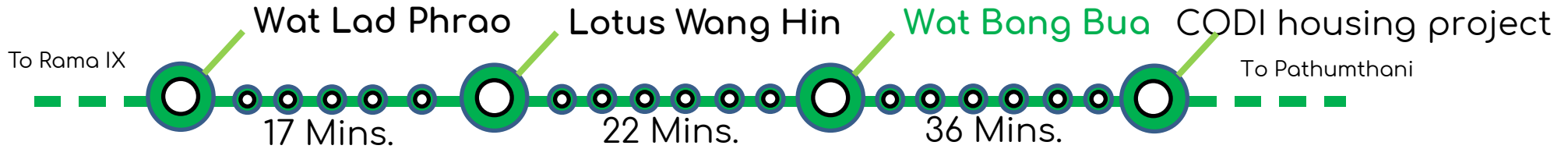
TOD SOLUTION: HOW ?

Survey route segment : Wat Bang Bua

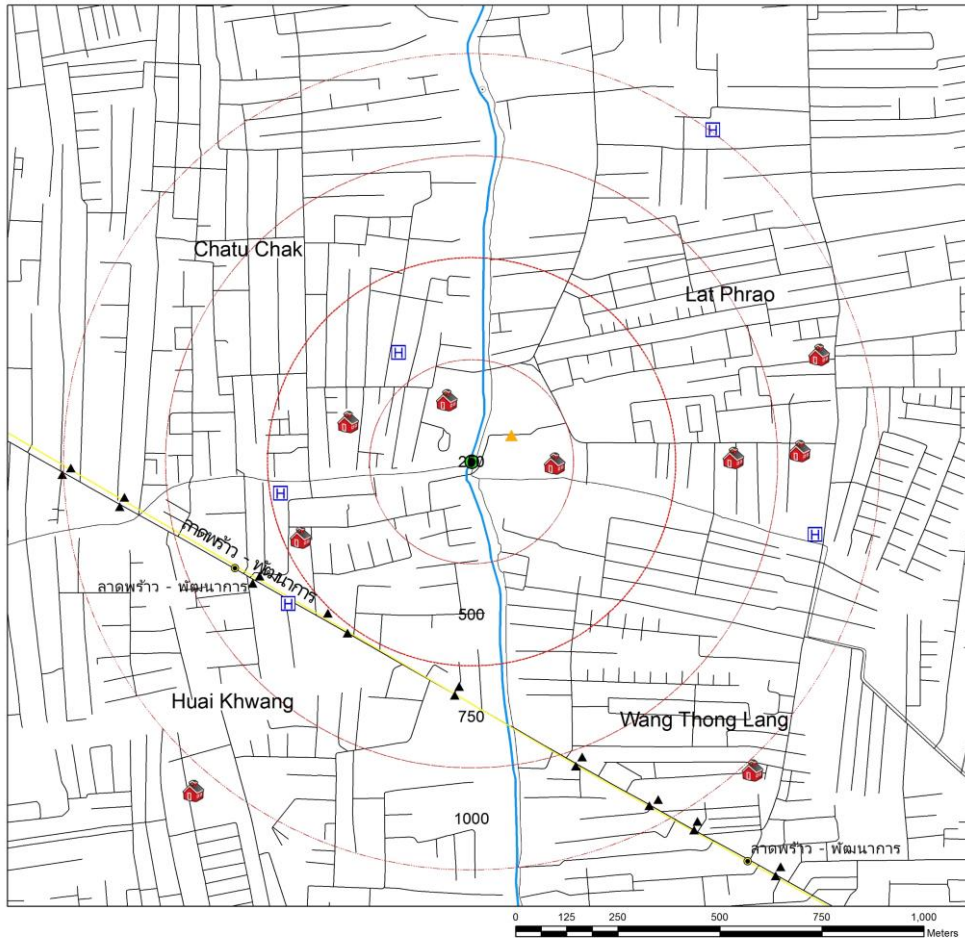


TOD SOLUTION: HOW ?

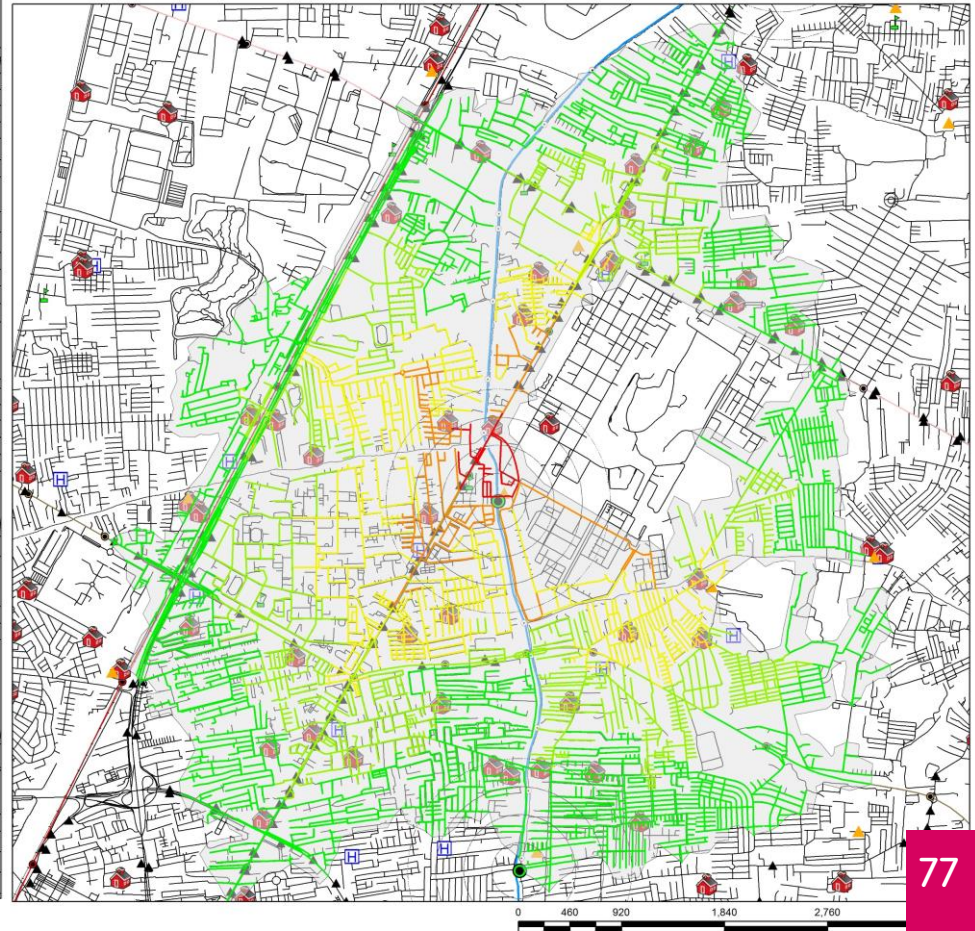
Survey route segment : Wat Bang Bua



Location and nearby places

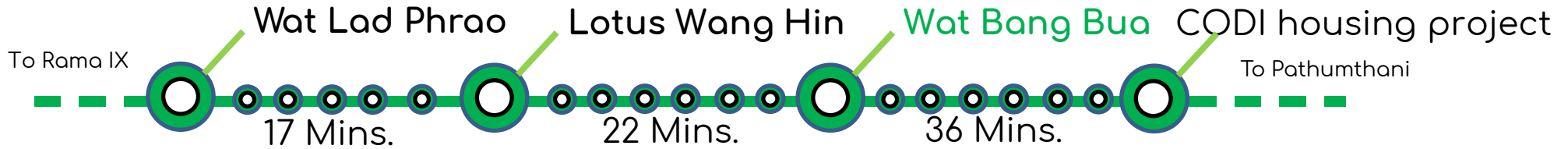


Reachability to pier location (5 Km)

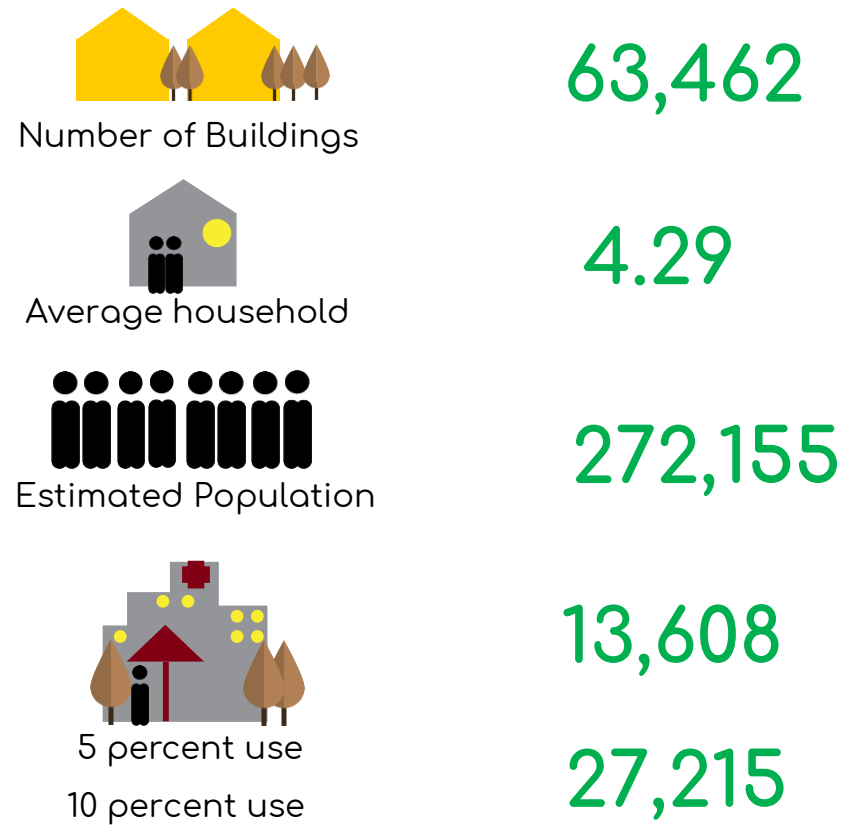
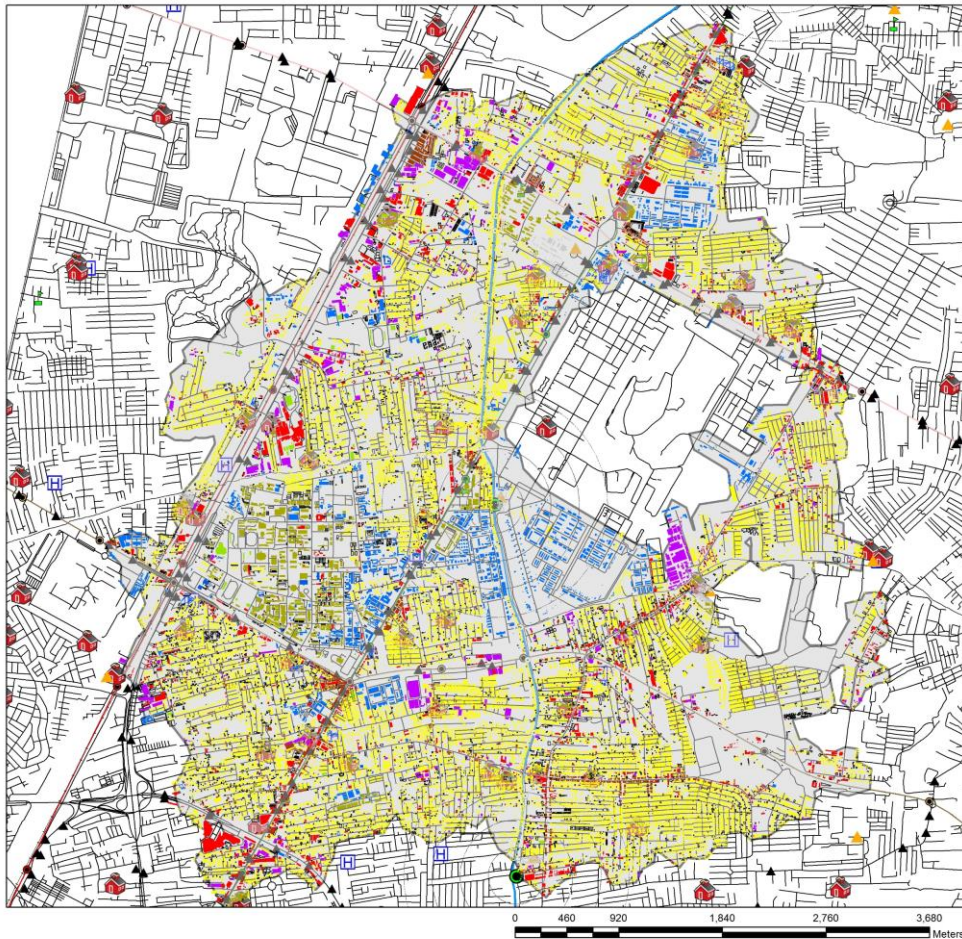


TOD SOLUTION: HOW ?

Survey route segment : Wat Bang Bua

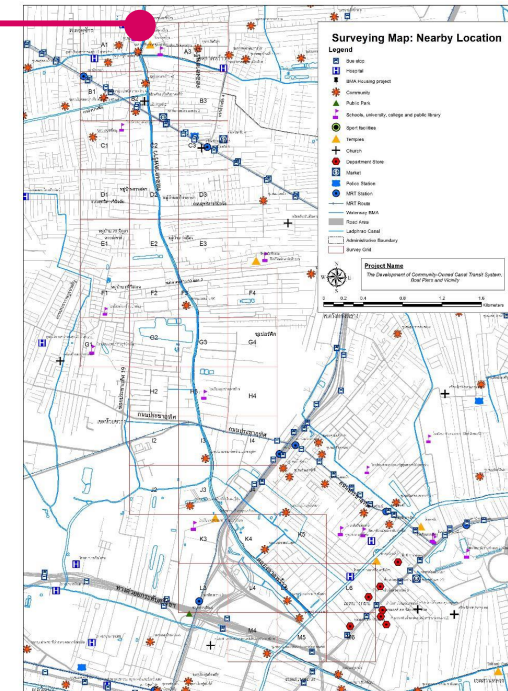
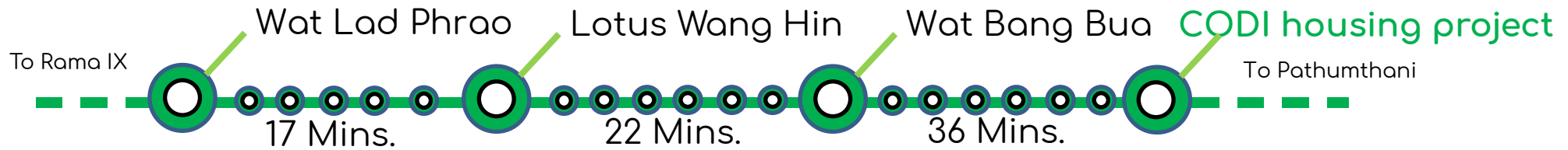


Building use condition



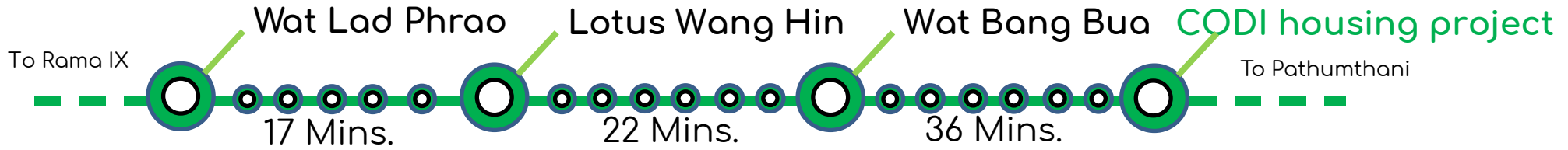
TOD SOLUTION: HOW ?

Survey route segment : CODI housing project



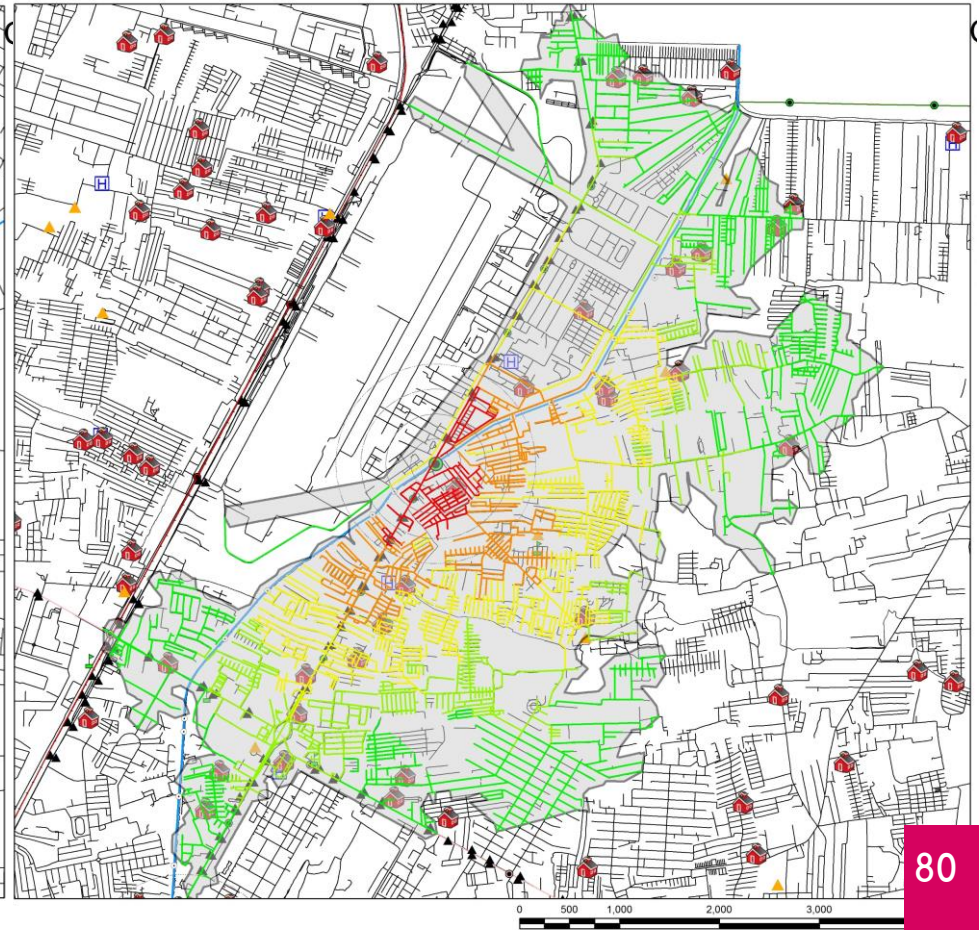
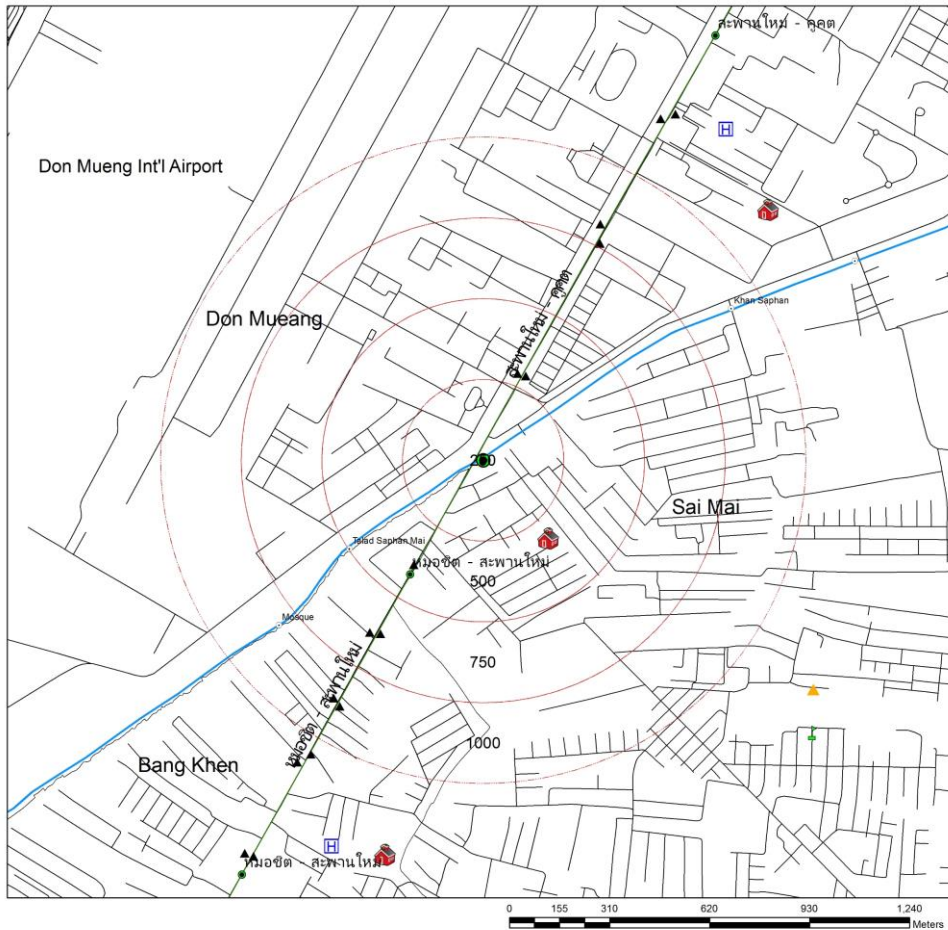
TOD SOLUTION: HOW ?

Survey route segment : CODI housing project



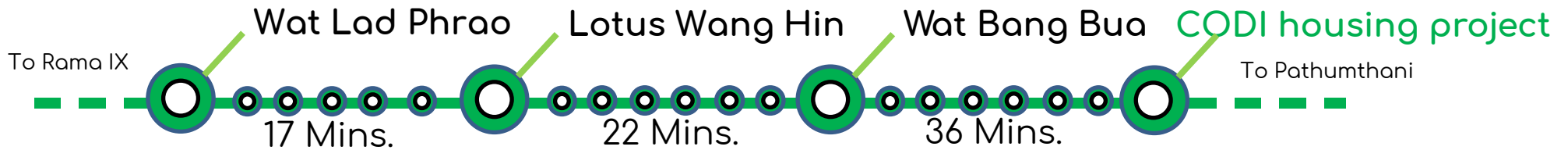
Location and nearby places

Reachability to pier location (5 Km)

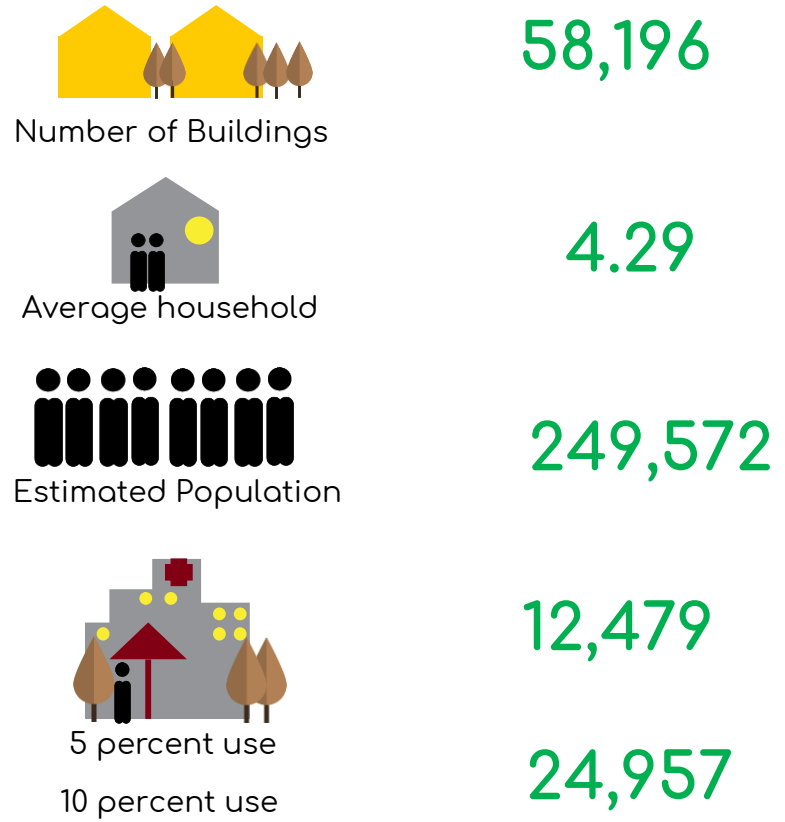
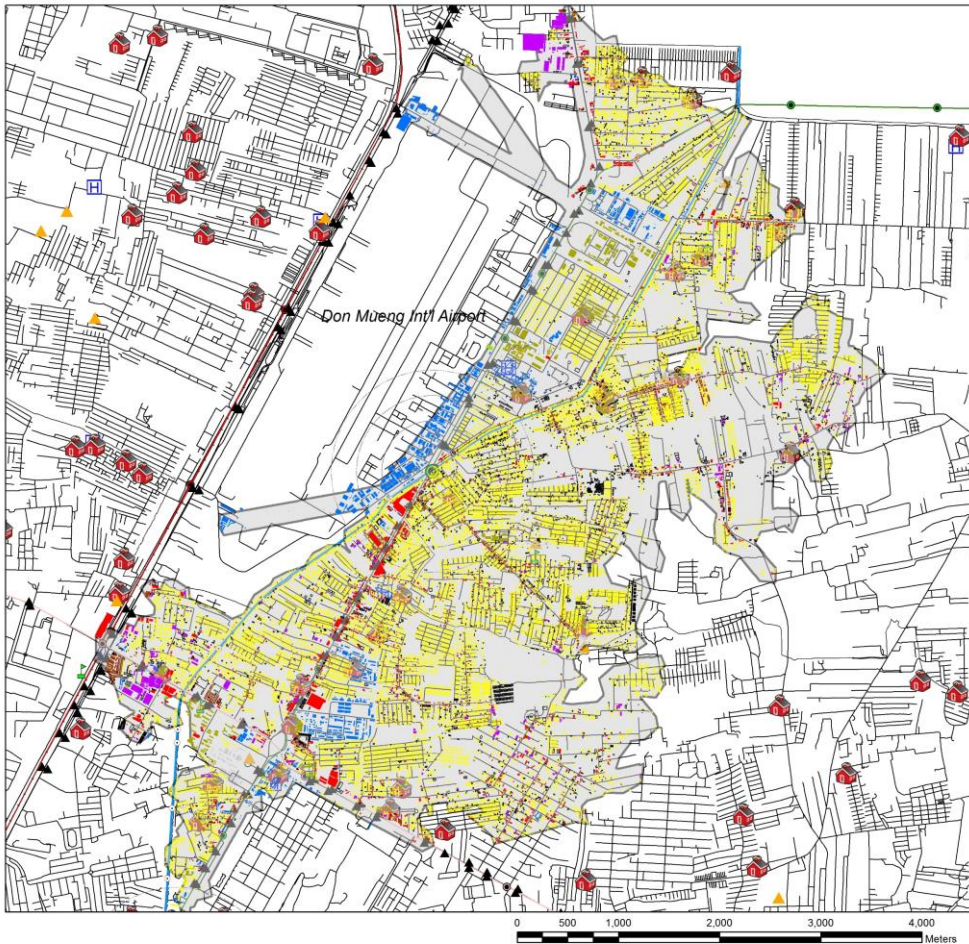


TOD SOLUTION: HOW ?

Survey route segment : CODI housing project



Building use condition



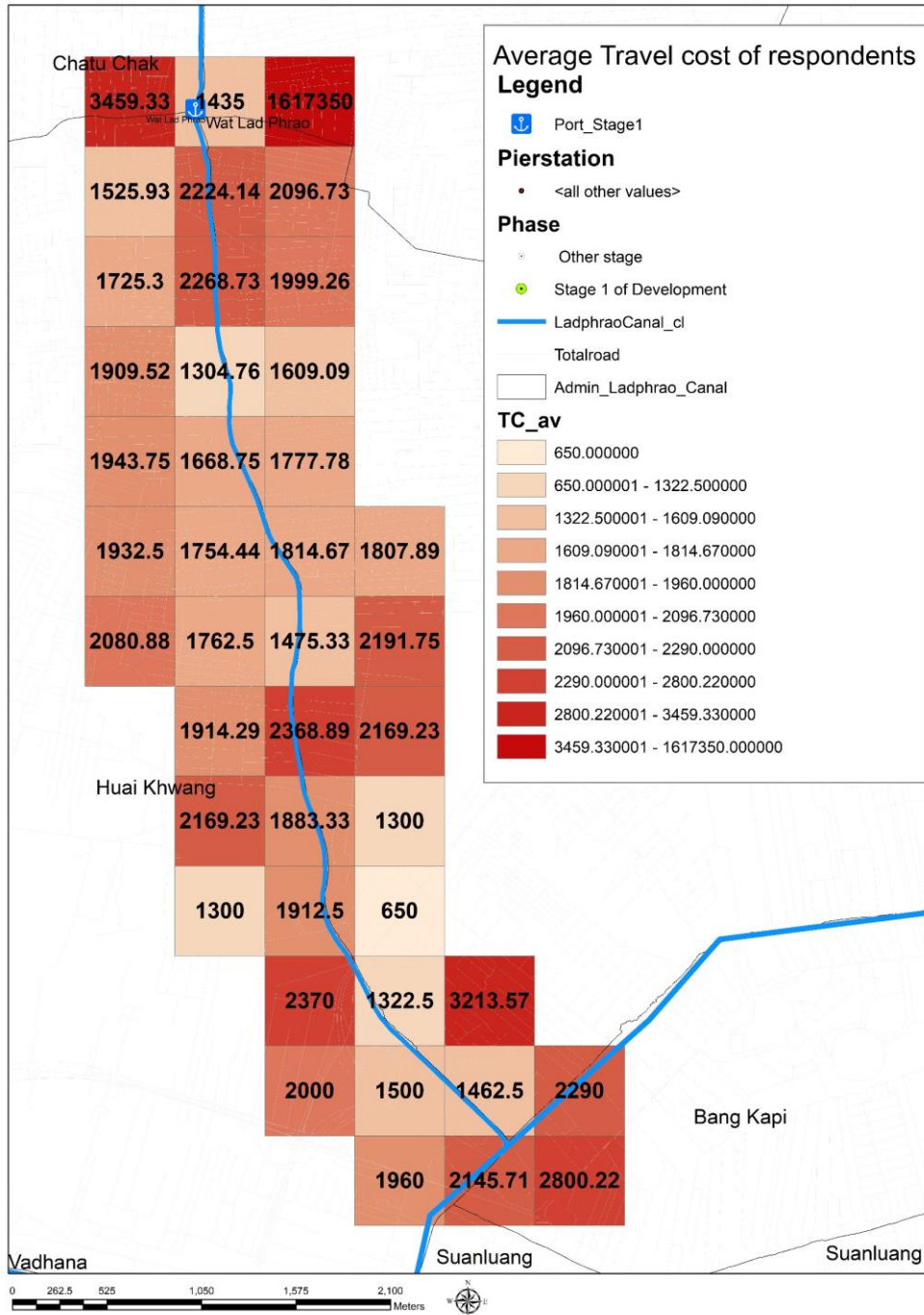
Travel behavior

TOD SOLUTIONS

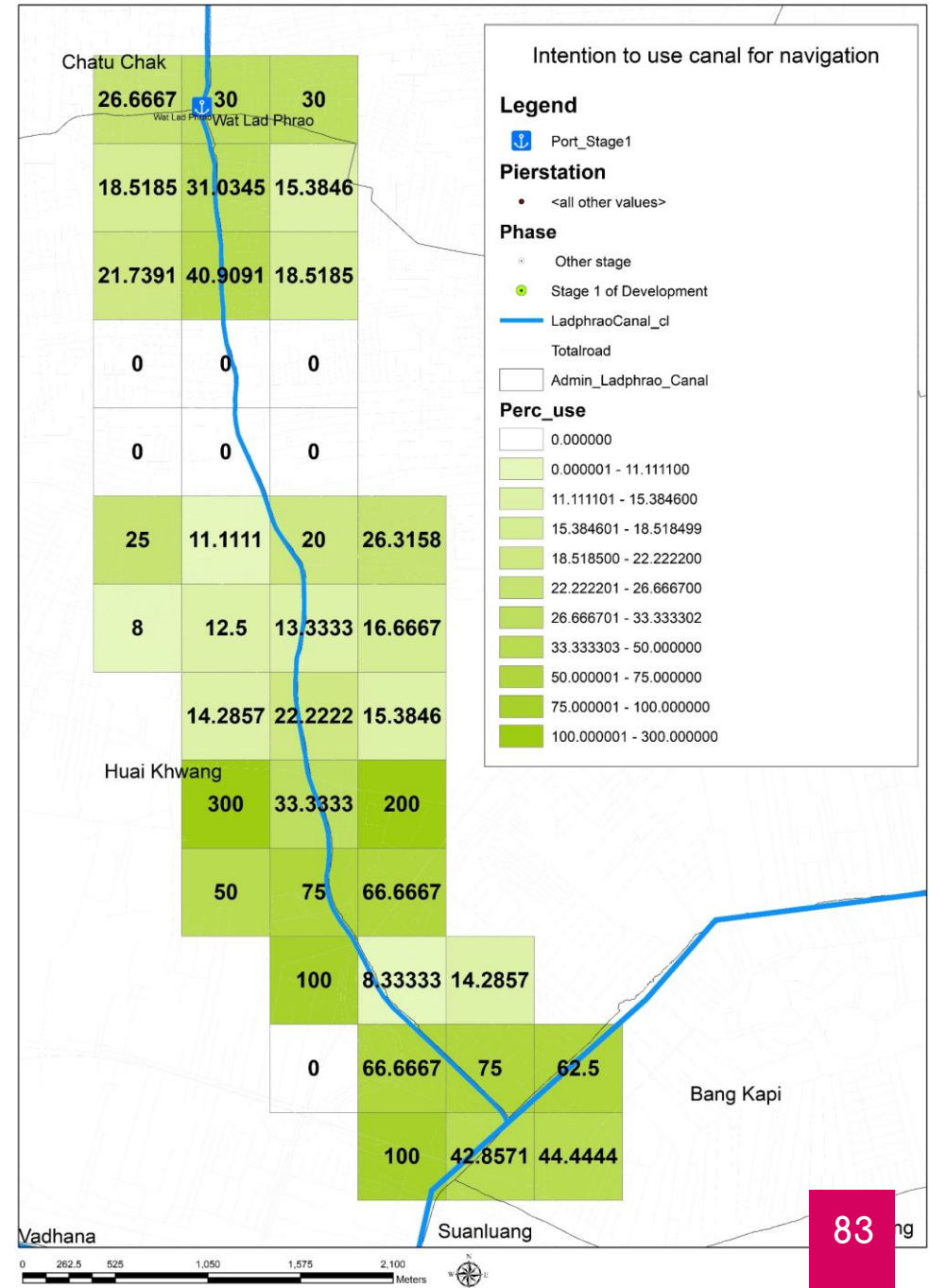
TOD SOLUTION: HOW ?

Travel Behavior

Average travel cost per month per grid

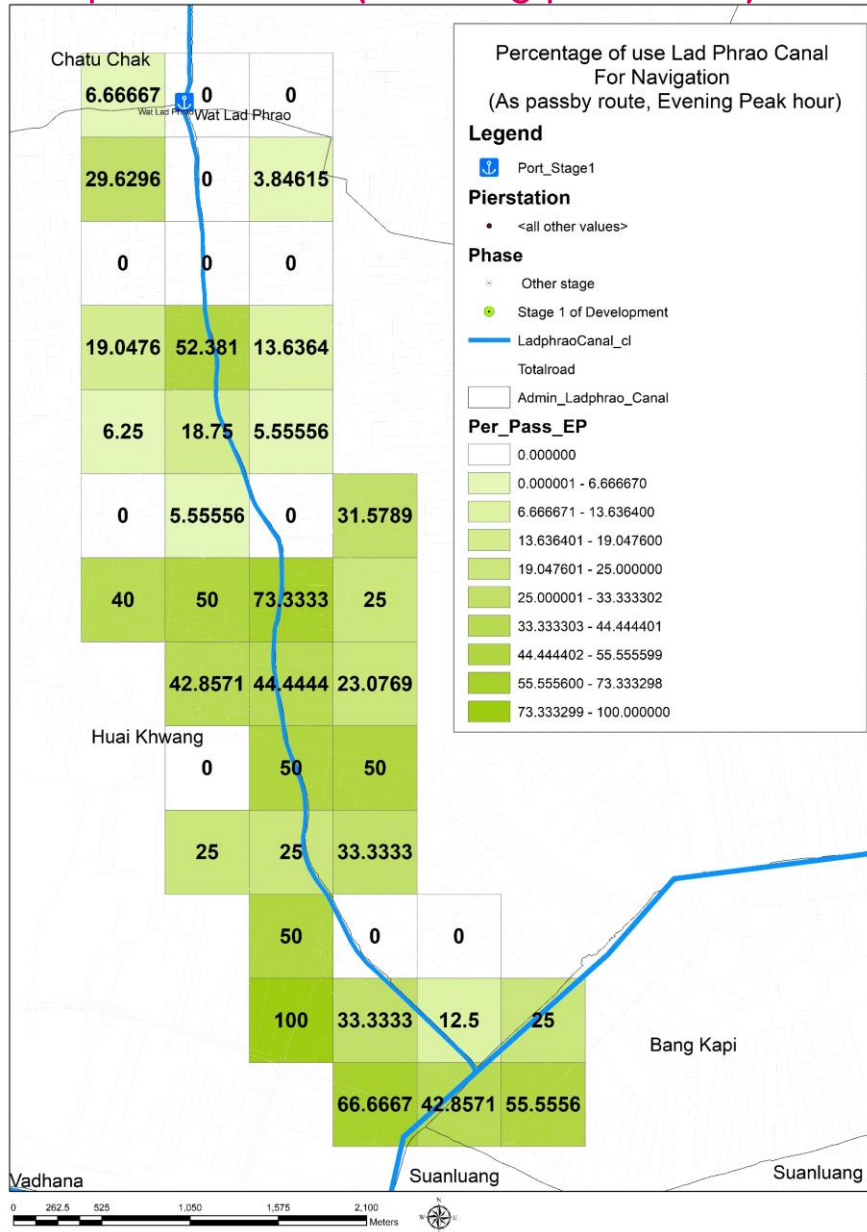


Percentage use Lad Phrao canal for navigation

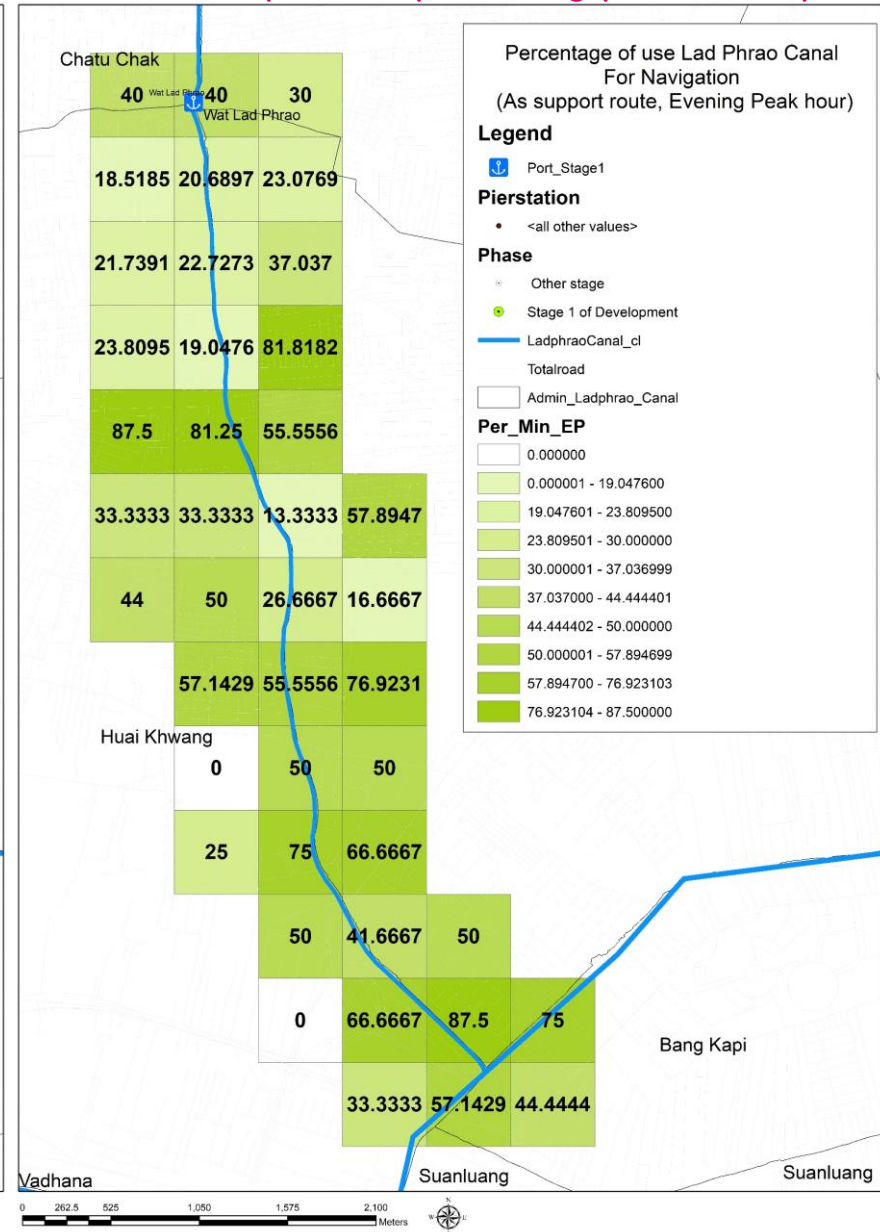


Navigation - Morning peak hour (7AM-9AM)

Percentage of use as
Optional route (Morning peak hour)



Percentage of use as
Pass-by route (Morning peak hour)



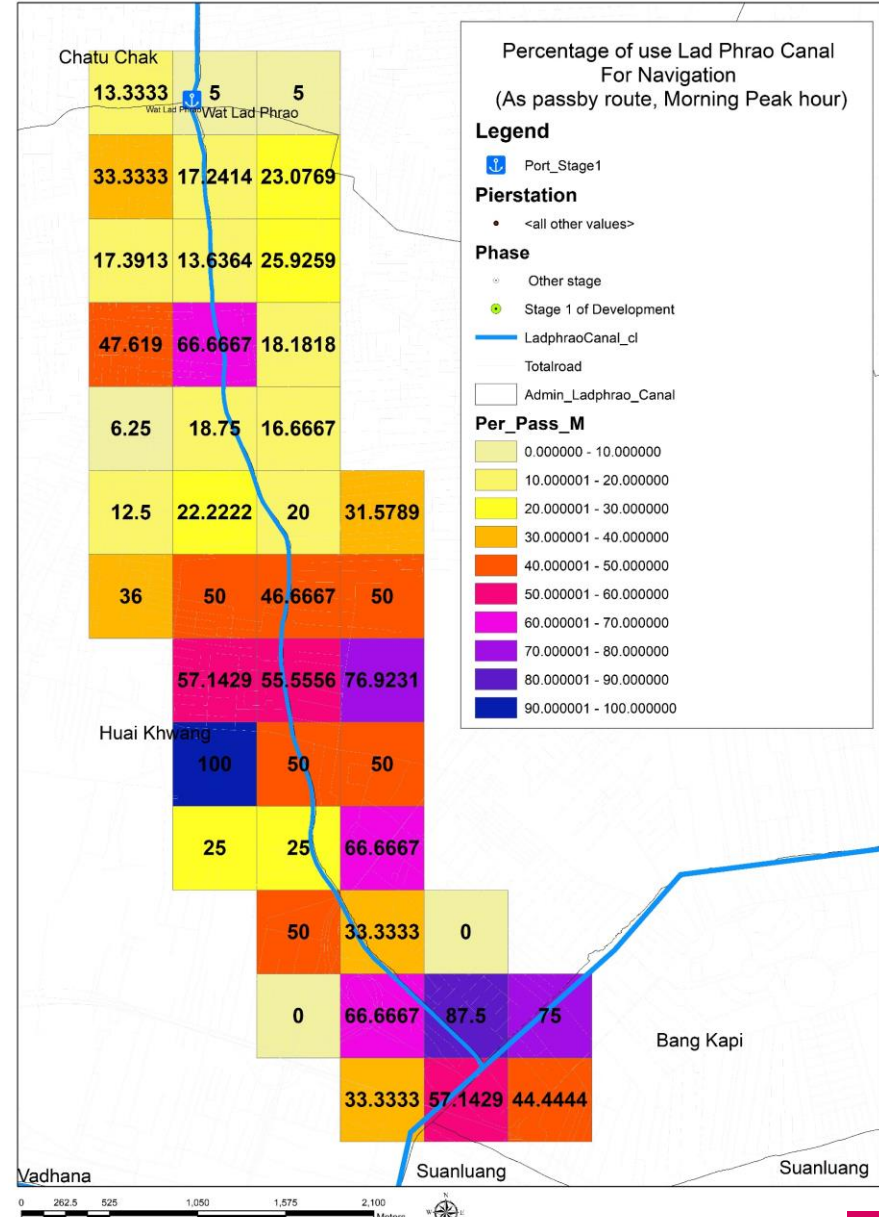
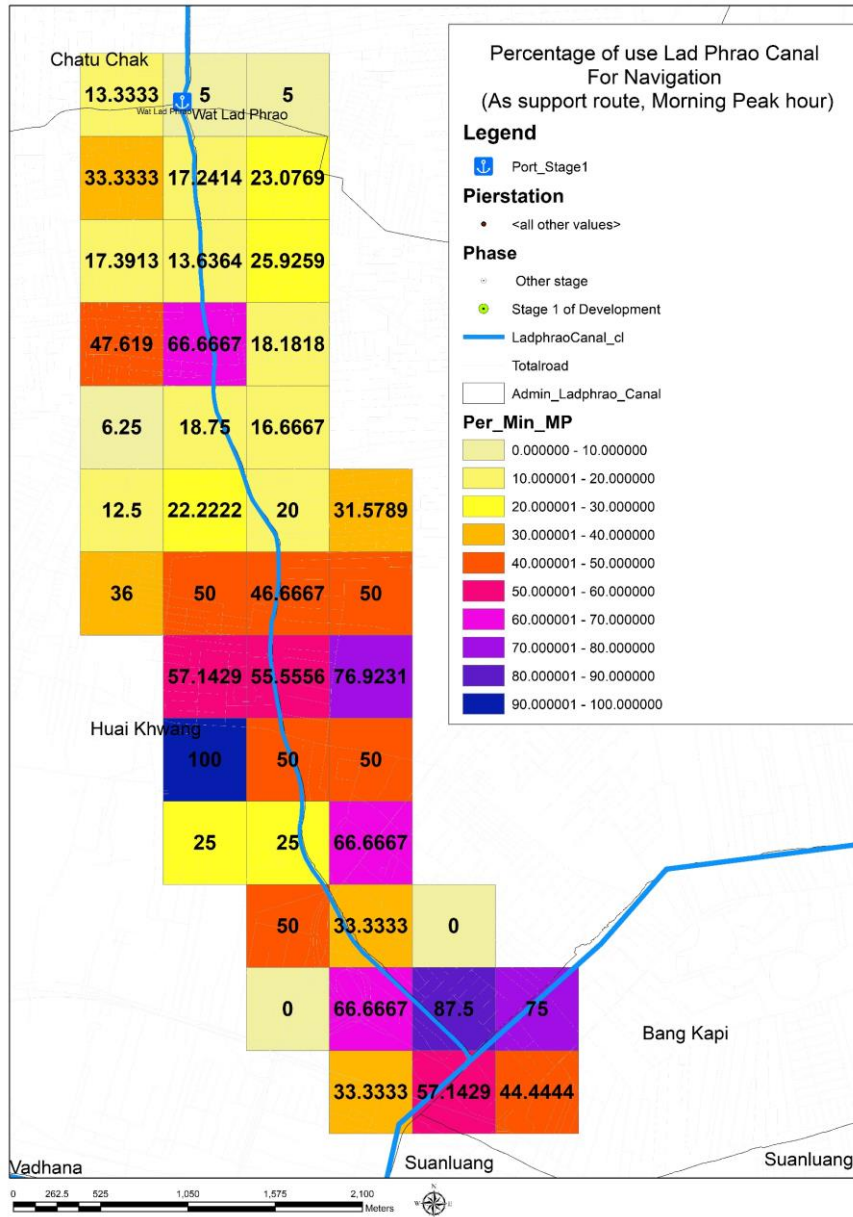
Statistic in dataset (Of 1,200 Set of questionnaire survey)
Use as optional route for navigation = 337 cases (28.10%)

Statistic in dataset (Of 1,200 Set of questionnaire survey)
Use as pass-by route for navigation = 203 cases (16.90%)

Navigation - Evening peak hour (4PM-7PM)

Percentage of use as
Optional route (Morning peak hour)

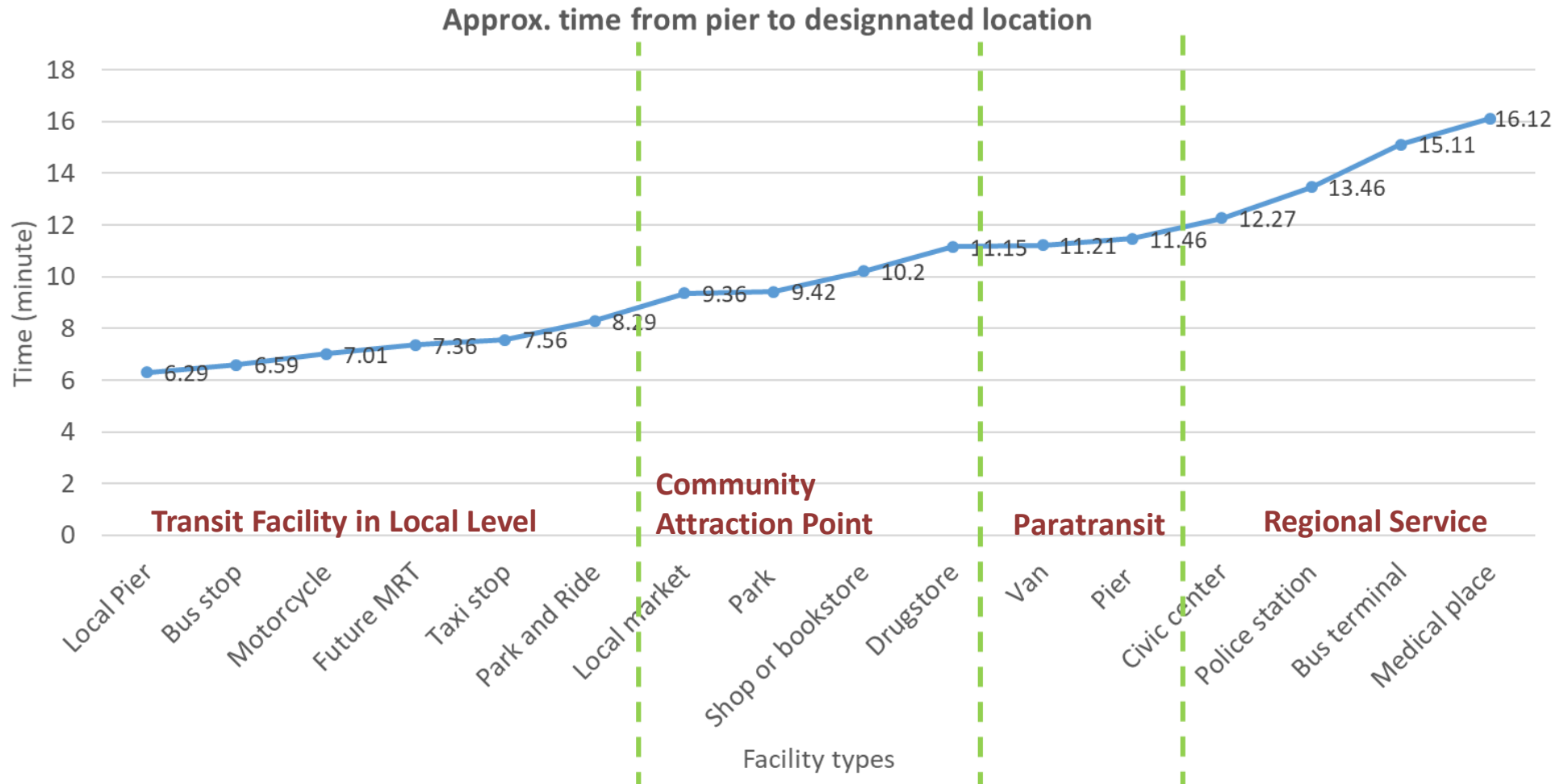
Percentage of use as
Pass-by route (Morning peak hour)



Statistic in dataset (Of 1,200 Set of questionnaire survey)
Use as optional route for navigation = 452 cases (37.70%)

Statistic in dataset (Of 1,200 Set of questionnaire survey)
Use as pass-by route for navigation = 189 cases (15.80%)

Connectivity to other facilities



Calculation assumptions and remarks

- (1) Average time from location to pier (minute) derived from questionnaire survey
- (2) Walking distance (meter) calculated based on normal people walking speed (1.22 m/s)
- (3) Driving distance (motorcycle) (meter) calculated based on fixed speed (30 Km/hr which is equal to 8.33 m/s). Acceleration and deacceleration are not in calculation

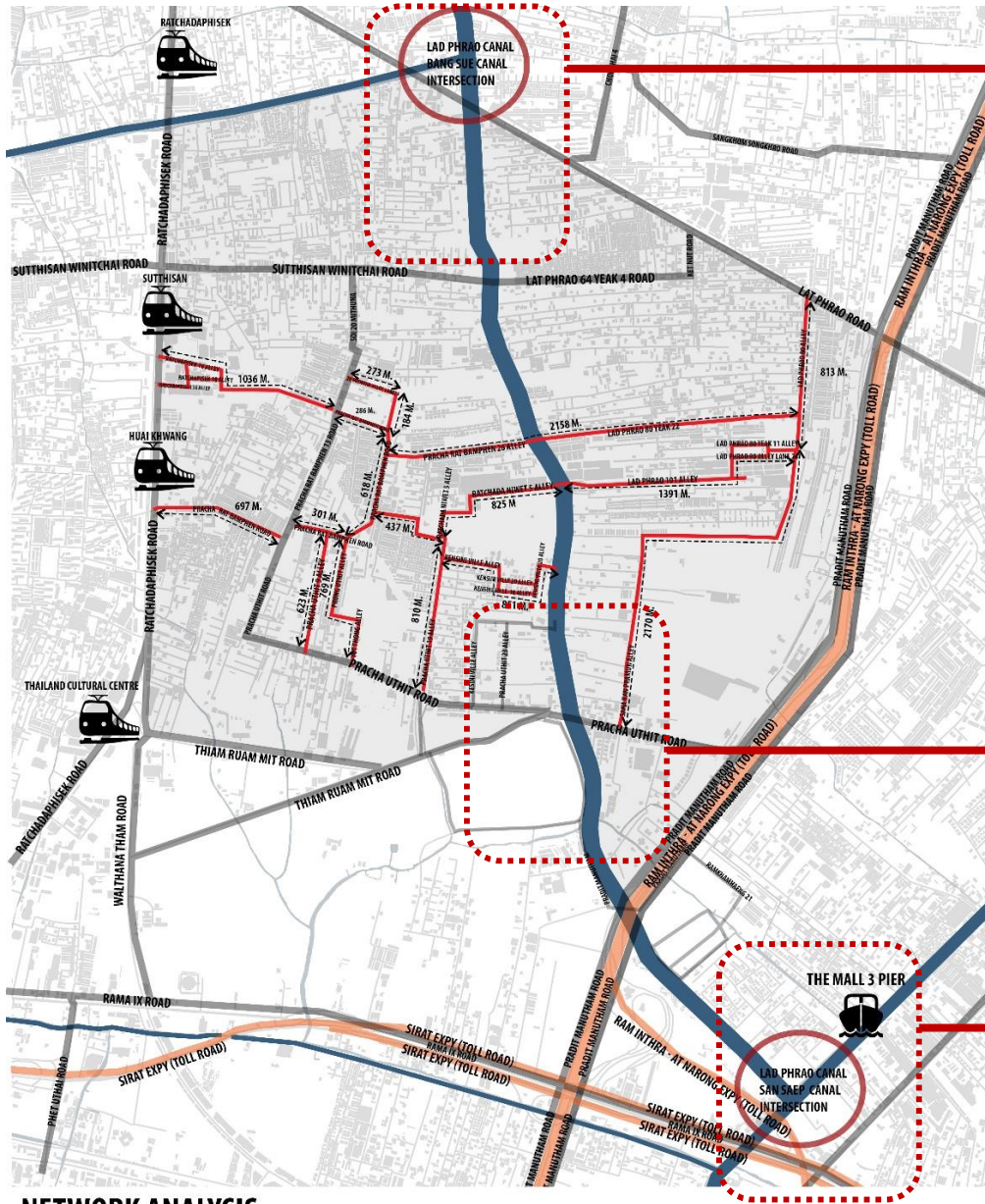
Klong Designed

-

3 Section
(North, Central
and South)

TOD SOLUTIONS

TOD SOLUTION: HOW ?



Northern section of the canal intersect with Lat Phrao Road at Phiboon Ubpathum School and Lat Phrao Temple. The closest MRT station is Huai Kwang station.

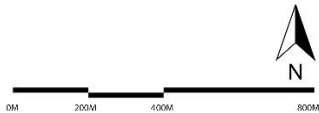
Central section of the canal align with Tien Ruam Mitr Road at MRT office and Depot. It locates 2.5 km away from Ratchadapisek Road.

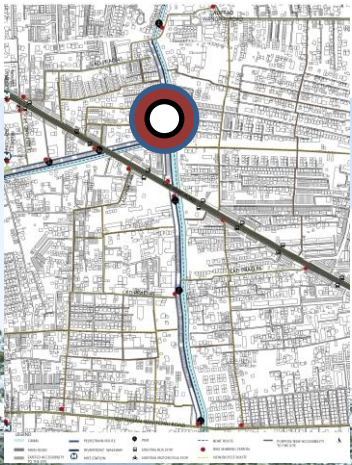
Southern section of the canal meets Saen Saep canal (there is a public boat service already). The site is utilized as water treatment pond. It has closest access to Prad Manuthum Road.

NETWORK ANALYSIS

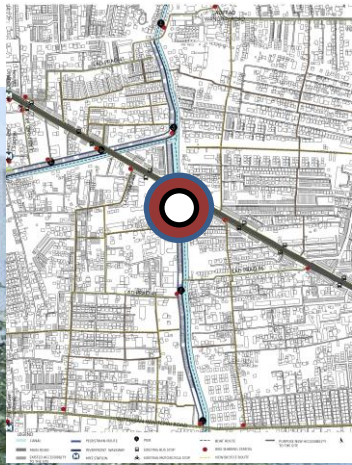
LEGENDS

- MRT STATIONS
- PIER
- ALLEYS
- MAIN ROADS
- TOLL WAYS
- DISTANCE
- ALLEYS CONNECTING FROM MAIN ROADS TO THE CANAL

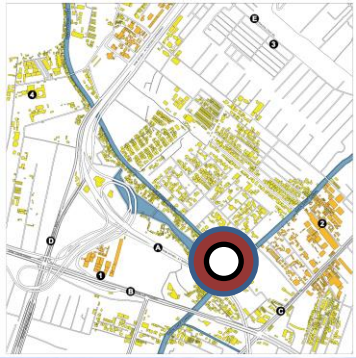




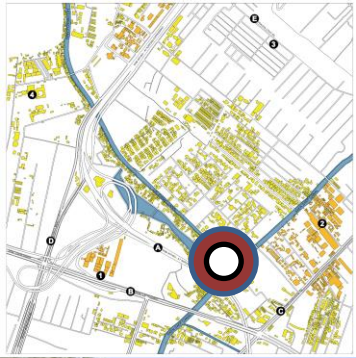
Perspective of the community scale pier
at Lat Phrao 45 community



Perspective of District scale pier in front
of Phiboon Uppathum school



Perspective of the community scale pier
at Rama IX Pattana community



Perspective of district scale pier at Bueng Rama IX community
(Near Lat Phrao and Saen Saeb canal interchange)

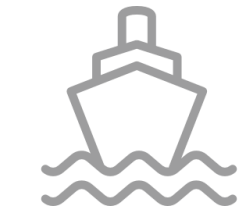
TOD SOLUTION: HOW ?

Community Assets and Needs Assessments



Assets Assessment

Method: Assets-Based Community Development (ABCD) and Perception of Potential (PoP)



Smart Boat



Coop Boat



Solar Energy Power



OTOP Product Center



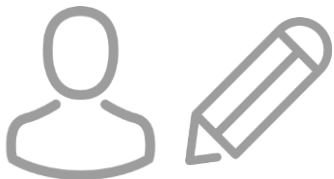
General Business at The Pier



Laundry House



Grocery Store



Research Trip



AirBNB



Needs Assessment

Method: Focus group and In-depth interview



TOD SOLUTION: HOW ?

Community Assets and Needs Assessments

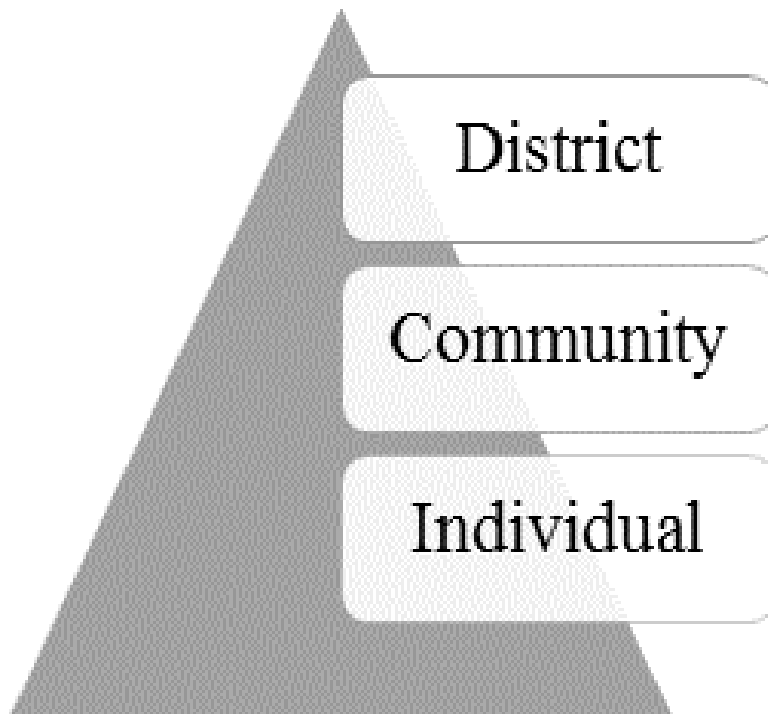


Figure 1: Possible forms of business

- Public Private Partnership (PPP)
- Boat Operating Entity
- Social Enterprise
- Cooperative
- Community-based Enterprise
- Sole Proprietorship and Informal Partnership

TOD SOLUTION: HOW ?

Smart Boat with PPP Feasibility Study



From the summarize above, the value of B/C ratio, Smart Boat case is profitable. In the same way of seeing in IRR rate, that shown the same direction of the benefits in each alternative. At this point, at 7% discount rate, this case is profitable.



Sensitivity Analysis
Increase Estimation of Cost 40%
NPV 2,885,390.58
IRR 9%

The program is still profitable.

Klong
“Lad
Phrao”



Circular
Economy

TOD SOLUTIONS

TOD SOLUTION: HOW ?

Canal
community

Physical
development

Waste
management

Renewable Energy

LINEAR ECONOMY



Circular
village



Sustainable
Approach

Production/
Consumption
for self
sustainable
development

Public participation with
all stakeholders

Energy Consumption

REFERENCES

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TOD and Its Sustainability



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