Thailand
Office of Transport and Traffic Policy and Planning (OTP)
State Railway of Thailand (SRT)

Data Collection Survey on Urban Redevelopment in Bang Sue Area in the Kingdom of Thailand

Final Report

November 2017

Japan International Cooperation Agency (JICA)

Nippon Koei Co., LTD.
KISHO KUROKAWA architect & associates
UR Linkage Co., LTD.

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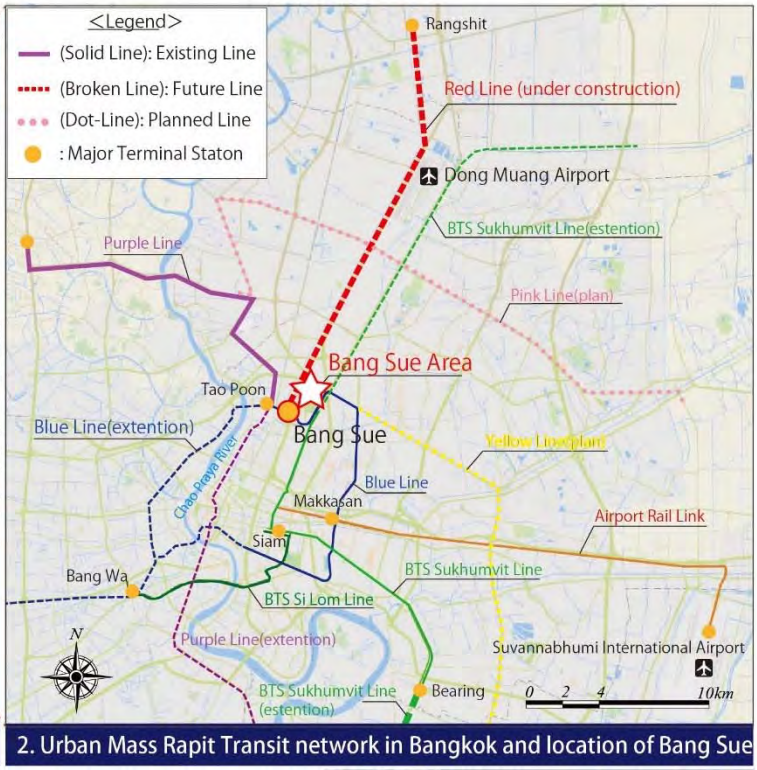
1. Location of Bangkok

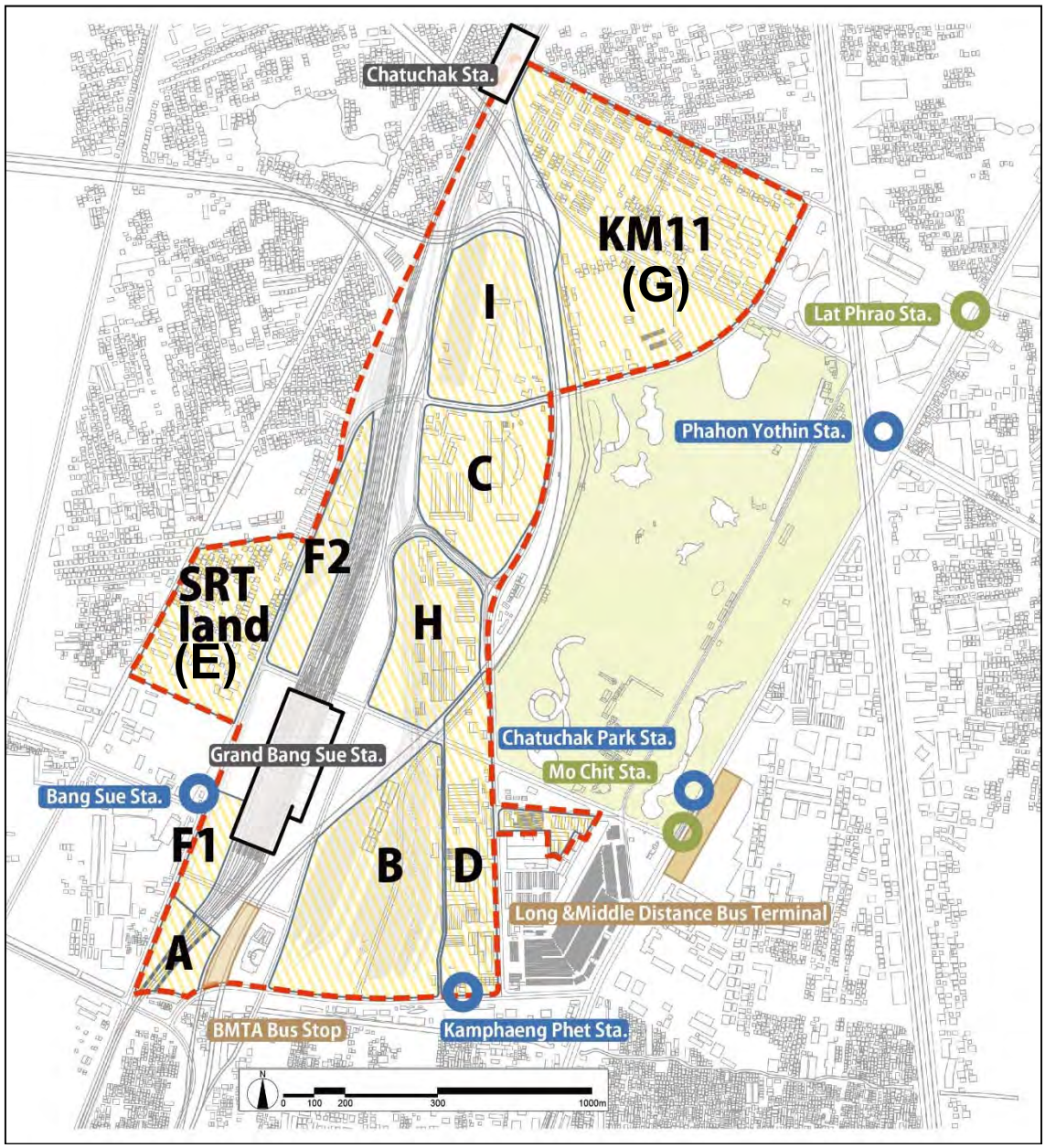


2. Urban Mass Rapit Transit network in Bangkok and location of Bang Sue

3. Bang Sue Area Detailed Chart

Source: JST

Location Map



Note: In the present survey, each zone in survey area shall be named as shown above.

Source: JST

Bang Sue Area Zoning Map

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ABBREVIATION

ARL	Airport Rail Link
ASEAN	Association of South - East Asian Nations
BCP	Business Continuity Plan
BMA	Bangkok Metropolitan Administration Region
BMTA	Bangkok Mass Transit Authority
BRT	Bus Rapid Transit
BTS	Bangkok Mass Transit System
CAPEX	Capital Expenditure
CBD	Central Business District
DOH	Department of Highway, Ministy of Transport
DPT	Department of Public Works and Town & City Planning, Ministry of Interior
EEC	Eastern Economic Corridor
EGAT	Electricity Generating Authority of Thailand
EPPO	Energy Policy and Planning Office
EXAT	Expressway Authority of Thailand
FAR	Floor Area Ratio
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
LCC	Low Cost Carrier
MEA	Metropolitan Electricity Authority
METI	Ministry of Economy, Trade and Industry
MICE	Meetings, Incentives, Conferences and Exhibitions
MLIT	Ministry of Land, Infrastructure, Transport and Tourism, Japan
M-Map	Mass Rapid Transit Master Plan in Bangkok Metropolitan, Japan
MOE	Ministry of Energy
MOF	Ministry of Finance
MOT	Ministry of Transport
MRT	Mass Rapid Transit
MRTA	Mass Rapid Transit Authority of Thailand
MWA	Metropolitan Waterworks Authority
NESDB	Office of the National Economic and Social Development Board
NMT	Non-Motorized Transport
ODA	Official Development Assistance
OPEX	Operating Expense
OSR	Open Space Ratio
OTP	Office of Transport and Traffic Policy and Planning
PCU	Passenger Car Unit
PPP	Public-Private Partnership
PTPS	Public Transportation Priority Systems
PTT	PTT Public Company Limited
SEPO	State Enterprise Policy Office, Ministry of Finance
SPP	Small Power Producers
SRT	State Railway of Thailand
TOD	Transit Oriented Development
UMRT	Urban Mass Rapid Transit
WG	Working Group
WS	Work Shop

The exchange rate used in this report is
1USD=112.185 JPY
1THB=3.3069 JPY
(July 2017, JICA Monthly exchange rate)

บทสรุปผู้บริหาร

1.ความเป็นมา

กรุงเทพมหานครและปริมณฑลซึ่งประกอบไปด้วยเขตพื้นที่กรุงเทพมหานครและจังหวัดทั้งห้าที่ตั้งอยู่โดยรอบ ปัจจุบันมีจำนวนประชากรทั้งหมด 10,730,000คน จากข้อมูลรายได้ต่อหัวของประชากรในเขตพื้นที่กรุงเทพมหานครและปริมณฑลในปี พ.ศ. 2556 คิดเป็น 376,463 บาท ซึ่งสูงกว่ารายได้ต่อหัวของประชากรในประเทศที่ 193,394 บาทถึงเกือบสองเท่า นอกจากนี้ในเขตพื้นที่ดังกล่าวยังมีประชากรอาศัยอยู่มากที่สุด และถือเป็นศูนย์กลางของเศรษฐกิจและการเมืองในประเทศ

เพื่อแก้ไขปัญหาการจราจรติดขัดรวมถึงปัญหาสิ่งแวดล้อมที่เกิดในพื้นที่กรุงเทพมหานครและปริมณฑล กระทรวงคมนาคมแห่งประเทศไทยได้เริ่มนำระบบการขนส่งมวลชนเข้ามาใช้ในช่วงปีพ.ศ. 2533-2542 จากข้อมูล ณ เดือนมกราคม พ.ศ. 2560 พบว่า มีเส้นทางขนส่งมวลชนที่เปิดให้บริการด้วยกัน 4 เส้น ได้แก่ รถไฟฟ้าบีทีเอสสายสุขุมวิท รถไฟฟ้าบีทีเอสสายสีลม รถไฟฟ้ามหานครสายสีน้ำเงิน รถไฟฟ้ามหานครสายสีม่วง และเส้นทางระหว่างสนามบิน 1 เส้น ได้แก่ แอร์พอร์ตเรลลิงก์ นอกจากนี้ยังมีอีกหลายโครงการที่อยู่ระหว่างดำเนินงาน และอยู่ระหว่างการก่อสร้างเพื่อที่จะขยายต่อเส้นทางปัจจุบัน รวมถึงการสร้างเส้นทางใหม่เพื่อที่จะยกระดับโครงข่ายระบบการขนส่งมวลชนในเมืองให้สมบูรณ์

สำหรับโครงการรถไฟสายชานเมืองสีแดงของการรถไฟแห่งประเทศไทย (รฟท.) ซึ่งครอบคลุมถึงสถานีกลางบางซื่อโดยมีความยาวทั้งสิ้น 26.3 กิโลเมตร และมีแหล่งเงินทุนสำคัญหนึ่งมาจากเงินกู้องค์กรของญี่ปุ่น รฟท.ในฐานะของผู้ดำเนินการพัฒนาโครงข่ายตั้งเป้าหมายที่จะเปิดให้บริการเดินรถได้ในเดือนกรกฎาคม พ.ศ. 2563 สถานีกลางบางซื่อจะกลายเป็นสถานีขนส่งที่ใหญ่ที่สุดในกรุงเทพมหานคร โดยมีระบบขนส่งมวลชนในเมืองหลายสาย รวมถึงรถไฟสายชานเมืองสีแดงที่จะเข้าจอดที่สถานีกลางบางซื่อนี

พื้นที่เป้าหมายในการศึกษาครั้งนี้ (ต่อจากนี้จะเรียกว่า "พื้นที่บางซื่อ") ประกอบด้วยสถานีกลางบางซื่อและที่ดินผืนใหญ่เพื่อระบบและสิ่งอำนวยความสะดวกทางราง ด้วยตำแหน่งที่ตั้งซึ่งจะเป็นศูนย์กลางการขนส่งของกรุงเทพมหานครในอนาคต พื้นที่ดังกล่าวจึงถือว่ามีศักยภาพอย่างมากที่จะเป็นพื้นที่ศูนย์กลางการพัฒนาเมือง ทั้งนี้ทางสำนักนโยบายและแผนการขนส่งและจราจร (สนข.) และรฟท. ได้ทำการศึกษาแผนแนวคิดในการพัฒนาต่าง ๆ โดยรฟท. โดยมีความต้องการที่จะพัฒนาฟื้นฟูพื้นที่ดังกล่าวในรูปแบบของการร่วมลงทุนระหว่างระหว่างภาครัฐกับเอกชน อย่างไรก็ตามรฟท.ประสบกับอุปสรรคต่าง ๆ เป็นต้นว่า การขาดการพัฒนาแบบบูรณาการอย่างเป็นขั้นตอน การขาดการประสานงานในแต่ละโครงการซึ่งได้ออกแบบบนแผนแม่บทเดียวกัน

ท่ามกลางสภาวะดังกล่าว กระทรวงคมนาคมแห่งประเทศไทยจึงร้องขอให้กระทวงที่ดิน ระบบโครงสร้างพื้นฐานคมนาคม และการท่องเที่ยวญี่ปุ่น (MLIT) ให้การสนับสนุนการพัฒนาแผนแม่บทซึ่งผ่านการผสมผสานบูรณาการเป็นแผนใหญ่เดียวกันสำหรับสถานีกลางบางซื่อและพื้นที่ต่อเนื่อง ด้วยความเป็นมาดังกล่าวสนข. รฟท. และ MLIT ได้ร่วมกันพิจารณา และเห็นถึงความจำเป็นอย่างมากของแผนแม่บทซึ่งจะต้องครอบคลุมแผนโครงสร้างพื้นฐานและรายละเอียดโครงการทั้งหมด ด้วยความตระหนักถึงความสำคัญดังกล่าวองค์การความร่วมมือระหว่างประเทศแห่งญี่ปุ่น (JICA) จึงเห็นควรที่จะให้ความร่วมมือในการตั้งทีมสำรวจเพื่อที่จะศึกษาและนำไปสู่การจัดร่างแผนแม่บทฉบับองค์รวม

1.1 วัตถุประสงค์การศึกษา

วัตถุประสงค์ของการสำรวจศึกษาในครั้งมีดังต่อไปนี

1. ทีมสำรวจของไจก้า (JST) จะรวบรวมและวิเคราะห์ข่าวสารและข้อมูลเพื่อการพัฒนาฟื้นฟูพื้นที่บางซื่อ โดยอ้างอิงตามผลการอภิปรายของคณะทำงาน และข้อมูลที่ MLIT ได้รวบรวมไว้ก่อนหน้านี้ ทั้งนี้ทีม สำรวจของไจก้าจะจัดทำ "วิสัยทัศน์การพัฒนา" และ "เอกสารเชิงหลักการ(ร่าง)" และผลักดันให้ผู้มีส่วน ได้ส่วนเสียเห็นพ้องต้องกันเพื่อดำเนินงานตามแผนพัฒนาแบบองค์รวม

2. ทีมสำรวจของไจก้าจะจัดทำแผนทั้งหมดทีเกียวข้องซึงประกอบด้วย โครงร่างเพื่อจัดดำเนินงาน โครงการ รวมถึงการจัดหาแหล่งทุนจากผู้มีส่วนได้ส่วนเสีย อาทิ รัฐบาลไทย องค์กรท้องถิน และ ภาคเอกชน เพื่อสนับสนุนการเตรียมโครงร่างการจัดดำเนินงานเพื่อการพัฒนาฟืนฟูพืนทีบางซือ

1.2 พืนทีสำรวจ

พืนทีเป้าหมายในการสำรวจแสดงตามรูป 1

ทีมา: ทีมสำรวจไจก้า

รูป 1 พืนทีบางซือ (พืนทีสำรวจ)

1.3 คณะทำงาน และการประชุมเชิงปฏิบัติการ

ระหว่างการสำรวจ(ตังแต่เดือนมีนาคมถึงเดือนสิงหาคม พ.ศ. 2560) มีการจัดการประชุมคณะทำงาน 3 ครัง การประชุมระดับปฏิบัติการ 9 ครังในกรุงเทพมหานคร โดยมีจุดประสงค์เพื่อรวบรวมความคิดเห็นของผู้มีส่วนได้ส่วนเสีย 3 ราย (ได้แก่ กระทรวงคมนาคม สนข. และรฟท.)

2. แผนขันนโยบายประเทศ

2.1 แผนการใช้ทีดิน แผนเพื่อการพัฒนาเมืองใหญ่ และแผนระบบรถไฟฟ้าขนส่งมวลชน

แผนสำคัญเพื่อการพัฒนาเมืองซึงเกียวกับการพัฒนาพืนทีบางซือมีรายละเอียดดังตาราง 1.

ตาราง 1 แผนสำคัญเพื่อการพัฒนาเมืองอันเกียวเนืองกับการพัฒนาพืนทีบางซือ

พืนที	แผน	ผู้จัดทำ	สาระสำคัญ
ประเทศ	ผังประเทศไทยพ.ศ. 2600 (Thailand National Spatial Development Plan 2057)	กรมโยธาธิการและผังเมือง (DPT)	เพื่อบรรลุวิสัยทัศน์ด้านการผังเมืองของประเทศภายในปี พ.ศ. 2600 จึงมีการศึกษาและกำหนด "กรอบแนวทางการพัฒนาผังเมือง" "พืนทียุทธศาสตร์และแนวทางการพัฒนาในอนาคต" "อุปสรรคสำคัญในนโยบายการพัฒนาของประเทศ" และมาตรการดำเนินงานต่าง ๆ ตามนโยบายผังเมืองในระยะเวลา 50 ปี
ภูมิภาค	นโยบายการพัฒนาระดับภูมิภาค	กรมโยธาธิการและผังเมือง	นโยบายการพัฒนาของ 6 ภูมิภาคซึงประกอบด้วยภาคกรุงเทพมหานครและปริมณฑล ภาคตะวันออก ภาคกลาง

พื้นที่	แผน	ผู้จัดทำ	สาระสำคัญ
		(DPT)	ภาคตะวันออกเฉียงเหนือ ภาคเหนือ และภาคใต้
จังหวัด	ผังเมืองรวมกรุงเทพมหานคร พ.ศ. 2556	กรุงเทพมหานคร (BMA)	แผนผังกำหนดการใช้ประโยชน์ที่ดินและการพัฒนาโครงสร้างพื้นฐาน ซึ่งระบุถึงข้อกำหนดการพัฒนาพื้นที่ เช่น ประเภทและขนาดกิจการที่จะอนุญาตให้ดำเนินการ อัตราส่วนพื้นที่อาคารรวมกันทุกชั้นของอาคารทุกหลังต่อพื้นที่แปลงที่ดินที่ใช้เป็นที่ตั้งอาคาร (FAR) อัตราส่วนพื้นที่ว่างอันปราศจากสิ่งปกคลุมของแปลงที่ดินที่อาคารตั้งอยู่ต่อพื้นที่ใช้สอยรวมของอาคาร (OSR) เป็นต้น
ระบบรถไฟฟ้าขนส่งมวลชน	แผนแม่บทระบบขนส่งมวลชนทางรางในกรุงเทพมหานครและปริมณฑล (M-MAP)	สำนักงานนโยบายและแผนการขนส่งและจราจร (OTP)	แผนพัฒนาระบบขนส่งมวลชนทางรางจำนวน 12 เส้นทาง (ระยะทาง556กิโลเมตร) ในภาคกรุงเทพมหานครและปริมณฑล ในแผนดังกล่าวระบุให้พื้นที่บางซื่อเป็นศูนย์กลางการขนส่งสำคัญในกรุงเทพมหานคร

ที่มา: ทีมสำรวจไจก้า

2.2 นโยบายและแผนในการพัฒนาเศรษฐกิจและอุตสาหกรรม

นโยบายสำคัญและแผนในการพัฒนาเศรษฐกิจและอุตสาหกรรมของประเทศไทยมีรายละเอียดดังในตาราง 2

ตาราง 2 นโยบายสำคัญและแผนในการพัฒนาเศรษฐกิจและอุตสาหกรรมของประเทศไทย

แผน	ผู้จัดทำ	สาระสำคัญ
ประเทศไทย 4.0	รัฐบาลไทย	รัฐบาลไทยวางนโยบายที่จะปรับจากเศรษฐกิจปัจจุบันซึ่งเน้นการลงทุนจากต่างประเทศในกลุ่มอุตสาหกรรม อาทิ รถยนต์ไฟฟ้าและอิเลกทรอนิกส์ ปิโตรเคมี ฯลฯ (ยุค3.0) ไปสู่ระบบเศรษฐกิจที่ขับเคลื่อนด้วยความรู้ ความคิดสร้างสรรค์ และนวัตกรรมโดยมุ่งเน้นไปที่อุตสาหกรรมซึ่งเน้นการใช้ความรู้ อุตสาหกรรมสีเขียว พลังงานที่นำกลับมาใช้ใหม่ได้ การให้บริการทางการแพทย์ และการขนส่ง
แผนยุทธศาสตร์ 20 ปี (พ.ศ.2560-2579)	สำนักงานคณะกรรมการพัฒนาการเศรษฐกิจและสังคมแห่งชาติ (NESDB)	รัฐบาลไทยได้กำหนดแผนยุทธศาสตร์ชาติเพื่อเป็นนโยบาย ระยะยาว ซึ่งประกอบด้วยเป้าหมายครอบคลุม 6 ด้าน โดยมี 6 ยุทธศาสตร์สำคัญและ 4 ยุทธศาสตร์ย่อยเพื่อสนับสนุนโดยมีรายละเอียดดังในตาราง 2.2.2 หรือที่เรียกกันว่า "ยุทธศาสตร์ 6-6-4"
แผนพัฒนาเศรษฐกิจและสังคมแห่งชาติ ฉบับที่ 12	สำนักงานคณะกรรมการพัฒนาการเศรษฐกิจและสังคมแห่งชาติ (NESDB)	แผนพัฒนาฯฉบับที่ 12 มีสาระสำคัญที่สานต่อแนวทางการพัฒนาจากแผนฉบับที่ 11 บนวิสัยทัศน์ว่าด้วย "สังคมแห่งความสุขซึ่งมีความเท่าเทียม ความยุติธรรม และความมั่นคงมีภูมิคุ้มกัน" โดยมี 10 ยุทธศาสตร์ที่มุ่งลดความเหลื่อมล้ำของรายได้ สร้างความเข้มแข็งทางเศรษฐกิจและพัฒนาความสามารถการแข่งขันในสังคมโลก
ระเบียงเศรษฐกิจภาคตะวันออก (EEC)	สำนักงานคณะกรรมการพัฒนาการเศรษฐกิจและสังคมแห่งชาติ (NESDB)	โครงการเขตเศรษฐกิจพิเศษภาคตะวันออกมีพื้นที่เป้าหมายครอบคลุมจังหวัดชลบุรี ระยอง และฉะเชิงเทรา โดยมีนโยบายเพื่อส่งเสริมการลงทุนในอุตสาหกรรมเทคโนโลยีขั้นสูง 10 กลุ่ม เช่น ยานยนต์พลังงานไฟฟ้า ยานยนต์พลังงานไฮบริด บริการทางการแพทย์ การบิน หุ่นยนต์ เป็นต้น
นโยบายการพัฒนาเขตเศรษฐกิจพิเศษคลัสเตอร์	สำนักงานคณะกรรมการส่งเสริมการลงทุนและรัฐบาลไทย	นโยบายมีจุดมุ่งหมายเพื่อสร้างเครือข่ายวิสาหกิจและสถาบันต่างๆที่เกี่ยวข้องเพื่อเกิดการรวมกลุ่มและดำเนินงานภายในพื้นที่เดียวกัน นโยบายคลัสเตอร์ทางธุรกิจมีจุดประสงค์เพื่อผลักดัน ให้เกิดการยกระดับการสนับสนุนและความร่วมมือในด้านต่างๆ ทางธุรกิจเพื่อที่จะทำให้ห่วงโซ่มูลค่าทางอุตสาหกรรมเข้มแข็ง ขึ้น เป็น การเสริมศักยภาพด้านการลงทุนและขีดความสามารถในการแข่งขันของไทยให้เพิ่มขึ้น และขยายการพัฒนาทางด้านสังคมและเศรษฐกิจสู่ภูมิภาคและท้องถิ่น
นโยบายเขตเศรษฐกิจพิเศษบริเวณชายแดน	รัฐบาลไทย	นโยบายครอบคลุมพื้นที่บริเวณกว้างโดยมุ่งพัฒนาเขตเศรษฐกิจพิเศษในเขตชายแดนของประเทศ ซึ่งได้มีการพัฒนาความร่วมมือทางด้านเศรษฐกิจในอนุภูมิภาคลุ่มแม่น้ำโขงกันมาก่อน

ที่มา: ทีมสำรวจไจก้า

2.3 นโยบายและยุทธศาสตร์อื่นๆ

นโยบายทีเกียวข้องอืนๆ อาทิ นโยบายและยุทธศาสตร์การวิจัยของชาติ (พ.ศ.2560-2564) นโยบายและแผนวิทยาศาสตร์ เทคโนโลยีและนวัตกรรมแห่งชาติ (พ.ศ.2555-2564) ฯลฯ ซึงได้กล่าวถึงกลยุทธ์การพัฒนาอุตสาหกรรมการจัดงานกิจกรรมทางธุรกิจ (MICE) แนวโน้มทางการแพทย์และสุขภาพและโครงสร้างประชากรทีจะเข้าสู่สังคมสูงวัย

2.4 ความสำคัญของพืนทีบางซือในประเทศไทย

จากแผนแม่บทระบบขนส่งมวลชนทางรางในกรุงเทพมหานครและปริมณฑล (M-MAP) ซึงจัดทำโดยสนข.ได้ให้ความสำคัญของพืนทีบางซือและพืนทีมักกะสันเป็นศูนย์กลางการขนส่งต่อเนืองหลายรูปแบบของกรุงเทพมหานคร นอกจากนันจากผังเมืองรวมกรุงเทพมหานคร พ.ศ.2556 ระบุให้พืนทีบางซือเป็นเขตพาณิชยกรรมซึงอัตราส่วนพืนทีอาคารรวมต่อพืนทีดิน (FAR) กำหนดไว้สูงเป็นลำดับสองรองจากพืนทีสีลมจากพืนทีทังหมดในกรุงเทพมหานคร จากข้างต้นพืนทีบางซือจึงนับว่ามีศักยภาพในการทีจะพัฒนาเป็นใจกลางในการพัฒนาพืนทีรอบสถานีขนส่งมวลชน (Transit Oriented Development-TOD) ซึงจะเป็นศูนย์กลางการคมนาคมสำคัญในอนาคต

2.5 ระบบกฎหมายและนโยบายทีเกียวข้องกับการพัฒนาเมือง

ระบบกฎหมายทีเกียวข้องกับการพัฒนาเมืองในประเทศไทยและสาระสำคัญมีรายละเอียดดังในภาคผนวก 2-1 "รายการระบบกฎหมายทีเกียวข้องกับแผนพัฒนาเมืองของญีปุ่นเทียบเคียงของไทย" สำหรับระบบกฎหมายของไทยมีกฎหมายและข้อกำหนดสำคัญทีเกียวข้องกับการดำเนินงานพัฒนาพืนทีบางซือขึนซึงเป็นโครงการขนาดใหญ่มีดังนี พระราชบัญญัติการผังเมืองพ.ศ.2518 พระราชบัญญัติควบคุมอาคารพ.ศ.2522 พระราชบัญญัติจัดรูปทีดินพ.ศ.2547 พระราชบัญญัติการจัดสรรทีดินพ.ศ.2543 พระราชบัญญัติส่งเสริมและรักษาคุณภาพสิงแวดล้อมแห่งชาติพ.ศ.2535 เกณฑ์และมาตรฐานผังเมืองรวมพ.ศ.2549 มาตรฐานผังเมืองกรุงเทพมหานครพ.ศ.2553

3. สภาพโดยทัวไปและแผนพัฒนาทีเกียวข้องกับพืนทีบางซือ

3.1 สภาพปัจจุบันของพืนทีบางซือ

พืนทีบางซือตังอยู่ห่างจากจุดศูนย์กลางธุรกิจขึนไปทางทิศเหนือประมาณ 10 กิโลเมตร โดยห่างจากสนามบินนานาชาติสุวรรณภูมิออกไปราว 35 กิโลเมตร และห่างจากสนามบินดอนเมืองซึงรองรับสายการบินภายในประเทศและสายการบินต้นทุนต่ำออกไปราว 14 กิโลเมตร ทังนีพืนทีบางซือได้รับการวางแผนเพือเป็นศูนย์กลางการคมนาคมในอนาคต โดยปัจจุบันในพืนทีและรอบข้างมีเส้นทางรถไฟฟ้ามหานคร (MRT) สายสีน้ำเงินสถานีบางซือและสถานีกำแพงเพชร รถไฟฟ้าบีทีเอสสถานีหมอชิต และสถานีกลางบางซือของรฟท.

สภาพพืนทีในปัจจุบันประกอบด้วยสถานีขนส่งรถโดยสารและระบบรถไฟรวมถึงรถไฟสายสีแดงทีกำลังดำเนินการก่อสร้าง พืนทีบางซือส่วนใหญ่มีรฟท.เป็นเจ้าของโดยใช้เป็นพืนทีเพือรองรับโครงการรถไฟสายสีแดง ทังนีเมือเทียบกับพืนทีซึงมีขนาด 33 ตารางกิโลเมตร พบว่ามีจำนวนผู้อาศัยทีไม่หนาแน่น จากข้อมูลของรฟท. จำนวนครัวเรือนในกม.ที11 และในพืนทีของรฟท. มี 1,931 ครัวเรือนและ 509 ครัวเรือนตามลำดับ จากข้อมูลขนาดครัวเรือนในพืนทีเขตเมืองโดยเฉลียคิดเป็น 3.5 คน[1] จำนวนผู้อยู่อาศัยในพืนทีดังกล่าว ประมาณได้เป็น 7,000 คนในพืนทีกม.11 และ 2,000 คนในพืนทีรฟท. ตามลำดับ

[1] สำนักงานสถิติแห่งชาติ (พ.ศ.2548)

3.2 แผนพัฒนาโดยรฟท.และสนข.

รฟท.ได้จัดดำเนินการศึกษาความเป็นไปได้เพื่อการลงทุนพัฒนาฟื้นฟูพื้นที่บางซื่อในปี พ.ศ.2558 - 2559 เพื่อที่จะสร้างมูลค่าเพิ่มของที่ดินและเพื่อการบริหารทรัพย์สินของรฟท. โดยมีพื้นที่เป้าหมายโซน "เอ" (A) ขนาด 35 ไร่ โซน "บี" (B) ขนาด 78 ไร่ โซน "ซี" (C) ขนาด 105 ไร่ ในขณะที่สนข.ได้ทำการศึกษาพื้นที่โซน "ดี" (D)) ขนาด 80 ไร่ และพื้นที่ส่วนเชื่อมต่อในช่วงเวลาเดียวกัน

3.3 แผนการเชื่อมต่อระหว่างพื้นที่โดยสนข.

แผนการเชื่อมต่อระหว่างพื้นที่ของสนข.มีวัตถุประสงค์เพื่อเสริมสร้างการเชื่อมต่อระหว่างโครงข่าย และทำให้การสัญจรสามารถเดินทางถึงกันได้ เบื้องต้นสนข.ได้เสนอระบบรถโดยสารด่วนพิเศษ (บีอาร์ที) เพื่อเป็นรูปแบบการโดยสารสาธารณะหลักในพื้นที่

นอกจากนี้สนข.ได้ประมาณการความต้องการขนส่งและจราจรในปี พ.ศ. 2565 พ.ศ.2575 และพ.ศ.2580 โดยการสำรวจปริมาณจราจรบริเวณทางแยก ข้อมูลสัมภาษณ์ตารางการเดินทาง (O-D) อัตราความเร็วในการเดินทาง โดยคาดการณ์ว่าในแต่ละวันจะมีผู้โดยสารจำนวน 1.42 ล้านคนที่ใช้งานสถานีกลางบางซื่อ

3.4 ผังแนวความคิดเมืองอัจฉริยะโดยปตท.

พื้นที่บางซื่อนับเป็น 1 ใน 10 พื้นที่เป้าหมายที่รัฐบาลไทยต้องการผลักดันให้เป็นเมืองอัจฉริยะ โดยมีแนวความคิดเพื่อปรับปรุงประสิทธิภาพการใช้พลังงานทั้งในส่วนของน้ำประปา ก๊าซ ไฟฟ้า พลังงานความร้อน ระบบการผลิตพลังงานร่วม (Co-generation) และระบบทำความเย็น ปตท.ได้ร่วมมือกับจุฬาลงกรณ์มหาวิทยาลัยเพื่อออกแบบผังแนวความคิดการพัฒนาเมืองอัจฉริยะสำหรับพื้นที่บางซื่อ โดยให้มีระบบเทคโนโลยีสำคัญซึ่งมีรายละเอียดดังนี้ 1) ระบบรถไฟฟ้าขนส่งมวลชน (MRT) 2) จุดให้บริการอินเทอร์เน็ตไร้สาย (Wi-Fi) สาธารณะ 3) ระบบทำความเย็น

4. ข้อมูลสภาพโครงสร้างพื้นฐาน

4.1 ข้อมูลสภาพโครงสร้างพื้นฐานบริเวณพื้นที่บางซื่อ

ข้อมูลสภาพโครงสร้างพื้นฐานบริเวณพื้นที่บางซื่อมีรายละเอียดดังในตาราง 3

ตาราง 3 ข้อมูลสภาพโครงสร้างพื้นฐานบริเวณพื้นที่บางซื่อ

ประเภท	ข้อมูลโดยสรุป
ระบบขนส่งมวลชนทางรางในเมือง	สภาพการจราจรที่แออัดบนถนนเส้นหลักในกรุงเทพมหานคร เป็นสิ่งที่ทราบกันโดยทั่วไป ปัจจุบันมีผู้ใช้บริการรถไฟฟ้าบีทีเอสกันอย่างมากมายโดยมองว่าเป็นรูปแบบการเดินทางที่สะดวกสามารถหลีกหนีรถติดได้ ระบบขนส่งมวลชนทางรางในกรุงเทพมหานครที่เปิดดำเนินการอยู่ ได้แก่ รถไฟฟ้าบีทีเอส (สายสีเขียวอ่อนและสายสีเขียวเข้ม) รถไฟฟ้ามหานคร (MRT สายสีน้ำเงินและสายสีม่วง) และรถไฟฟ้าแอร์พอร์ตเรลลิงก์ เส้นทางรถไฟที่เชื่อมต่อจากใจกลางเมืองสู่ชานเมืองฝั่งตะวันออก ได้แก่ รถไฟฟ้าสายสีชมพู รถไฟฟ้าสายสีเหลือง รถไฟฟ้าสายสีส้ม ทั้งนี้ รถไฟฟ้าสายดังกล่าวยังอยู่ใน ขั้นตอนการประกวดราคา หรือระหว่างการวางแผน ยังไม่ได้เริ่มการก่อสร้างจากข้อมูล ณ เดือนตุลาคม พ.ศ. 2560
รถไฟความเร็วสูง	ในปี พ.ศ. 2559 รัฐบาลไทยได้ลงนามบันทึกข้อตกลงในการนำใช้เทคโนโลยีญี่ปุ่นในโครงการรถไฟความเร็วสูงเส้นทางกรุงเทพฯ-เชียงใหม่ โดยมีระยะทางทั้งสิ้น 670 กิโลเมตร เมื่อรวมกับเส้นทางอื่นๆจะมีด้วยกัน 5 เส้นทางที่รัฐบาลไทยกำหนดที่จะพัฒนา ในโครงการรถไฟความเร็วสูง

ประเภท	ข้อมูลโดยสรุป
ถนน	บริเวณโดยรอบพื้นที่บางซื่อมีถนนหลายสายตัดผ่าน อาทิ ทางด่วนดอนเมือง-โทลเวย์ ทางด่วนศรีรัช ถนนพหลโยธิน และถนนกำแพงเพชร ฯลฯ ซึ่งดำเนินงานโดยบริษัทเอกชน การทางพิเศษแห่งประเทศไทยสังกัดกระทรวงคมนาคม และสำนักการโยธากรุงเทพมหานคร
สถานีขนส่งผู้โดยสาร	สถานีขนส่งผู้โดยสารในพื้นที่บางซื่อซึ่งเรียกกันโดยทั่วไปว่า สถานีขนส่งหมอชิต 2 ดำเนินงานโดยบริษัทขนส่งจำกัด (บขส.) ซึ่งเป็นหน่วยงานรัฐวิสาหกิจสังกัดกระทรวงคมนาคม บขส.ยังให้บริการรถโดยสารระยะทางไกลด้วย รถโดยสารระหว่างเมืองมีด้วยกัน 2 ประเภท ได้แก่ รถโดยสารขนาดใหญ่ซึ่งให้บริการในเส้นทางระยะไกลสู่เมืองทางภาคเหนือ ภาคตะวันออกเฉียงเหนือ และประเทศเพื่อนบ้าน และรถตู้โดยสารสำหรับเส้นทางระยะกลางซึ่งท่ารถที่ให้บริการจะอยู่แยกกันไปในสถานีขนส่งหมอชิต2 นอกจากนั้นยังมีสถานีรถโดยสารวิ่งรอบเมือง โดยองค์การขนส่งมวลชนกรุงเทพมหานคร (ขสมก.) เป็นผู้บริหารจัดการสถานีขนส่งและให้บริการเดินรถ จากข้อมูลปี พ.ศ. 2560 มีการให้บริการเดินรถทั้งหมด 209 เส้นทาง เฉพาะในพื้นที่บางซื่อมี 14 เส้นทางเดินรถที่มีต้นทางจากสถานีขนส่งขสมก. ข้อมูลปริมาณการสัญจรตามช่วงเวลาพบว่า การขนส่งและเดินทางจากฝั่งตะวันออกมีปริมาณมากกว่าเส้นทางอื่นในช่วงกลางวันตลอด 12 ชั่วโมง ทั้งนี้มีโครงการพัฒนาทาง ลาดที่จุดเชื่อมต่อสู่ภาคเหนือในเร็ววันนี้ จึงคาดว่าปริมาณการสัญจรจากทิศเหนือจะเพิ่ม มากขึ้นในอนาคต
ระบบระบายน้ำฝน	ระบบระบายน้ำฝนมีสำนักการระบายน้ำกรุงเทพมหานครทำการบริหารและดำเนินงาน พื้นที่บางซื่อตั้งอยู่ในที่ราบลุ่มแม่น้ำเจ้าพระยา ทั้งนี้ภูมิประเทศกรุงเทพมหานครเป็นพื้นที่ราบมีความสูงเฉลี่ยจากระดับน้ำทะเลประมาณ 0 เมตร การระบายน้ำอาศัยคูคลองตามธรรมชาติและทางระบายน้ำเพื่อที่จะระบายน้ำสู่แม่น้ำเจ้าพระยาซึ่งจะทำงานได้ดีในช่วงน้ำลง ดังนั้นการระบายน้ำโดยปกติจะใช้สถานีสูบน้ำและประตูน้ำในการปรับและระบายน้ำฝนสู่แม่น้ำเจ้าพระยา ทั้งนี้มีแผนที่จะก่อสร้างอุโมงค์ระบายน้ำใต้คลองบางซื่อเพื่อที่จะ ระบายน้ำสู่แม่น้ำเจ้าพระยาโดยตรง
ระบบน้ำประปา	ระบบน้ำประปาในกรุงเทพมหานครมีกรมประปานครหลวงเป็นผู้ให้บริการ โดยพื้นที่บางซื่ออยู่ในเขตสำนักงานประปาสาขาพญาไท กรมประปาฯสามารถจ่ายน้ำให้กับพื้นที่กรุงเทพมหานครได้ 98% น้ำประปาในพื้นที่บางซื่อผลิตโดยโรงผลิตน้ำบางเขน (กำลังผลิต 3.9 ล้านลูกบาศก์เมตรต่อวัน) และส่งน้ำโดยโรงสูบน้ำพหลโยธิน
ระบบระบายน้ำเสีย	ระบบระบายน้ำเสียในกรุงเทพมหานครมีสำนักการระบายน้ำกรุงเทพมหานครเป็นผู้ให้บริการ ในบริเวณใกล้เคียงพื้นที่บางซื่อมีโรงบำบัดน้ำเสีย 2 แห่ง ได้แก่ โรงบำบัดน้ำเสียบางซื่อ (120,000ลูกบาศก์เมตรต่อวัน) โรงบำบัดน้ำเสียจตุจักร (150,000ลูกบาศก์ เมตรต่อวัน)
ระบบการไฟฟ้า	พื้นที่บางซื่อและบริเวณใกล้เคียงได้รับพลังงานไฟฟ้าซึ่งจ่ายโดยสถานีย่อย 2 แห่งของ กรมไฟฟ้านครหลวง นอกจากนี้รฟท.ยังมีแผนตกลงร่วมกับการไฟฟ้านครหลวงที่จะ พัฒนาสถานีไฟฟ้าย่อยแห่งใหม่ขนาดประมาณ 6,400 ตารางเมตรในอนาคต
ท่อส่งน้ำมันและก๊าซ	ในพื้นที่บางซื่อมีท่อส่งน้ำมันและท่อส่งก๊าซในรูปแบบท่อฝังอยู่ใต้ดิน ทั้งนี้ ท่อส่งก๊าซมี ไว้เพื่อธุรกิจและอุตสาหกรรม ในขณะที่ครัวเรือนใช้ก๊าซโปรเพนเพื่อการหุงต้ม
ระบบกำจัดขยะ	การกำจัดขยะในกรุงเทพมหานครบริหารจัดการโดยสำนักสิ่งแวดล้อมกรุงเทพมหานคร ขยะในเมืองจะถูกรวบรวมไปที่สถานีขนถ่ายขยะมูลฝอย 3 แห่ง (สายไหม หนองแขม และอ่อนนุช) และขยะจะถูกแยกออกเป็นขยะทั่วไป ขยะอันตรายจากโรงพยาบาลและโรงงาน และขยะรีไซเคิล หลังจากนั้นจะผ่านกระบวนการนำกลับมาใช้ใหม่ หรืออัด/เผา ขยะที่ ผ่านการกำจัดเบื้องต้นจะถูกส่งต่อไปยังโรงกำจัดสุดท้ายที่จังหวัดนครปฐม หรืออำเภอ พนมสารคามจังหวัดฉะเชิงเทราเพื่อฝังกลบ

ที่มา: ทีมสำรวจไจก้า

5. การคาดการณ์ความต้องการในอนาคต

5.1 ผู้โดยสารรถไฟในและรอบบริเวณพื้นทีบางซือ

การคาดการณ์จำนวนผู้โดยสารรถไฟทั้งในและรอบบริเวณพื้นทีบางซือใช้วิธีประมาณการจาก 1) จำนวนผู้โดยสารซึงมาเปลียนต่อรถทีสถานีกลางบางซือ 2) คนในพื้นทีบางซือทีเข้ามาเพือกิจกรรมต่างๆทีออกแบบไว้ 3) ผู้มาเทียวชมทำกิจกรรมจากนอกพื้นทีบางซือ ตัวเลขจำนวนเทียวต่อคนต่อวันประมาณการไว้ที 2.0 -2.2 เทียวตามจุดประสงค์การเดินทาง สัดส่วนการใช้รถไฟในพื้นทีบางซือคาดการณ์ว่าจะสูงถึง 40% ในอนาคต

จากประมาณการข้างต้น คาดว่าจะเกิดการเดินทางในพื้นทีบางซือทังสิน 136,000 เทียวในปีพ.ศ.2565 เพิมเป็น 359,600 เทียวในปี พ.ศ.2570 และเพิมเป็น 624,000 เทียวในปี พ.ศ.2575 โดยตังอยู่บนสมมุติฐานว่าหากมีการพัฒนาอย่างสอดประสานรวมพลังและมีประสิทธิภาพภายใต้แผนแม่บทฉบับบูรณาการ

5.2 ความต้องการของตลาดอสังหาริมทรัพย์ในกรุงเทพมหานครและสภาพการณ์ (ผลประมาณการต้นฉบับ)

การประมาณการความต้องการด้านอสังหาริมทรัพย์ในพื้นทีบางซือในอนาคตใช้ข้อมูลปัจจุบันของตลาดอสังหาริมทรัพย์ซึงประกอบด้วยข้อมูลจำนวนอสังหาริมทรัพย์ทีมีในสต็อกในช่วงปี พ.ศ. 2549-2559 และปริมาณพื้นทีอาคารรวมในช่วงปี พ.ศ.2560-2564 โดยตังสมมุติฐานว่าอุปทานของตลาดจะสามารถรองรับความต้องการของตลาดได้ ในการศึกษานีจึงประมาณการบนพื้นฐานว่าอุปทานของตลาดในอนาคตคือขนาดความต้องการของอสังหาริมทรัพย์ในอนาคต จากข้อมูลคาดการณ์จำนวนอสังหาริมทรัพย์ในสต็อกในปี พ.ศ.2564 ได้มีการประมาณการอุปทานของอสังหาริมทรัพย์ในเขตจตุจักร (ประมาณการต้นฉบับ) ในพ.ศ.2570, พ.ศ.2575, พ.ศ.2580 ไว้ ตามข้อมูลดังกล่าวประมาณการอุปทานของอสังหาริมทรัพย์ในปี พ.ศ.2575 คิดเป็นพื้นทีสำนักงาน 55,704 ตารางเมตร(พื้นทีอาคารรวมสุทธิ) พื้นทีเพือการค้าปลีก 91,748 ตารางเมตร (พื้นทีอาคารรวม) คอนโดมิเนียม 27,367 หน่วย โรงแรม 656 ห้อง

6. รายงานสรุปเชิงหลักการโครงการพัฒนาฟื้นฟู และแนวทางการพัฒนา

6.1 ประโยชน์ใช้สอยของเมืองทีจำเป็นในพืนทีบางซือ

ประโยชน์ใช้สอยของเมืองทีจำเป็นในพืนทีบางซือในผลศึกษานีได้มาจากการทบทวนและวิเคราะห์แผนระดับนโยบายหรือแผนทีมีอยู่ในปัจจุบัน ความต้องการของตลาดอสังหาริมทรัพย์ และบทเรียนทีถอดจากประสบการณ์ในอดีตของญีปุ่นโดยมีรายละเอียดดังในตาราง4 สำหรับประโยชน์ใช้สอยสำคัญ ได้แก่ "ศูนย์ราชการ" "ศูนย์ประชุมและแสดงสินค้า (MICE)" "ศูนย์บ่มเพาะอุตสาหกรรมใหม่ (New Industry Incubation Center)" โดยประโยชน์ทีจะเกิดตามมาจะเป็นแหล่งสร้างรายได้สำคัญสำหรับเจ้าของทีดิน สำนักงาน การค้าพาณิชย์ ทีอยู่อาศัย และโรงแรม

ตาราง 4 ประโยชน์ใช้สอยของเมืองทีจำเป็นในพืนทีบางซือ

	แนวทาง 1	แนวทาง 2	แนวทาง 3
ความท้าทาย	พื้นที่ราชการในบรรยากาศที่สะดวกสบาย สร้างสรรค์ ต้อนรับผู้มาใช้บริการ	จุดประสงค์ของผู้ที่เข้ามาในพื้นที่ที่หลากหลายมากขึ้น	เสริมสร้างอุตสาหกรรมอุดมปัญญา เน้นการวิจัยและพัฒนา
ประโยชน์ใช้สอยสำคัญ	ศูนย์ราชการ	ศูนย์ประชุมและแสดงสินค้า	ศูนย์บ่มเพาะอุตสาหกรรมใหม่
ประโยชน์ร่วม	• อาคารราชการ • พิพิธภัณฑ์ • สำนักงาน • ธุรกิจการค้า • ที่อยู่อาศัย • โรงแรม	• ศูนย์ประชุม • โรงแรม • สำนักงาน • ธุรกิจการค้า • ที่อยู่อาศัย • พิพิธภัณฑ์	• สำนักงาน • มหาวิทยาลัย • ธุรกิจการค้า • ที่อยู่อาศัย • พิพิธภัณฑ์ • โรงแรม
ผลที่คาดหวัง	• รับประกันจำนวนผู้โดยสารรถไฟฟ้าโครงการใหม่ •เกิดการพัฒนาโครงสร้างพื้นฐานอย่างรวดเร็ว	• รับประกันจำนวนผู้โดยสารรถไฟฟ้าโครงการใหม่ • นำโอกาสทางธุรกิจมาสร้างประโยชน์สูงสุด	•รับประกันจำนวนผู้โดยสารรถไฟฟ้าโครงการใหม่ • ก่อร่างสร้างแนวทางอุตสาหกรรมของประเทศ

ทีมา: ทีมสำรวจไจก้า

6.2 รายงานสรุปเชิงหลักการการพัฒนา(ร่าง)

สรุปสาระสำคัญของร่าง "รายงานสรุปเชิงหลักการการพัฒนา" มีรายละเอียดดังในตาราง 5 สำหรับร่าง"รายงานสรุปเชิงหลักการการพัฒนา" แสดงในภาคผนวก 6-1

ตาราง 5 สรุปสาระสำคัญของร่าง "รายงานสรุปเชิงหลักการการพัฒนา"

หัวข้อ	รายละเอียด
วิสัยทัศน์	บางซื่อ – ประตูสู่เทพนคร (Gateway to "City of Angels")
นโยบายพื้นฐาน	แนวคิด 1: เพื่อสร้างจุดศูนย์กลางซึ่งจะเป็นแกนดึงดูดในพื้นที่มหานครกรุงเทพฯ อันจะมีบทบาทสำคัญในสังคมนานาชาติ (1) สร้างศูนย์กลางทางธุรกิจและการแลกเปลี่ยนในระดับภูมิภาคและระดับประเทศ (2) สร้างหลักประกันความยั่งยืนทั้งในด้านความปลอดภัยและเป็นมิตรต่อสิ่งแวดล้อม แนวคิด 2: เพื่อสร้างเมืองอันเป็นศูนย์กลางแห่งใหม่ที่เต็มไปด้วยเสน่ห์มากมายซึ่งผู้คนจะหลงรักไม่เสื่อมคลาย (1) สร้างความมีเสน่ห์ดึงดูดของชีวิตในเมืองใหญ่ซึ่งหลากหลายผสมผสานรูปแบบเก่าใหม่ มีทั้งตลาดนัดจนกระทั่งตึกสูงระฟ้านำสมัย (2) สร้างพื้นที่ทางเดินที่สะดวกสบายซึ่งผู้คนจะรู้สึกเพลิดเพลินไปกับการเดินทอดน่องสัญจรไปบนระเบียงทางเดิน แนวคิด 3: เพื่อสร้างสถานีขนส่งซึ่งเป็นมิตรกับผู้เดินทางที่ไม่ว่าใครก็ใช้งานได้ง่าย สะดวกสบาย (1) สร้างสถานีขนส่งมาตรฐานโลกซึ่งทั้งคนไทยและคนต่างชาติเข้าใจง่าย ใช้งานสะดวก (2) เพิ่มความสะดวกสำหรับผู้โดยสารในการเปลี่ยนต่อรถหลากหลายรูปแบบ แนวคิด 4: ภาครัฐและเอกชนได้ร่วมมือกันเพื่อทำให้แผนหลักการสู่การปฏิบัติ (1) เพื่อส่งเสริมความร่วมมือระหว่างภาครัฐและเอกชนในรูปแบบต่างๆ โดยภาครัฐเป็นผู้ริเริ่มเพื่อขับเคลื่อนให้แผนหลักการสู่การปฏิบัติ

ทีมา: ทีมสำรวจไจก้า

6.3 แนวทางในการพัฒนา

ในการพัฒนาโครงการตามแนวคิดข้างต้นมีด้วย 2 แนวทาง ได้แก่ แนวทางที 1:"การพัฒนาแบบแยกส่วน" และแนวทางที 2:"การพัฒนาแบบบูรณาการ" โดยมีรายละเอียดดังในตาราง 6 และตาราง 7 สำหรับแนวทางที 1 เป็นการพัฒนาโดยภาคเอกชนซึ่งตั้งอยู่บนจุดประสงค์เฉพาะของเอกชนรายนั้นๆ ส่วนแนวทางที 2 เป็นการตั้งให้เป็นโครงการระดับประเทศโดยกำหนดเป็นนโยบายที่จะยกระดับมูลค่าโดยรวมของพื้นที่บางซื่อด้วยแผนพัฒนาอย่างเป็นองค์รวมเพื่อที่จะสร้างให้เกิดผลประโยชน์สูงสุดกับผู้ลงทุน ในการที่จะสร้างหลักประกันการพัฒนาฟื้นฟูพื้นที่บางซื่ออย่างยั่งยืน โดยจัดวางให้เกิดประโยชน์ใช้สอยของเมืองใหญ่ตามที่แสดงในตาราง 4 โครงการพัฒนาโดยการนำของรัฐบาลเป็นสิ่งที่สำคัญอย่างยิ่ง จากข้างต้นผลการศึกษานี้จึงเสนอให้ใช้แนวทางที 2

ตาราง6 ผลสรุปเปรียบเทียบ "แนวทางพัฒนาแบบบูรณาการ" กับ "แนวทางพัฒนาแบบแยกส่วน"

กรอบการพัฒนา/ เงื่อนไขการลงทุน		แผน1: แผนพัฒนาแบบแยกส่วน	แผน 2: แผนพัฒนาแบบบูรณการ
กรอบการพัฒนา	วางนโยบายแผนแม่บท	แผนแม่บทอนุมัติโดยคณะกรรมการบริหารรฟท.	แผนแม่บทอนุมัติโดยคณะรัฐมนตรี โดยถือเป็นโครงการพัฒนาพื้นที่พิเศษ
	รายละเอียดแผนแม่บท	ทำได้ในขอบเขตที่เอกชนสามารถพัฒนาได้เช่น พัฒนาสำนักงานให้เช่า ค้าปลีก ที่อยู่อาศัย	พัฒนาผลักดันมูลค่าเพิ่มและเป็นการผสานพลังระหว่างรัฐและเอกชนเกิดประโยชน์สูงสุดบนแนวคิดการพัฒนารูปแบบ TOD/เมืองอัจฉริยะ
	โครงสร้างการดำเนินงาน	การดำเนินงานระหว่างรฟท.กับบริษัทเอกชน	ขับเคลื่อนโดย3เสาหลักได้แก่ รัฐบาล รฟท.และเอกชน
	กระบวนการประสานงาน	ประสานงานกับแต่ละหน่วยงานรัฐที่เกี่ยวข้อง	ผลักดันการพัฒนารูปแบบพื้นที่พิเศษผ่านกลไกช่องทางอนุมัติเบ็ดเสร็จในจุดเดียว (One stop)
	ขั้นตอนการพัฒนา	พัฒนาจากที่ดินผืนที่ว่างก่อนตามลำดับ	พัฒนาอย่างเป็นระบบขั้นตอนโดยมุ่งหวังเพิ่มมูลค่าที่ดิน
เงื่อนไขการลงทุน	ขั้นตอนประมูล PPP	เงื่อนไขประมูลและเอกสารต่างๆมีลักษณะไม่ยืดหยุ่น	เกิดเงื่อนไขการประมูลและเอกสารต่างๆผ่านการพูดคุยเจรจากับภาคเอกชนอย่างสร้างสรรค์ เกิดการรับประกันในด้านผลกำไรจากการปล่อยสินเชื่อแก่โครงการ(bankability)
	ระยะเวลาเช่าซื้อ	30 ปี	50 ปี (จากมาตรการพิเศษของกรุงเทพมหานคร)
	การสนับสนุนของรัฐ	ไม่มี	สิทธิประโยชน์ทางภาษีและระยะผ่อนปรนการชำระเงินต้นซึ่งเป็นส่วนหนึ่งของการสนับสนุนการพัฒนาพิเศษ
ผลสัมฤทธิ์ที่ได้		เป็นการพัฒนาของเอกชนในแบบเดิม ผลลัพธ์ด้านรายได้และผลดีทางเศรษฐกิจเปลี่ยนแปลงตามแนวคิดของผู้ลงทุนรายนั้นๆ	บริษัทที่สนใจร่วมประมูลมีมาก โครงการพัฒนาคุณภาพสูง ผลลัพธ์ด้านรายได้และผลดีทางเศรษฐกิจสูง

ทีมา: ทีมสำรวจไจก้า

ตาราง7 ผลต่างระหว่างแนวทางพัฒนาแบบแยกส่วนกับแนวทางพัฒนาแบบบูรณาการ

ภาครัฐ/ภาคเอกชน	ประโยชน์ใช้สอยพื้นที่อาคาร	แผน1: แผนพัฒนาแบบแยกส่วน	แผน 2: แผนพัฒนาแบบบูรณการ
การพัฒนาในส่วนของเอกชน	สำนักงาน	-กรณีสัญญาเช่า 30 ปีการพัฒนาอาคารสำนักงานตึกระฟ้าเกรด A เป็นเรื่องยาก การพัฒนาจะถูกจำกัดทำได้เพียงอาคารความสูงปานกลางเกรด B ใช้เป็นอาคารสำนักงานเพื่อสนับสนุน เป็นต้น	-สามารถพัฒนาเป็นอาคารระฟ้า เกรดA เพื่อเป็นอาคารสำนักงานสำหรับสำนักงานใหญ่ของบริษัทได้ -อย่างไรก็ดีต้องประเมินอุปทานของอาคารสำนักงานโดยรวมให้เกิดสมดุล เช่น กำหนดอุปทานของตึกสำนักงานใหม่จนถึงปีพ.ศ.2570 ไว้ที่ 20% ของอุปทานรวมในพื้นที่กรุงเทพฯตอนเหนือ
	ค้าปลีก	-ถูกจำกัดโดยอุปสงค์หมุนเวียน(flow-demand)ของผู้ใช้งานเพื่อผ่านสถานีกลาง เบื้องต้นจะเป็นการพัฒนาลักษณะร้านค้าปลีกขนาดเล็กถึงกลางตอบสนองการจับจ่ายรายวัน	-การค้าปลีกทั้งรูปแบบอุปสงค์หมุนเวียน และอุปสงค์คงเหลือ(flow and stock demand) ที่เกิดจากสำนักงานและผู้อยู่อาศัย โดยเป็นการค้าปลีกขนาดใหญ่ซึ่งผู้ใช้งานมีจุดมุ่งหมายตั้งใจมาจับจ่ายที่นี่
	โรงแรม	-โรงแรมชั้นนักธุรกิจ โรงแรมขนาดสามดาวสำหรับกลุ่มลูกค้าจากต่างจังหวัดที่เข้ามาทำงานเป็นครั้งคราว	-โรงแรมชั้นนำ ขนาดสี่หรือห้าดาวซึ่งสามารถได้ลูกค้าต่างประเทศ
	คอนโดมิเนียม/ที่พักอาศัย	-เนื่องจากเป็นการเช่า30ปี การสร้างบ้านเพื่ออยู่อาศัยจึงมีข้อจำกัด การพัฒนาคอนโดมิเนียมเองก็จะถูกจำกัดด้วยรูปแบบการเช่าระยะสั้น ปริมาณพื้นที่ที่จะพัฒนาจะถูกจำกัดตามไปด้วย	-กรณีสัญญาเช่า 50ปี สามารถพัฒนาคอนโดมิเนียมและบ้านที่อยู่อาศัยที่ถือครองสิทธิได้ช่วงหนึ่งได้ เมื่อมีการพัฒนาโครงข่ายสีเขียวเสริมเข้าด้วยกันทำให้เป็นแหล่งที่อยู่อาศัยชั้นนำ
	ศูนย์ประชุมและแสดงสินค้า(MICE)	-เนื่องจากการจะทำให้พื้นที่เป็นจุดหมายหรือแหล่งดึงดูดที่ต้องมาทำได้ยาก ไมซ์จึงไม่มีความจำเป็น	-เกิดไมซ์ และต้องโดดเด่นแตกต่างกับไมซ์ชั้นในกรุงเทพฯเพื่อให้มีความสามารถในการแข่งขันทั้งในด้านขนาด และประโยชน์ใช้สอย
การพัฒนาในส่วนของภาครัฐ	ระบบการคมนาคมขนส่ง(ถนนภายในทางเดินลอยฟ้า ที่จอดรถและต่อรถอื่น ลานจอดรถแท็กซี่ ฯลฯ)	-งบประมาณรัฐมีจำกัดและใช้เวลานานในการพิจารณา ทำให้พัฒนาได้เพียงระบบการคมนาคมที่เป็นส่วนเสริมให้กับการพัฒนาโดยเอกชน ผลคือต้องยอมรับข้อจำกัดเรื่องความไม่สะดวกสบายในการเดินทางในเมือง	-สามารถผลักดันการพัฒนาระบบคมนาคมขนส่งแบบTODให้เร็วกว่าแผนใช้บนงบประมาณของรัฐ และหรือรูปแบบPPPบนเรื่องในการจ่ายเมื่อพร้อม (Availability Payment) ผลที่ได้คือเกิดระบบคมนาคมในเมืองที่มีความสะดวกสบายสูง
	โครงข่ายสีเขียวและเป็นมิตรต่อสิ่งแวดล้อม (สวนสาธารณะ พื้นที่สีเขียว ทางระบายอากาศ ฯลฯ)	-การประสานงานล้านผังเมืองทำได้ล่าช้า เนื่องจากเป็นแผนพัฒนาที่ดินของรฟท. โดยรฟท. ผลทำให้โครงข่ายสีเขียวถูกจำกัดไม่นำสู่การพัฒนา	-เนื่องจากเป็นแผนที่ผ่านการอนุมัติโดยรัฐมนตรี สืบเนื่องจากที่เป็นแผนผังเมืองจึงมีงบประมาณด้วย ทำให้เกิดการพัฒนาโครงข่ายสีเขียวในจุดมหัศจรรย์ได้ จากข้างต้นส่งผลให้เกิดมูลค่าเพิ่มในการพัฒนาย่านที่อยู่อาศัย และส่งผลดีน่าคนภายนอกให้เข้ามาเพิ่มขึ้น
	โครงสร้างพื้นฐาน (ระบบบำบัดน้ำ ไฟ ก๊าซ) ระบบประหยัดพลังงานและระบบสิ่งแวดล้อม	-การพัฒนาโครงสร้างพื้นฐานเกิดล่าช้าเนื่องจากต้องปรับประสานงานกับหน่วยราชการหลายส่วน ภาคเอกชนบ้างก็จัดทำสิ่งอำนวยความสะดวกด้านสิ่งแวดล้อมแยกต่างหาก ทำให้ประสิทธิภาพของทั้งระบบไม่ดี	-ด้วยการที่มีหน่วยงานกลางที่เป็นผู้ประสานเบ็ดเสร็จ(One-stop) ทำให้การพัฒนาระบบดำเนินงานได้รวดเร็ว สำหรับระบบเพื่อมุ่งสร้างเมืองอัจฉริยะก็จะมีงบประมาณมาด้วย

ทีมา: ทีมสำรวจไจก้า

6.4 bการปรับผลการคาดการณ์ความต้องการอสังหาริมทรัพย์สำหรับแนวทางที่ **2** (แนวทางพัฒนาแบบบูรณาการ)

ความต้องการด้านอสังหาริมทรัพย์หลังปี พ.ศ. 2564 ซึ่งได้ประมาณการไว้ตามหัวข้อ 5.2 เป็นการคำนวณแนวโน้มด้วยวิธีกำลังสองน้อยที่สุด (least squares method) จากข้อมูลจนถึงปัจจุบันและปริมาณอุปทานของพื้นที่อาคารที่มีการวางแผนไว้ ทั้งนี้ หากเป็นการพัฒนาตามแนวทางที่ 2 ซึ่งนำโดยรัฐบาลในการพัฒนาพื้นที่บางซื่อแบบบูรณาการให้เกิดมูลค่าเพิ่มโดยรวมสูงสุด คาดการณ์ว่าจะเกิดความความต้องการด้านอสังหาริมทรัพย์มากยิ่งขึ้น ในการศึกษานี้จึงมีการปรับค่าประมาณการโดยอ้างอิงตามเงื่อนไขของแนวทางที่ 2 โดยอุปทานด้านอสังหาริมทรัพย์ในเขตจตุจักร (ประมาณการด้วยค่าสูงสุดสำหรับแนวทางที่ 2) ในปี พ.ศ. 2575 มีรายละเอียดดังนี้ พื้นที่สำนักงาน 530,742 ตารางเมตร (พื้นที่อาคารรวมสุทธิ) พื้นที่เพื่อการค้าปลีก 730,664 ตารางเมตร (พื้นที่อาคารรวม) คอนโดมิเนียม 31,735 หน่วย โรงแรม 6,249 ห้อง

ประมาณการขนาดพื้นที่อาคารรวม (Gross floor area) ในอนาคตในเขตจตุจักรในปี พ.ศ. 2575 มีรายละเอียดดังในตาราง 8

ตาราง 8 พื้นที่อาคารรวมในเขตจตุจักรในปี พ.ศ. 2575 (แนวทางที่ 2)

ประเภท	พื้นที่อาคารรวม	สัดส่วน
1) **พื้นที่สำนักงาน**	884,570 m^2	15.8%
2) **พื้นที่เพื่อการค้าปลีก**	730,664 m^2	13.0%
3) **คอนโดมิเนียม**	3,626,902 m^2	64.7%
4) **โรงแรม**	364,518 m^2	6.5%
รวม	5,606,654 m^2	100.0%

หมายเหตุ ประมาณการอุปทานในผลศึกษานี้เพื่อพิจารณาความต้องการและอุปสงค์ของตลาด
ที่มา: ทีมสำรวจไจก้า คำนวณอ้างอิงจากข้อมูลโจนส์ แลง ลาซาลล์

6.5 การพัฒนาอย่างเป็นขั้นตอน

การพัฒนาอย่างเป็นขั้นตอนมีรายละเอียดดังรูป 2 และตาราง 9 การศึกษานี้ได้ผลสรุปสำหรับการพัฒนาอย่างเป็นขั้นตอนโดยพิจารณาจากมุมมองดังนี้ (ก) ช่วงเวลาเปิดให้บริการระบบรถไฟมวลชนที่อยู่ระหว่างการก่อสร้างและที่จะก่อสร้างในอนาคต (ข) ขั้นตอนการเตรียมความพร้อมของที่ดิน (การได้สิทธิพัฒนาที่ดิน ช่วงเวลาการพัฒนาโครงสร้างพื้นฐานโดยภาครัฐเพื่อเพิ่มราคาที่ดิน) (ค) ความต้องการของตลาด (ง) การจัดหาเงินทุน

ระยะสั้น(ระยะที1) [ถึงพ.ศ. 2565]

ระยะกลาง(ระยะที2) [ถึงพ.ศ. 2570]

ระยะยาว(ระยะที3) [ถึงพ.ศ. 2575]

ทีมา: ทีมสำรวจไจก้า

รูป 2 ข้อเสนอการพัฒนาอย่างเป็นขั้นตอนแยกรายพื้นที

ตาราง 9 ข้อเสนอการพัฒนาอย่างเป็นขั้นตอนแยกรายพื้นที

ลำดับ	พื้นที / ระบบ	ระยะสั้น (ถึงพ.ศ. 2565)	ระยะกลาง (ถึง พ.ศ. 2570)	ระยะยาว (ถึงพ.ศ. 2575)
1	รถไฟสายสีแดง / สถานีกลาง	เริม-จบ	เสร็จสมบูรณ์	เสร็จสมบูรณ์
2	รถไฟแอร์พอร์ตลิงก์	เริม-จบ	เสร็จสมบูรณ์	เสร็จสมบูรณ์
3	โซน A	เริม-จบ	เสร็จสมบูรณ์	เสร็จสมบูรณ์
4-1	โซน D1	เริม	จบ	เสร็จสมบูรณ์
4-2*	โซน D2/D3*	-	-	เริม*
5	ทางเดินเชื่อมต่อลอยฟ้า (ทางแยก A-D)	เริม	จบ	เสร็จสมบูรณ์
6-1	โซน B1, B2*	-	-	เริม-จบ*
6-2	โซน B3, B4*	-	-	เริม*
7	โซน C*	-	เริม-จบ*	เสร็จสมบูรณ์*
8	กม.11(โซน G)*	-	เริม-จบ*	เสร็จสมบูรณ์*
9	โครงการพัฒนาทีราชพัสดุ (BKT, หมอชิตเก่า)	เริม	จบ	เสร็จสมบูรณ์
10	รถโดยสารด่วนพิเศษ(บีอาร์ทีม รถโดยสารวิงรอบ)*	-	เริม-จบ*	เสร็จสมบูรณ์
11-1*	ทีดินรฟท. (โซน E1, E3)*	เริม-จบ*	เสร็จสมบูรณ์*	เสร็จสมบูรณ์*
11-2*	ทีดินรฟท. (โซน E2)*	เริม*	จบ*	เสร็จสมบูรณ์*
12*	โซน F*	-	เริม-จบ*	เสร็จสมบูรณ์*
13*	โซน H*	-	-	เริม*
14*	โซน I*	-	-	เริม-จบ*

หมายเหตุ ช่องทีระบายสีเป็นหัวข้อซึงเสนอโดยฝังญีปุ่น ช่องทีมีสัญลักษณ์ * คือหัวข้อทีเสนอต่างไปจาก ข้อเสนอแรกเริมของฝังไทย
หมายเหตุ การเปิดให้บริการของรถไฟสายสีแดง สถานีกลาง และรถไฟแอร์พอร์ตลิงก์เป็นไปตามกรอบเวลาตามแผนปัจจุบันของฝังไทย
ทีมา: ทีมสำรวจไจก้า (เริม: ก่อสร้าง, จบ: เปิดให้บริการ)

7. แผนพัฒนาพืนทีบางซือ

7.1 นโยบายพืนฐาน

ในการจัดทำแผนพัฒนาพืนทีบางซือ เพือให้บรรลุวัตถุประสงค์ตาม "วิสัยทัศน์" ทีได้ตังไว้ ในการศึกษานีได้พิจารณาปัจจัยแวดล้อม อาทิ แผนในระดับนโยบาย สภาพเงือนไขในพืนที และทิศทางทางเศรษฐกิจและสังคม ประกอบกับรายละเอียดของแผนโครงการซึงทางรฟท.และสนข.ได้จัดทำขึน และนำความรู้และประสบการณ์จากเมือครังทีญีปุ่นทำการพัฒนาเมืองขนาดใหญ่มาใช้ ผลศึกษาได้ข้อสรุปนโยบายพืนฐานและข้อควรพิจารณาใน

แผนพัฒนาโดยมีรายละเอียดดังตาราง 10

ตาราง 10 นโยบายในการวางแผนพัฒนา

นโยบาย	ข้อควรพิจารณาในแผนพัฒนา
(1) เพื่อสร้างจุดศูนย์กลางซึ่งจะเป็นแกนดึงดูดในพื้นที่มหานครกรุงเทพฯ อันจะมีบทบาทสำคัญในสังคมนานาชาติ	• การจัดทำแผนแม่บทฉบับบูรณาการเพื่อนำสู่การฟื้นฟูพื้นที่ทั้งหมดให้ประสบความสำเร็จ • การสร้างสิ่งอำนวยความสะดวกสำคัญอันได้แก่ สิ่งปลูกสร้างที่เป็นสัญลักษณ์ของเมือง เมืองอัจฉริยะ ฯลฯ • การพัฒนาให้เกิดประโยชน์ใช้สอยของเมืองใหญ่อันเป็นเสน่ห์ที่จะผลักดันศักยภาพการพัฒนาของพื้นที่ทั้งหมด
(2) เพื่อสร้างเมืองอันเป็นศูนย์กลางแห่งใหม่ที่เต็มไปด้วยเสน่ห์มากมายซึ่งผู้คนจะหลงรักไม่เสื่อมคลาย	• การพัฒนาระบบอำนวยความสะดวกพื้นฐานที่จะทำให้เกิดการเชื่อมต่อและเกิดโครงข่ายระหว่างพื้นที่ย่อย • การพัฒนาโครงสร้างพื้นฐานและพื้นที่สาธารณะที่จะเพิ่มศักยภาพของพื้นที่ทั้งหมด • การจัดเตรียมแนวทางที่จะส่งเสริมให้เกิดการพัฒนาพื้นที่ที่เป็นไปอย่างสมดุล • การพัฒนาโครงสร้างพื้นฐานและสิ่งอำนวยความสะดวกที่ยกระดับมูลค่าอันจะส่งผลให้ศักยภาพของพื้นที่สูงขึ้น • การสร้างและประชาสัมพันธ์ให้ผู้คนรู้จักการใช้งานและประโยชน์ใช้สอยซึ่งจะเพิ่มศักยภาพของพื้นที่ทั้งหมด • การวางแนวทางที่จะขับเคลื่อนการสร้างเมืองอย่างเป็นขั้นตอนตามแผน
(3) เพื่อสร้างสถานีขนส่งซึ่งเป็นมิตรกับผู้เดินทางที่ไม่ว่าใครก็ใช้งานได้ง่าย สะดวกสบาย	• การสร้างการเชื่อมต่อเพื่อเปลี่ยนต่อระหว่างสถานีรถไฟกับรูปแบบการเดินทางอื่นๆให้ทำได้สะดวก • การสร้างทางเดิน และลานกว้างสาธารณะ • การนำใช้รูปแบบการขนส่งเพื่อป้อนคน(เช่น รถ BRT) และระบบการขนส่งและการจราจรอัจฉริยะ (ITS) มาใช้ในพื้นที่
(4) ภาครัฐและเอกชนได้ร่วมมือกันเพื่อทำให้แผนหลักการสู่การปฏิบัติ	• การจัดทำแผนการดำเนินงานอย่างเป็นขั้นตอนเพื่อให้ปฏิบัติได้จริงและเห็นผลสัมฤทธิ์ • การส่งเสริมการนำศักยภาพของภาคเอกชนในด้านเงินทุน และโครงการริเริ่มมาใช้ • พิจารณาการแบ่งบทบาทหน้าที่ระหว่างภาครัฐและเอกชนเพื่อที่จะให้เกิดความร่วมมือที่ต่างฝ่ายต่างได้ประโยชน์

ที่มา: ทีมสำรวจไจก้า

7.2 แผนพัฒนาโครงสร้างพื้นฐานของเมือง

ผลการศึกษานี้ได้ข้อสรุปแผนพัฒนาพื้นที่บางซื่อโดยมีโครงสร้างพื้นฐาน สิ่งแวดล้อมและโครงข่ายประหยัดพลังงาน โครงข่ายการคมนาคมซึ่งมีรายละเอียดดังตาราง 11

ตาราง 11 หัวข้อพิจารณาที่เกี่ยวเนื่องกับการพัฒนาโครงสร้างพื้นฐาน

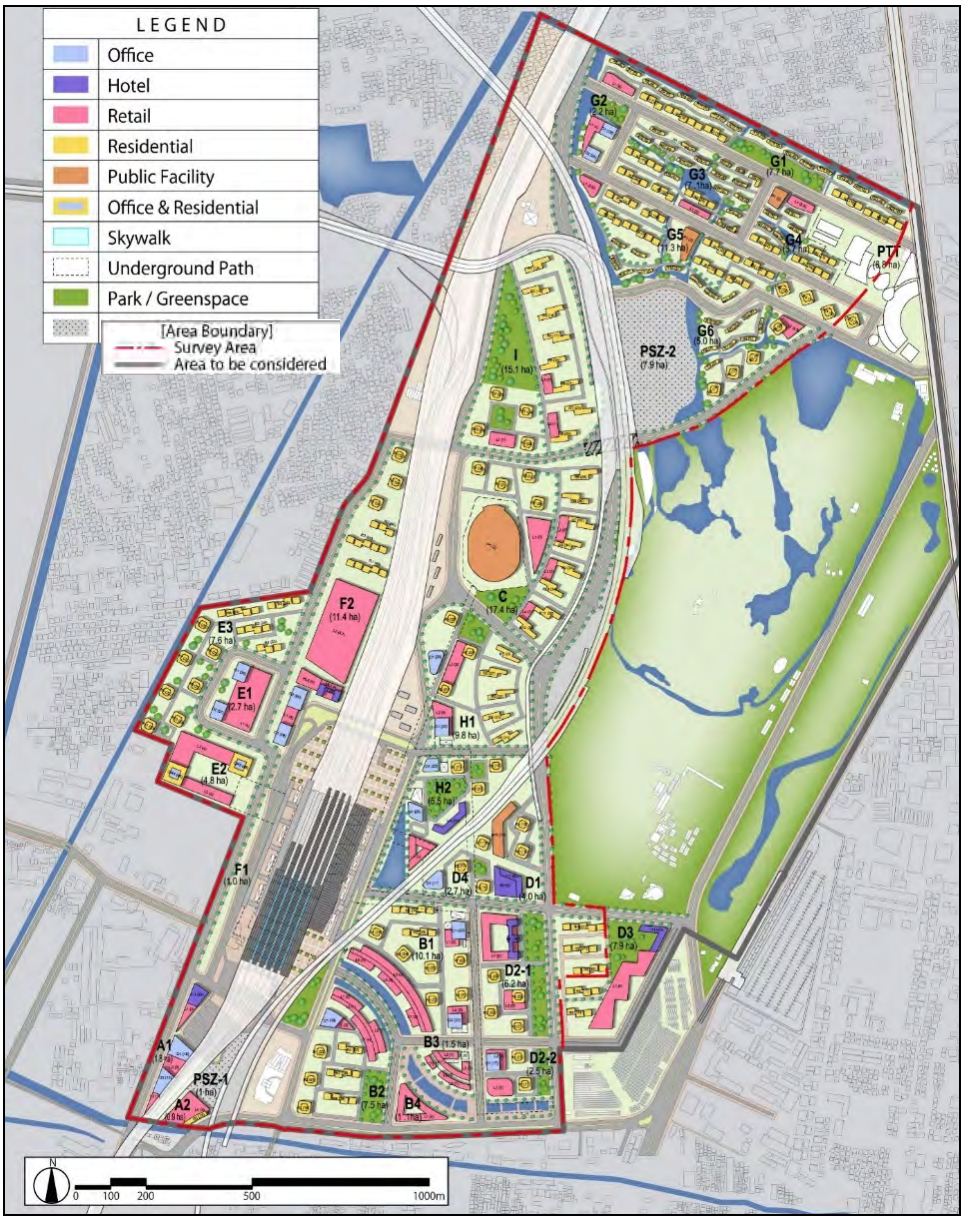
หัวข้อใหญ่	หัวข้อย่อย
โครงสร้างพื้นฐาน	แผนการเตรียมที่ดิน แผนระบบถนน แผนระบบระบายน้ำฝน แผนระบบน้ำประปา แผนระบบระบายน้ำเสีย แผนระบบไฟฟ้า แผนระบบสื่อสาร ระบบพลังงาน (ระบบพลังงานร่วม ระบบทำความเย็น) ระบบบริหารจัดการพลังงงาน (CEMS)
สิ่งแวดล้อมและโครงข่ายสีเขียว (กรีนเน็ตเวิร์ค)	มาตรการเรื่องน้ำท่วม การป้องกันและบรรเทาสาธารณะภัย/แผนสำรองเพื่อ ความต่อเนื่องทางธุรกิจ (BCP) โครงข่ายสีเขียว การสร้างภูมิทัศน์
โครงข่ายการคมนาคม	แผนระบบถนน แผนทางเดิน แผนระบบขนส่งสาธารณะ (รวมถึงสถานีขนส่งผู้โดยสาร) การสำรวจปริมาณการจราจร
สิ่งอำนวยความสะดวกเพื่อยกระดับ	ทางเดินลอยฟ้า ทางเดินใต้ดิน ระบบการขนส่งและการจราจรอัจฉริยะ (ITS)

ที่มา: ทีมสำรวจไจก้า

7.3 แผนการใช้ทีดิน

แผนการใช้ทีดินในการศึกษานีแบ่งได้เป็น 3 ประเภท ได้แก่ (1) ทีดินเพือการพาณิชย์ (ใจกลางพืนที) (2) ทีดินเพือใช้ประโยชน์อเนกประสงค์ (พืนทีเพือการพาณิชย์และธุรกิจเป็นส่วนหลัก และทีดินเพือทีอยู่อาศัยเป็นส่วนรอง) (3) ทีดินเพือทีอยู่อาศัย (เขตทีอยู่อาศัยซึงเน้นคุณภาพ)

แผนการใช้ประโยชน์ทีดินมีรายละเอียดดังในรูป 3 สำหรับอนาคตภาพตามแผนดังกล่าวมีรายละเอียดดังรูป 4 และรูป 5



ทีมา : ทีมสำรวจไจก้า

รูป 3 แผนการพัฒนา

ทีมา : ทีมสำรวจไจก้า

รูป 4 อนาคตภาพการพัฒนา [พื้นทีบางซือ]

ทีมา : ทีมสำรวจไจก้า

รูป 5 อนาคตภาพการพัฒนา [สถานทีกลางบางซือโดยรอบ]

7.4 การวิเคราะห์ปริมาณพืนทีและค่าใช้จ่ายโดยประมาณ

ผลการศึกษานีมีการประมาณปริมาณพืนทีอาคารสำนักงาน สิงอำนวยความสะดวกเพือการพาณิชย์ โรงแรม และอาคารทีอยู่อาศัยจากข้อมูลทีได้จากการสำรวจตลาดและการสัมภาษณ์บริษัทอสังหาริมทรัพย์ในประเทศไทย ประมาณการพืนทีอาคาร จำนวนประชากรทีจะเกิดตามมา และค่าใช้จ่ายการก่อสร้างมีรายละเอียดดังในตาราง 12 และตาราง 13 สำหรับค่าซ่อมบำรุงประมาณการไว้ที 2% ของค่าใช้จ่ายการก่อสร้าง

ตาราง 12 ประมาณการพืนทีอาคารและประชากรทีจะเกิดตามมา

การใช้ทีดิน	รายละเอียด	ขนาด(ตรม./ห้อง/คน)
(1) สำนักงาน	พืนทีพิเศษ	530,760 ตรม.
	จำนวนคนในสำนักงาน	44,230 คน
(2)สิงอำนวยความสะดวกเพือการพาณิชย์	พืนทีเช่า	365,350 ตรม.
	จำนวนลูกค้า	292,280 คน
(3)โรงแรม	จำนวนห้อง	31,735 ห้อง
	จำนวนคน	9,373 คน
(4)สิงอำนวยความสะดวกเพือทีอยู่อาศัย	จำนวนห้อง	6,249 ห้อง
	จำนวนผู้อยู่อาศัย	126,942 คน

ทีมา : ทีมสำรวจไจก้า

ตาราง 13 ประมาณการค่าใช้จ่ายการก่อสร้างเพื่อการพัฒนาฟื้นฟูพื้นที่บางซื่อ

ประเภท	หัวข้อย่อย	ค่าใช้จ่าย (หน่วย: 1,000$)
โครงสร้างพื้นฐานของเมือง	-	159,371
โครงข่ายการขนส่งและคมนาคม	-	309,432
โครงข่ายสีเขียว	-	6,100
สิ่งแวดล้อม	-	103,127
การป้องกันสาธารณภัย	-	11,000
สิ่งอำนวยความสะดวกเพื่อยกระดับ	-	81,500
อาคารสิ่งปลูกสร้าง	สำนักงาน	2,653,800
	สิ่งอำนวยความสะดวกเพื่อการพาณิชย์	2,189,400
	อาคารที่อยู่อาศัย	10,880,700
	โรงแรม	1,093,500
	สิ่งอำนวยความสะดวกด้านวัฒนธรรม	550,000
	สำนักงานรัฐ	300,000
รวม		18,337,930

ที่มา : ทีมสำรวจไจก้า

8. แผนปฏิบัติงาน

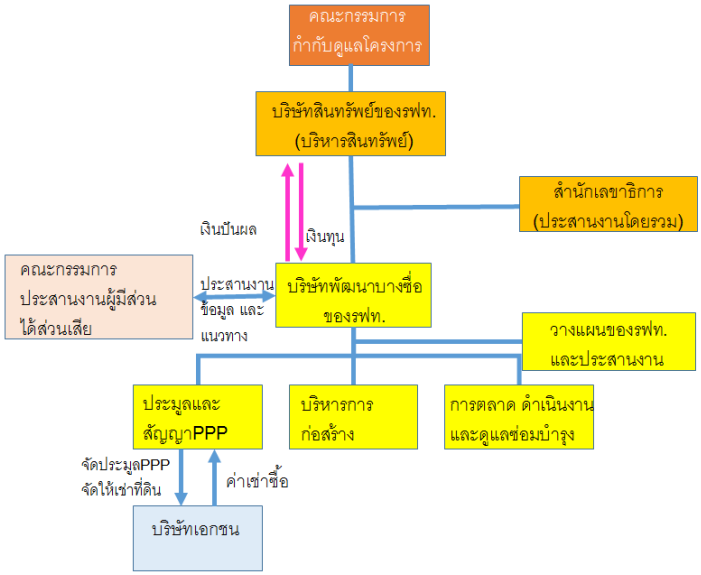
ในการนำแผนฟื้นฟูพื้นที่บางซื่อสู่การดำเนินงาน การจัดเตรียมองค์กรดำเนินงานและการจัดหาเงินทุนเป็นสิ่งที่จำเป็นอย่างมาก ผลการศึกษานี้ได้ข้อสรุปเป็ นข้อเสนอเกี่ยวกับองค์กรที่จะขับเคลื่อนการดำเนินงาน และกลไกในการจัดหาเงินทุนซึ่งมีรายละเอียดดังต่อไปนี้

8.1 องค์กรขับเคลื่อนโครงการ

โครงการฟื้นฟูพัฒนาพื้นที่บางซื่อจัดว่าเป็นโครงการขนาดใหญ่ทั้งในด้านขอบเขตของงานและความซับซ้อน ทั้งนี้เนื่องจากเป็นการพัฒนาหลายภาคชั้นทำให้มีผู้ส่วนได้ส่วนเสียด้วยกันหลายฝ่าย ผลการศึกษานี้ได้แบ่งการพัฒนาออกเป็น 5 ภาคชั้น ได้แก่ 1) โครงสร้างพื้นฐาน 2) โครงข่ายสีเขียวและสิ่งแวดล้อม 3) โครงข่ายการคมนาคมขนส่ง 4) สิ่งอำนวยความสะดวกเพื่อยกระดับพื้นที่ภายใต้แนวคิดการพัฒนาพื้นที่รอบสถานีขนส่งมวลชน (TOD) และเมืองอัจฉริยะ 5) การพาณิชย์และสิ่งอำนวยความสะดวกที่จะเป็นแม่เหล็กสำคัญ

ในการศึกษานี้พบว่า ลักษณะสำคัญของการพัฒนาในแต่ละภาคชั้นในโครงการนี้เป็นการพัฒนาบนผืนที่ดินของรฟท.ทั้งหมด จุดนี้เป็นสิ่งที่แตกต่างกับโครงการพัฒนาทั่วไปซึ่งเพิ่มความซับซ้อนให้กับโครงการ ตัวอย่างเช่น โครงข่ายถนนหลักในการพัฒนาชั้นที่ 1 โดยทั่วไปกรุงเทพมหานคร (กทม.) จะเป็นผู้จัดสร้างบนที่ดินของกทม. กรณีที่ต้องสร้างบนที่ดินของรฟท. จะต้องมีการลงนามบันทึกข้อตกลงระหว่างกทม.กับรฟท.เพื่อที่จะระบุส่วนรับผิดชอบในการก่อสร้าง การใช้งานและบำรุงรักษา (O&M) อย่างชัดเจน ทั้งนี้ไม่เฉพาะแต่การพัฒนาถนนสายหลัก ในเรื่องของโครงสร้างพื้นฐานอื่นๆก็จำเป็นที่จะต้องมีการจัดประสานงานกับองค์กรรัฐต่างๆ จากข้างต้นหากปราศจากกลไกซึ่งมีสิทธิอำนาจในการจัดประสานความร่วมมือดังกล่าว อาจทำให้ต้องใช้เวลาและกำลังแรงงานไปกับการประสานงานอย่างมาก

ผลการศึกษานี้จึงได้ข้อสรุปดังนี้ โครงสร้างการจัดดำเนินงานในลักษณะนโยบายจากรัฐบาลลงมา (Top-down) โดยให้ผู้มีส่วนได้ส่วนเสียทุกภาคส่วนเข้ามามีส่วนร่วมจะเป็นกุญแจสำคัญที่ทำให้การพัฒนาพื้นที่บางซื่อสำเร็จได้ จากผลการศึกษาทีมสำรวจไจก้าขอเสนอโครงสร้างกลไกการทำงานเพื่อขับเคลื่อนการปฏิบัติงานซึ่งมีรายละเอียดดังรูป 6 โครงสร้างดังกล่าวประกอบไปด้วย 6 กลไกทำงานซึ่งมีหน้าที่สำคัญของแต่ละส่วน ได้แก่ 1) คณะกรรมการกำกับดูแลโครงการ (Steering Committee) 2) บริษัทบริหารสินทรัพย์ของรฟท. (SRT Asset Holding Company) 3) สำนักเลขาธิการ (ประสานงานโดยรวม) (Secretariat/Overall Coordination) 4) บริษัทพัฒนาบางซื่อของรฟท. (SRT Bang Sue Development Company) 5)สำนักวางแผนและประสานงานโครงการ (Planning and Project Coordination) 6) คณะกรรมการประสานงานผู้มีส่วนได้ส่วนเสีย (Stakeholder Coordination Committee)



ทีมา : ทีมสำรวจไจก้า

รูป 6 โครงสร้างกลไกการทำงานเพื่อนำโครงการสู่การปฏิบัติ

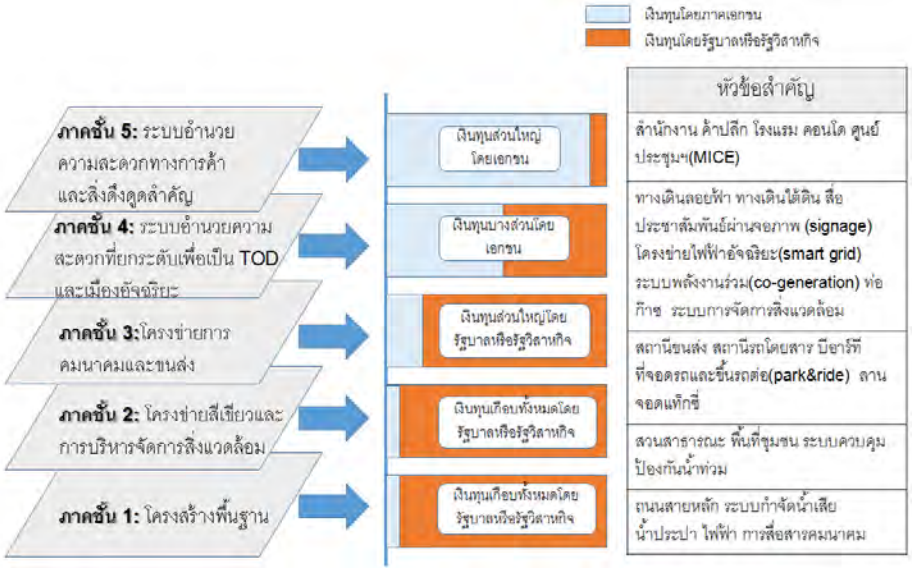
ทั้งนีบริษัทพัฒนาบางซือของรฟท.มีบทบาทหน้าทีในฐานะ "ผู้พัฒนาหลัก" และ "ผู้อำนวยการกำกับโครงการ" โดยจะต้องมีกลไกดำเนินงานทางธุรกิจทีสำคัญต่างๆดังมีรายละเอียดในรูป 7

ทีมา : ทีมสำรวจไจก้า

รูป 7 กลไกทำงานของบริษัทลูกของรฟท.ทีต้องมี

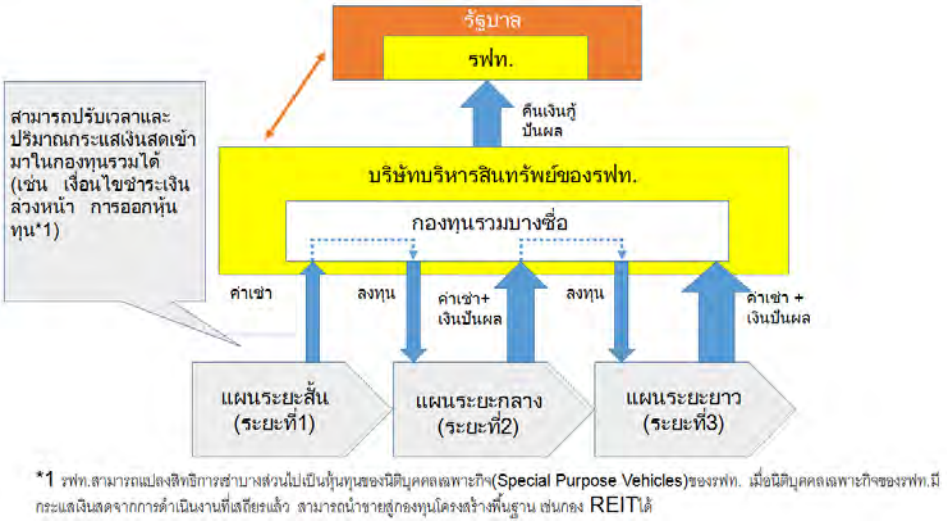
8.2 กลไกการจัดหาเงินทุน

การจัดหาเงินทุนสำหรับโครงการนี้จำเป็นที่จะต้องเป็นลักษณะผสมผสานระหว่างเงินทุนภาคเอกชนในลักษณะการร่วมลงทุนระหว่างภาครัฐและเอกชน (PPP) เงินทุนของรัฐบาล และเงินทุนของรัฐวิสาหกิจอย่างเลี่ยงไม่ได้ ทั้งนี้เนื่องด้วยโครงการนี้มิได้เป็นเพียงการพัฒนาสิ่งอำนวยความสะดวกเพื่อการพาณิชย์บนที่ดินของรฟท. จากข้างต้นในโครงการจะมีการพัฒนาด้วยกัน 5 ภาคชั้นโดยจำเป็นต้องพิจารณาแบ่งส่วนความรับผิดชอบด้านเงินทุนตามจุดเด่นของแต่ละการพัฒนา แนวคิดหลักการในการแบ่งส่วนความรับผิดชอบด้านเงินทุนมีรายละเอียดดังแสดงในรูป 8 และแนวคิดการใช้กองทุนเพื่อจัดหาเงินทุนแต่ละช่วงเวลาดังในรูป 9



ทีมา : ทีมสำรวจไจก้า

รูป 8 แนวคิดหลักการในการแบ่งส่วนความรับผิดชอบด้านเงินทุน



*1 รฟท.สามารถแปลงสิทธิการเช่าบางส่วนไปเป็นหุ้นทุนของนิติบุคคลเฉพาะกิจ(Special Purpose Vehicles)ของรฟท. เมื่อนิติบุคคลเฉพาะกิจของรฟท.มีกระแสเงินสดจากการดำเนินงานที่เสถียรแล้ว สามารถนำขายสู่กองทุนโครงสร้างพื้นฐาน เช่นกอง REITได้

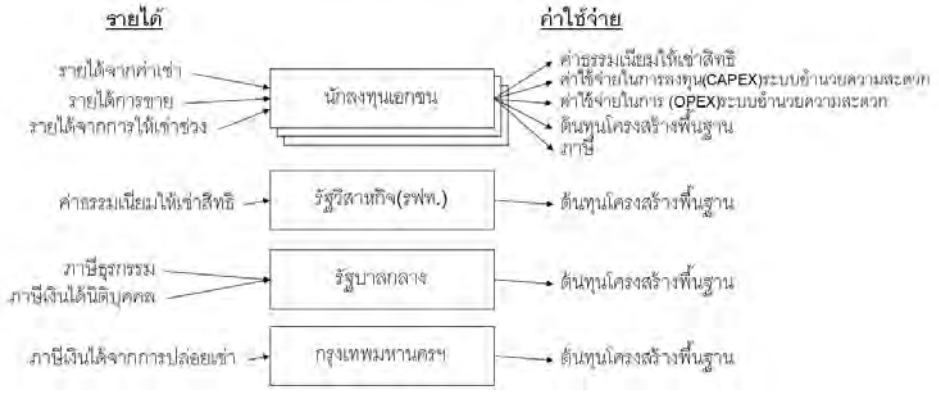
ทีมา : ทีมสำรวจไจก้า

รูป 9 แนวคิดการใช้กองทุนเพื่อจัดหาเงินทุนแต่ละช่วงเวลา

8.3 การวิเคราะห์ด้านการเงิน

เพื่อให้โครงการบรรลุผลสำเร็จได้ ในการศึกษานีได้วิเคราะห์ศักยภาพทางการเงินและความสามารถในการแบกรับภาระการเงินซึงเป็นปัจจัยสำคัญ ผู้ทีมีส่วนเกียวข้องสำคัญในโครงการมีได้แก่ 1) ภาคเอกชน 2) รัฐวิสาหกิจ ได้แก่รฟท. และการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย(กฟผ.) ฯลฯ 3) รัฐบาลไทย ได้แก่ กระทรวงคมนาคม กระทรวงการคลัง ฯลฯ และ 4) กรุงเทพมหานคร (BMA)

รูป 10 แสดงผังวิเคราะห์การเงิน สำหรับรายละเอียดพารามิเตอร์สำคัญในแนวทางที 1 และแนวทางที 2 รวมถึงเงือนไขจะอธิบายไว้ในตัวเล่มรายงาน



ทีมา : ทีมสำรวจไจก้า

รูป 10 แสดงผังวิเคราะห์การเงิน

ผลการวิเคราะห์ด้านการเงินสรุปได้ดังนี รายละเอียดจะแสดงในตัวเล่มรายงาน

1) ผู้ลงทุนเอกชน

ผลวิเคราะห์พบว่า ระหว่างแนวทางที 1 และแนวทางที 2 เกิดผลต่างอย่างชัดเจน กรณีแนวทางที 1 ผลตอบแทนผู้ถือหุ้น (Equity IRR) ทีได้พบว่าน้อยกว่า 5% ในขณะทีแนวทางที 2 ผลตอบแทนผู้ถือหุ้นอยู่ทีมากกว่า 15% เกือบทังหมดทุกโซน

2) รัฐวิสาหกิจ

สำหรับรายได้จากการให้เช่าทีดินกับผู้ลงทุนเอกชน หากคำนวนภายใต้เงือนไขการได้รับสิทธิผ่อนผันการชำระเงินต้นระยะเวลา 3 ปีแรกนับจากเริมเปิดดำเนินกิจการ และเงือนไขชำระคืนเงินกู้ที 10 ปี รายได้ทีรฟท. ได้รับจะเริมสะสมตังแต่ปี พ.ศ. 2562 – 2587 ทังนีรายได้ของรฟท.คำนวนจากมูลค่าปัจจุบันสุทธิ (NPV) จะสูงถึง 2.5 พันล้านบาทต่อปี ในขณะทีต้นทุนค่าโครงสร้างพืนฐานทีต้องจ่ายสูงสุดต่อปีคิดเป็น 1.2 พันล้านบาท ดังนันกำไรทีได้ขึนมาสามารถนำไปลงทุนในการพัฒนาระยะถัดไปได้

3) รัฐบาลไทยและกรุงเทพมหาคร

ผลศึกษาพบว่า รายได้จากภาษีตามแนวทางที 2 คิดเป็นมูลค่าทีสูงมาก กรณีเป็นสัญญาเช่ากับแต่ละโซนย่อยตามแผนระยะสัน (ระยะพัฒนาที 1) เป็นเวลา 50 ปีนับจาก พ.ศ. 2562 ประมาณการรายได้ภาษีในปี พ.ศ. 2611 รัฐบาลจะมีรายได้ 34 พันล้านบาท กรุงเทพมหานครจะมีรายได้ 25 ล้านบาท ซึงนับเป็นรายได้ทีสูงกว่าค่าการพัฒนาโครงสร้างพืนฐานทีแต่ละฝ่ายได้ลงทุน ในทางตรงข้ามสำหรับกรณีแนวทางที 1 รายได้จากภาษีทีได้ อยู่ทีประมาณ 10% ของแนวทางที 2 ซึงถือเป็นมูลค่าทีค่อนข้างน้อย จึงอาจกล่าวได้ว่า จากการทีทีดินไม่ถูกพัฒนามูลค่าให้สูงขึน ผลกำไรทีนักลงทุนเอกชนได้รับจึงไม่สูง ทำให้รายได้จากภาษีทีจะได้รับจากส่วนนีจึงไม่เพิมตามไปด้วย

8.4 กำหนดเวลาของโครงการ

ในการพัฒนาพืนทีบางซือ ผลศึกษานีได้ข้อสรุปเป็นข้อเสนอโครงการพัฒนาทีแบ่งระยะเวลาออกเป็น 3 ช่วง บนแนวคิดการพัฒนาแบบบูรณาการเป็นขันตอนและครอบคลุมพืนทีทังหมด การพัฒนาแบ่งเป็น 3 ระยะ ได้แก่ แผนระยะสัน (ระยะที1 เป้าหมายปี พ.ศ. 2565) แผนระยะกลาง (ระยะที2 เป้าหมายปี พ.ศ. 2570) และแผนระยะยาว (ระยะที3 เป้าหมายปี พ.ศ. 2575) รายละเอียดกำหนดเวลาของโครงการแสดงในตัวเล่มรายงาน

9. ความสนใจของนักลงทุนเอกชนญีปุ่น

ในการศึกษานีมีการเก็บแบบสำรวจและสอบถามสัมภาษณ์กับ 1) บริษัทสมาชิกของสมาคมนักลงทุนเพือการพัฒนาเมืองเป็นมิตรต่อสิงแวดล้อม (J-CODE) 2) บริษัทสมาชิกของหอการญีปุ่น-กรุงเทพฯ ชมรมกลุ่มการก่อสร้าง (จำนวนบริษัททีตอบแบบสอบถาม 26 บริษัท) เพือสำรวจความสนใจของบริษัทญีปุ่นในการร่วมลงทุนในธุรกิจพัฒนาเมือง และความเป็นไปได้ทีจะนำเทคโนโลยีโครงสร้างพืนฐานในการสร้างเมืองจากญีปุ่นมาใช้

ผลสำรวจพบว่า บริษัทญีปุ่นหลายแห่งมีความสนใจอย่างมากทีจะเข้าร่วมลงทุน โดยพิจารณาว่าโครงการพัฒนาบางซือเป็นแผนนโยบายจากระดับสูง มีระบบคมนาคมขนส่งทีสะดวก และการทีรฟท.เป็นเจ้าของทีดินทังผืน เป็นต้น อย่างไรก็ดีมีเสียงความคิดเห็นจากนักลงทุนทีต้องการให้ปรับขยายระยะเวลาสัญญาเช่า (ความคาดหวังจาก 50 ปีปรับเป็น 70 ปี) และต้องการให้รัฐบาลเป็นผู้จัดเตรียมด้านโครงสร้างพืนฐาน

10. การดำเนินงานต่อจากนี

ผลการศึกษาได้ข้อสรุปแผนปฏิบัติสำคัญซึงจะต้องจัดดำเนินงานในช่วงต้น (จนกระทังปีพ.ศ.2562) โดยมีรายละเอียดดังนี

(1) การดำเนินงานโดยรัฐบาลไทย

1) จัดทำแผนแม่บทฉบับสมบูรณ์ 2) จัดตังคณะกรรมการกำกับดูแลการพัฒนา และ 3) กำหนดและส่งเสริมมาตรการการสนับสนุนของรัฐบาลอย่างเป็นขันตอน โดยมีภาระงานจนถึงครึงปีแรกของ พ.ศ.2562

(2) การรถไฟแห่งประเทศไทย(รฟท)

1) ก่อตังและเริมดำเนินงานบริษัทบริหารสินทรัพย์ของรฟท.และบริษัทเพือพัฒนาพืนทีบางซือภายในปี พ.ศ.2560

2) จัดเตรียมเพือรองรับการดำเนินงานแผนพัฒนาระยะสัน (จนกระทัง พ.ศ.2565): นับแต่ปี พ.ศ.2561 เป็นต้นไป

3) จัดเตรียมเพือรองรับการดำเนินงานแผนพัฒนาระยะกลาง (จนกระทังพ.ศ.2570) 4) วางแผนและจัดเตรียมการพัฒนาเมืองอัจฉริยะ 5) วางแผนและจัดเตรียมการพัฒนาการพัฒนาพืนทีรอบสถานีขนส่งมวลชน (TOD) และระบบโครงข่าย 6) วางแผนและจัดเตรียมการพัฒนาโครงสร้างพืนฐาน 7) วางแผนและจัดเตรียมการพัฒนาอุตสาหกรรมการจัดงานกิจกรรมทางธุรกิจ (MICE): ตังแต่ปีพ.ศ.2562เป็นต้นไป

จบ

Executive Summary

1. Background

The Bangkok Metropolitan Region, Bangkok and its five surrounding prefectures, currently, has a population of 10,730,000 people. In 2013, the gross regional domestic product (GRDP) per capita was recorded at THB 376,463 which is slightly less than twice the gross domestic product (GDP) per capita for the whole country at THB 193,394 on the same year. The Bangkok Metropolitan Region has the biggest population and it is the center of economic and political activities in the country.

In order to solve heavy traffic and environmental problems in the Bangkok Metropolitan Region, Ministry of Transport (MOT) started introducing mass transit system in the 1990s. As of January 2017, four urban mass rapid transit (UMRT) lines, i.e., BTS Sukhumvit Line, BTS Silom Line, MRT Blue Line, MRT Purple Line, and one airport line, i.e., Airport Rail Link (ARL) are operated in Bangkok. Furthermore, they have several ongoing plans and under construction projects to extend these existing lines, as well as to construct new lines, to enhance UMRT networks.

State Railway of Thailand (SRT) Red Line Project, including Bang Sue Grand Station, has a total extension length of 26.3 km. One of the financial resources of the project is the yen loan. As the implementing agency, SRT aims to start its operation in July 2020. Bang Sue Grand Station shall be the biggest terminal station in Bangkok. Several UMRT lines, including Red Line shall stop at Bang Sue Grand Station.

The survey area (hereafter called as Bang Sue Area) includes Bang Sue Grand Station and large land for railway facilities. Being located at the future transport hub in Bangkok, it has a high potential for urban development. Office of Transport and Traffic Policy and Planning (OTP) and SRT studied on the development concept plans and SRT intends to redevelop the area by public-private partnership scheme. However, they are confronted with difficulties such as “lack of step-by-step integrated development” and “lack of arrangement of each project based on a single comprehensive master plan”.

In this context, MOT requested Japan Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) for support in developing an integrated master plan (MP) for Bang Sue Grand Station and the surrounding area. Accordingly, OTP, SRT, and MLIT established a Working Group for Urban Development (WG) in August 2016. Through the three WG sessions in August 2016, November 2016, and January 2017, OTP, SRT, and MLIT discussed the necessity of an integrated MP including an infrastructure plan and work items to be considered. With this situation in mind, Japan International Cooperation Agency (JICA) decided to take over the cooperation and assign a survey team to formulate an integrated MP.

1.1 Purpose of the Study

The purpose of the present survey are as follows:

1. Based on the discussions in the WGs and the former information gathering survey conducted by MLIT, the JICA Study Team (JST) shall collect and analyze related information and data for redevelopment in Bang Sue Area. JST shall formulate the “Development Vision” and “Draft Concept Paper”, and facilitate stakeholders to reach a consensus for integrated development.
2. JST shall formulate all plans including project implementation scheme and fund allocation

among stakeholders such as central government, local government and private sectors, which shall contribute to project implementation framework for redevelopment of Bang Sue Area.

1.2 Survey Area

The survey area is as shown in Figure 1.

Source: JST

Figure 1 Bang Sue Area (Survey Area)

1.3 Working Groups/ Workshops

During the survey period (from March to August 2017), three WGs and nine workshops (WS) were held in Bangkok to obtain opinions from major Thai stakeholders (MOT, OTP and SRT etc.).

2. Superior Plans

2.1 Spatial Plans/ Urban Development Related Plans/Urban Mass Rapid Transit Plan

Major urban development related plans which relate Bang Sue Area development are as shown in Table 1.

Table 1 Major Urban Development Related Plans which relate Bang Sue Area Development

Area	Name of Plan	Formulator	Outline
Nation wide	The National Spatial Development Plan 2057	DPT	To achieve the vision by 2057, “Development frameworks”, “Strategic position and future development trends”, “Major issues of national development policies”, and “Fields covered by the 50-year National Spatial Development Policy”, are specified in the plan.
Region	Regional Development Policies	DPT	Development policy of the six regions (Bangkok and its vicinity, Eastern Region, Central Region, Northeastern Region, Northern Region, and Southern Region) .
Province, City	Bangkok Comprehensive Plan (2013)	BMA	Zoning Plan, Floor Area Ratio, Open Space Conservation, Transport System Plan, and Infrastructure Development Plan etc.
Urban Mass Rapid Transit	Mass Rapid Transit Master Plan in Bangkok Metropolitan Region （M-MAP）	OTP	Development plan of 12 mass transit lines (556 km) in Bangkok Metropolitan region. In M-MAP, Bang Sue is noted as one of the important transportation hub in Bangkok.

Source: JST

2.2 Policies and Plans for Economics and Industrial Promotion

Major policies and plans for economic and industrial promotion in Thailand are as shown in Table 2.

Table 2 Major Policies and Plans for Economics and Industrial Promotion in Thailand

Name of Plan	Formulator	Outline
Thailand 4.0	The Government of Thailand	It aims to shift from the current economy led by foreign investments with focus on automobiles, electrical and electronics industry, petrochemicals, and others (Thailand 3.0) to an added-value economy based on knowledge, creation, and innovation focused mainly on the knowledge-intensive industry, the green industry, renewable energy, healthcare, and transport
20-year National Strategic Plan (2017-2036)	NESDB	As a long-term national plan created by the Government of Thailand, it consists of six areas, six primary strategies, and four supporting strategies as shown in Table 2.2.2. It is therefore also referred to as the "6-6-4 plan."
The 12th National Economic and Social Development Plan	NESDB	The 12th plan continues the major direction of the 11th plan "the vision of "A happy society with equality, fairness, and resilience", and the newly formulated ten strategies toward reducing income differences; strengthen economy and competitiveness in international society.
Eastern Economic Corridor (EEC)	NESDB	The target areas are three eastern provinces: Chonburi, Rayong, and Chachoengsao. The policy promotes investment in ten high-tech industry sectors including electric vehicles, hybrid vehicles, healthcare, aviation, and robots.
The Cluster-based Special Economic Development Zones Policy	BOI and The Government of Thailand	The policy is aimed at creating a cluster where interconnected businesses and related institutions are concentrated and operated within the same geographic areas. The aim of promoting business clusters is to boost the level of support and cooperation in all facets of business, in order to strengthen the industrial value chain, enhance Thailand's investment potential and competitiveness, and expand socioeconomic development to regional and local levels.
Border Special Economic Zone Policy	The Government of Thailand	It is a large-scale policy to develop special economic zones (SEZ) in its national borders, with the Greater Mekong Sub-region Development Program as background.

Source: JST

2.3 Other Strategies and Policies

Other related policies such as "The National Research Policy and Strategy (2017 - 2021)", "The National Science, Technology, and Innovation Policy Plan (2012-2021)", MICE strategy in Thailand and trends of medical and health- and longevity-related matters are reviewed.

2.4 Role of the Bang Sue Area in Thailand

In the M-MAP formulated by OTP, Bang Sue is counted as a multi-modal transport node in Bangkok, as well as and Makkasan. In addition, in the Bangkok Comprehensive Plan 2013, land use in Bang Sue area is categorized as commercial zone, and FAR is set as the second highest in Bangkok after Silom area. Accordingly, Bang Sue area is expected to develop as urban Transit Oriented Development (TOD) core, as it shall be a transportation hub in the future.

2.5 Legal Systems and Policies Related to Urban Development

The legal systems related to urban development in Thailand and its structure outline are described in Appendix 2-1 "List concerning the legal structure of Japan related to urban planning and similar plans of Thailand". Among the legal systems of Thailand, the following laws and regulations are especially important to implement the large-scale redevelopment in Bang Sue Area: Town Planning Act 1975, Building Control Act 1979, Land Readjustment Act 2004, Land Subdivision Act 2000, Enhancement and Conservation of National Environmental Quality Act 1992, Comprehensive Planning Criteria and Standards 2006, and Bangkok City Planning Standards 2010.

3. General Conditions and Related Plans in Bang Sue Area

3.1 Status in Bang Sue Are

Bang Sue Area is located at approximately 10 km to the north from the central business district (CBD). It is located at approximately 35 km from the Suvarnabhumi International Airport and 14 km from Don Muang Airport which is a base for domestic and low-cost carrier (LCC). Bang Sue Area is planned to be a future transportation hub. It has Metropolitan Rapid Transit (MRT) Bang Sue Station and Kamphaeng Phet Station (Blue Line), Mo Chit Station (Bangkok Mass Transit System (BTS)), and Bang Sue Grand Station (State Railway of Thailand (SRT)) in and around the area.

Currently, Bus terminal and railway facilities, and Red Line construction area are located inside of Bang Sue Area. Almost all land of Bang Sue Area is owned by SRT and utilized as facility area for Red Line project. Thus, the area has relatively less residents compared with its land area of 33 km^2. According to SRT, the number of households in KM 11 and SRT Land are 1,931 and 509, respectively. As the average number of people per household in urban areas is 3.5[1], it is estimated that there are approximately 7,000 and 2,000 residents in KM 11 and SRT Land, respectively.

3.2 Development Plan by SRT and OTP

SRT implemented a feasibility study for Bang Sue Area redevelopment from 2015 to 2016, in order to create additional land value of the area and SRT's asset management. The target area is Zone A (35 rai), Zone B(78rai), and Zone C(105rai) while Office of Transport and Traffic Policy and Planning (OTP) carried out a study for Zone D (80rai) and inter-area transportation at the same period.

3.3 Inter-Area Transportation Plan by OTP

In OTP's plan, the main purpose of inter-area transport is to enhance the connectivity and accessibility. OTP proposed Bus Rapid Transit (BRT) system as a major mode of public transportation in the area.

OTP also conducted traffic demand forecast through intersection traffic count, origin and destination interview, and travel speed survey. Traffic demand forecast was conducted for year 2022, 2032, and 2037. In 2037, OTP predicts approximately 1.42 million passengers per day using Bang Sue Grand Station in total.

3.4 Smart City Conceptual Plan by PTT

Bang Sue is one of ten candidate districts selected by the Government of Thailand to promote the model of Smart City. The model must improve the energy efficiency of the area in water supply, gas, power, heat supply, and cogeneration and district cooling system. PTT cooperated with the Chulalongkorn University to compose a conceptual plan of smart city for Bang Sue Area. The major points of technology installation of this plan are described in the following parts: 1) Mass Rapid Transit (MRT), 2) Provision of public free Wi-Fi, and 3) District Cooling System.

[1]Thailand National Statistics (2005)

4. Status of Existing Infrastructure

4.1 Status of Existing Infrastructure around Bang Sue Area

The status of the existing infrastructure around Bang Sue Area is as shown in Table 3.

Table 3 Status of Existing Infrastructure around Bang Sue Area

Category	Outline
Urban Mass Rapid Transit	In Bangkok, congestion on major arterial roads is a common issue. The Bangkok Mass Transit System (BTS) Skytrain is now widely used by passengers because they acknowledged that Skytrain is a convenient mode of transport which can help them avoid running into a traffic jam. The current Urban Mass Rapid Transit (UMRT) in Bangkok consists of two lines of BTS (Light Green Line - Dark Green Line), two lines of the metro rapid transit (MRT) (Blue Line - Purple Line) and Airport Rail Link (ARL). Pink Line, Yellow Line, and Orange Line connect central area to suburban area to the east. These lines are under bidding or at the planning stage and have not been constructed at the time of October 2017.
High Speed Railway	In 2016, a memorandum was signed on applying Japanese technology for a high-speed rail connecting Bangkok and Chiang Mai. The total length is approximately 670 km. Including the other planned routes, a total of five routes have been considered to develop.
Road	Around Bang Sue Area, many roads such as Don Mueang Expressway, Si-Rat Expressway, Phahonyothin Road and Kampheang Phet Road are already developed. Major authorities who manage these roads are private operation companies, Expressway Bureau of the Ministry of Transport (MOT) and Bangkok Public Works Bureau of BMA.
Bus Terminal	The bus terminal in Bang Sue Area is called Mo Chit 2 Bus Terminal, operated by Transport Co., Ltd., a state enterprise under MOT. The company also operates long-distance bus service. There are two types of inter-city buses, i.e.: large bus (coach) for long distance trip to cities in norther and northeastern Thailand or to foreign countries, and van-type bus for medium distance trip. Each platform is separated in Mo Chit 2 Bus Terminal. Besides Mo Chit 2 Bus Terminal, inner-city bus terminal is also located. Inner-city buses and its terminal are operated by the Bangkok Mass Transit Authority (BMTA). In 2017, 209 routes of buses were operated. In Bang Sue Area, 14 routes depart from BMTA Bus Terminal. In terms of traffic volume by time, traffic flow from east direction has more volume than other directions throughout the 12 hours. A ramp will be developed in the near future in the north of the intersection. Therefore, traffic volume from the north direction is considered to be bigger in the future.
Storm Drainage System	Storm drainage system is managed by the Department of Drainage and Sewerage, BMA. Bang Sue Area is in the basin of the Chao Praya River. However, as Bangkok's geography is generally flat and average altitude is approximately 0 m, the drainage network using the natural water body and channel to discharge to the Chao Praya River can work only in low tide period. Therefore, normally, pumping stations and water gates are used to discharge storm water to the Chao Praya River. Moreover, a trunk drain pipe that directly connects to the Chao Praya River is planned and constructed to be installed under the ground of Bang Sue Area.
Water Supply System	Water supply system in Bangkok is managed by the Metropolitan Waterworks Authority (MWA) and its Phaya Thai Office covers Bang Sue Area. The coverage of water supply system in Bangkok is 98%. Water supply for Bang Sue Area is treated at Bang Khen Water Treatment Plant (WTP, 3.9 million m^3/day) and delivered from Phahon Yothin Pump Station.
Sewerage System	Sewerage system in Bangkok is managed by the Department of Drainage and Sewerage, BMA. In the neighborhood of Bang Sue Area, there are two wastewater treatment plants (WWTPs): Bang Sue WWTP (120,000 m^3/day) and Chatuchak WWTP (150,000 m^3/day).
Power Supply and Distribution Infrastructure	In the Bang Sue Area and its surrounding area, electricity is supplied through two sub-stations which are managed by MEA. In addition, a new substation, having an area of about 6,400 m^2 in the Bang Sue Area, is planned under the agreement between SRT and Metropolitan Electricity Authority (MEA).
Oil and Gas Pipelines	One oil pipeline and one gas pipeline are buried under a road in Bang Sue Area. However, gas pipeline is for business use only. In Bangkok, piped town gas is not supplied, instead, households are using propane gas.
Waste Treatment	Waste treatment in Bangkok is managed by the Department of Environment, BMA. The collected waste is hauled to one of the three transfer stations (Sai Mai, Nongkham, and On Nuch) where waste is classified into conventional waste, dangerous waste from the hospitals and factories, and recycling waste. Then, it is treated either by recycling or pressurization/incineration. After that treated waste will be transported to final treatment sites in Nakhon Pathom Province or Chachoengsao Province, Phanom Sarakham District for landfill.

Source: JST

5. Future Demand Forecast

5.1 Railway Passengers in and around Bang Sue Area

The number of railway passengers in and around Bang Sue Area was forecasted based on the following estimated numbers: 1) the passengers who transfer trains in Bang Sue Grand Station, 2) the generated/attracted people in Bang Sue Area, and 3) the visitors from outside of Bang Sue Area. The figure of trip per person per day was from 2.0 to 2.2 depending on purposes of trip. The modal share of railway in Bang Sue Area was estimated to reach 40% in the future.

Based on the above mentioned assumptions, the number of generated trip in Bang Sue Area was estimated as 135,600 in Year 2022, 359,600 in Year2027, and 624,000 in Year 2032, in case of that the area is synergistically and efficiently developed under an integrated master plan.

5.2 Property Submarkets in Bangkok and its Environs (Original Estimation)

The future property demand in Bang Sue Area was estimated based on the recent property market data which contains the property stock from 2006 to 2016, and the planned floor area from 2017 to 2021. It is assumed that the market demand is naturally covered by the market supply; therefore, the estimated future supply shall be considered as the future demand. Based on the planned stock in 2021, the property supply in Chatuchak District (original estimation) in 2027, 2032, and 2037 is estimated. The estimated property supply in 2032 is: Office 55,704 m^2 (Net Floor Area), Retails 91,748 m^2(Gross Floor Area), Condominium 27,367 units, and Hotel 656 rooms.

6. Redevelopment Concept Paper and Scenario

6.1 Urban Functions Needed for Bang Sue Area

The urban functions needed in Bang Sue Area derived from reviewing and analysis on related superior plans/existing plans, property market demand, and lessons learned from Japan's experiences are as shown in Table 4. The key functions are "Government Center", "MICE Center" and "New Industry Incubation Center". The collateral functions, which shall be the main income source for the landowner, are office, commercial, residential, and hotel.

Table 4 Urban Functions Needed in Bang Sue Area

	Option 1	Option 2	Option 3
Challenging points	Government hospitality for visitors/ comfortable and creative public space	Further diversification of visitors' purposes	Enhancement of R&D, Intellectual Industry
Key function	Government Center	MICE Center	New Industry Incubation Center
Collateral functions	• Gov. building • Museum • Office • Commercial • Residential • Hotel	• Convention hall • Hotel • Office • Commercial • Residential • Museum	• Office • University • Commercial • Residential • Museum • Hotel
Expected effects	• Ensure the ridership of new railways • Allow rapid infrastructure development	• Ensure the ridership of new railways • Make the best use of potential business chances	• Ensure the ridership of new railways • Initiate the country's industrial policy

Source: JST

6.2 Development Concept Paper (Draft)

The essence of the draft "Development Concept Paper" is as shown in Table 5. The draft "Development Concept Paper" is as shown in Appendix 6-1.

Table 5 Essence of the Draft "Development Concept Paper"

Essence	Content
Vision	Bang Sue – Gateway to "City of Angels"
Basic Concept	Concept 1: To grow up to a centripetal urban core in Bangkok Metropolitan Area, which plays important roles in the international community. (1) To form an international and regional business and interaction center. (2) To ensure sustainability including safety and environmental friendliness. Concept 2: To create an eternally beloved new central district full of various attractiveness. (1) To create various attractions of urban life, from old to new, from a bustle of market places to ultramodern skyscrapers. (2) To create a comfortable walking space so that everyone would enjoy strolling along decks and paths in the area. Concept 3: To create a visitor-friendly traffic terminal area comfortable for everyone. (1) To create a world-class traffic terminal area comfortable for both Thai and foreign visitors. (2) To upgrade the user-friendliness in terms of transfer by creating public spaces. Concept 4: To stepwisely realize the conceptual plan by both public and private sectors. (1) To enhance all kinds of partnership between public-private and private-private, beside a strong initiative by the public, in order to properly realize the conceptual plan.

Source: JST

6.3 Development Scenario

There are two types of development, i.e.: Scenario 1 "Individual Development" and Scenario 2 "Integrated Development" as shown in Table 6 and Table 7. Scenario 1 consists of individual development thoroughly by the private sector on an ad hoc basis, while Scenario 2 is a national project based on the country's distinct policy for upgrading the whole value of Bang Sue Area with an integrated development to provide potential investors with maximum advantages. Scenario 2, which is recommended for Bang Sue Area with the national government's strong initiative, is indispensable to ensure a sustainable redevelopment with appropriate assignment of the urban functions described in Table 4.

Table 6 Comparison between "Integrated Development" and "Individual Development"

Development Framework/ Investment Condition		Scenario 1: Individual Development	Scenario 2: Integrated Development
Development Framework	M/P Positioning	M/P approved by SRT Board	M/P approved by Cabinet, designated as special development district
	M/P Contents	Primarily private development of office/retail/ residential area, wherever feasible	Model case of TOD/Smart City with both public infrastructure and private development, orchestrated to maximize land value
	Implementation Structure	Implementation between SRT and Private	Implementation between Gov't, SRT and Private
	Coordination Process	Coordinate separately with each related agency	Establish "One Stop" window for accelerated coordination within special district
	Development Steps	Develop primarily based on availability of land	Step-wise development to maximize land value
Investment Condition	PPP Tender Process	Tender conditions and documents are developed top-down	Tender conditions and documents are developed interactively with inputs from private, so as to ensure bankability
	Leasehold Period	30 years	50 years（based on BMA special zone regulation）
	Government Support	Nothing specific	Tax incentives and longer grace period as part of special development district support
Expected Results		Usual private development. Profitability and economic effects are changed depending on developer's tendency.	Many bidders, A grade development, high profitability, significant economic benefit

Source: JST

Table 7 Differences between Individual Development and Integrated Development

Private/ Public	Floor use/ facilities	Scenario1: Individual Development	Scenario2: Integrated Development
Private Development Portion	Office	-Difficult to develop A grade skyscraper under 30 year leasehold condition. Suitable for back office demand, B grade, mid-low rise building.	-Possible to cultivate corporate HQ demand and develop A grade skyscraper. -However, balancing of office space supply is required. For example, ceiling supply set at 20% of total incremental supply forecast in North Bangkok area.
	Retail	-Limited to "flow-based" demand from terminal station pass-thru users. Primarily develop small-mid scale retail outlets to fulfill daily shopping needs.	-Both flow and stock (from office and residential dev) demand as catchment. Large scale retail development assuming destination shopping behavior.
	Hotel	-Business hotel to capture business trips from local cities, three star hotel.	-Capture international visitors, high grade , four to five star hotel.
	Condominium/House	-Difficult to justify landed house under 30year leasehold. Limited to apartments for short-term lease. Development area will need to be limited.	-Condominium and landed houses can be developed under 50year leasehold. Together with green network, prime residential district brand can be developed.
	MICE Facility	-MICE facilities are not feasible since it is difficult to develop as "destination" district.	-MICE facilities can be justified. However, size and function will need to take into account other competing MICE facilities in Bangkok.
Public Infrastructure Portion	Transport facilities（Inner zone roads, skywalk, park&ride, taxi bay, etc.)	-Limited gov't budget for inner zone transport. Private develops portions of transport facility, which may not be sufficient. As a result, transport convenience is sacrificed.	-Proactive development of transport facilities based on gov't budget and PPP availability payment scheme. Inner transport is extremely convenient and recognized as model case of TOD.
	Green and environment friendly network(park, green space, wind corridor, etc.)	-Coordination with city planning is delayed since this is SRT land solely developed by SRT. As a result, green network development is limited.	-Budgeting coordination with city planning is smooth, as this is cabinet approved special district. Ideal green network is developed, which will generate premium value for residential development and add to visitor demand generation.
	Basic utility (water treatment, electricity, gas) ,energy saving and other environment facilities	-Basic utility development requires coordination with multiple agencies, which could cause delay. Private is required to invest in own environment facilities, which sacrifices overall efficiency.	-"One stop" window allows coordinated planning and development of basic utilities. Budget/incentives for smart city related facilities are in place.

Source: JST

6.4 Adjustment of Demand Forecast for Scenario 2 (Integrated Development)

The estimated property demand after 2021 as shown in Section 5.2 was estimated by the least squares method based on the past trend and the planned floor supply. Be that as it may, more demand shall be expected with Scenario 2 which subjects to maximizing the gross value added of the redevelopment through government initiative. Therefore, the property demand estimation was adjusted based on conditions of Scenario 2. The property supply in Chatuchak District (high-end estimation for Scenario 2) in 2032 was estimated as follows: Office 530,742 m^2 (NFA), Retail 730,664 m^2 (GFA), Condominium 31,735 units and Hotel 6,249 rooms

The future gross floor area (converted) in Chatuchak District in 2032 was estimated as shown in Table 8.

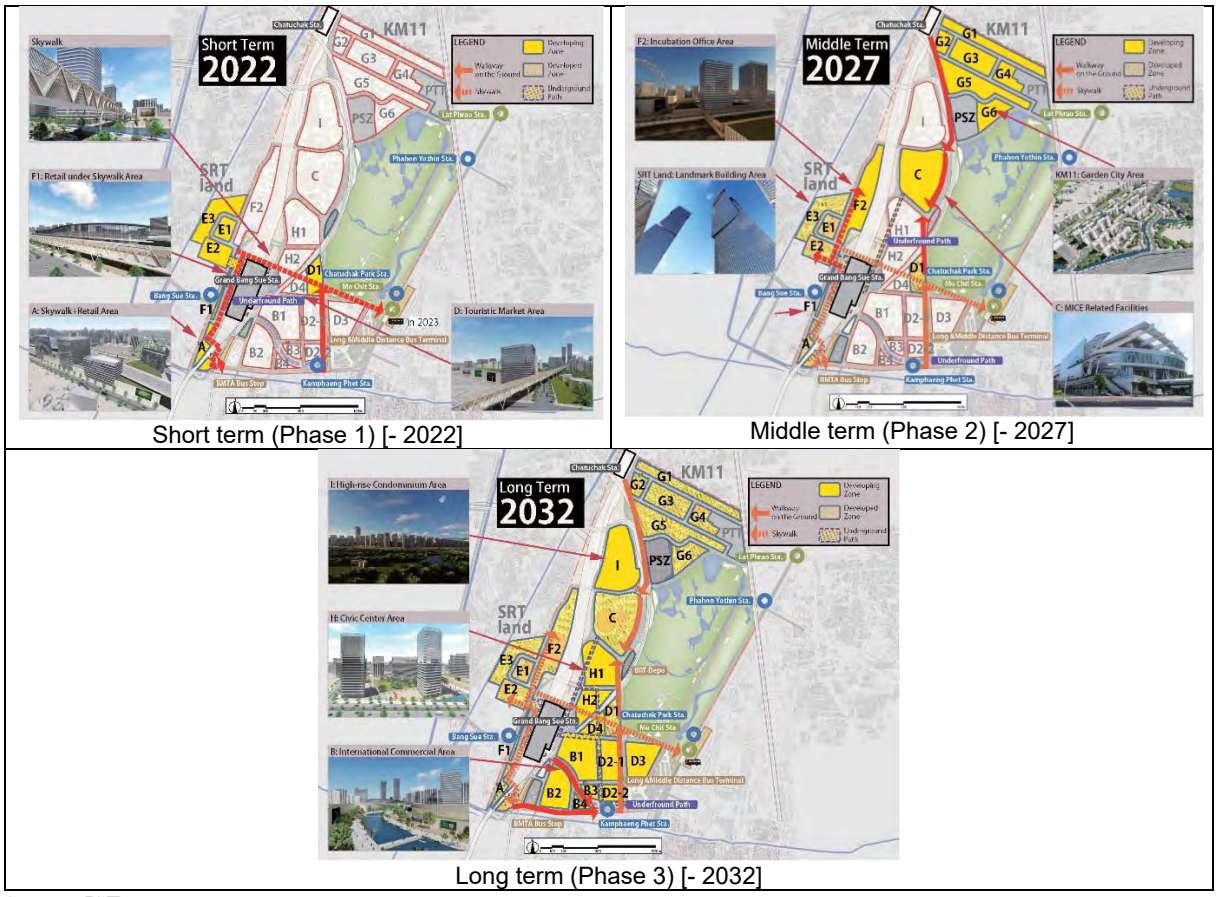
Table 8 Future Gross Floor Area in Chatuchak District in 2032 (Scenario 2)

Category	Gross Floor Area	Share
1) Office	884,570 m^2	15.8%
2) Retail	730,664 m^2	13.0%
3) Condominium	3,626,902 m^2	64.7%
4) Hotel	364,518 m^2	6.5%
Total	5,606,654 m^2	100.0%

Note: In this report, estimated supply shall be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

6.5 Stepwise Development

The stepwise development that is shown in Figure 2 and Table 9 is recommendable in terms of the following points of view: (a) inauguration of new urban mass transit railways, which are being constructed or will be constructed, (b) land status (availability, infrastructure including different types of utility), (c) market demand, and (d) financial arrangements.



Source: JST

Figure 2 Recommendable Stepwise Development by Zone

Table 9 Recommendable Stepwise Development by Zone

No.	Development Zone/ Facility	Short (-2022)	Middle (-2027)	Long (-2032)
1	Red Line/ Grand Station	Start-End	Operated	Operated
2	Airport Link	Start-End	Operated	Operated
3	Zone A	Start-End	Operated	Operated
4-1	Zone D1	Start	End	Operated
4-2	Zone D2/D3	-	-	Start
5	Skywalk (A-D Intersection)	Start	End	Operated
6-1	Zone B1, B2	-	-	Start-End
6-2	Zone B3, B4	-	-	Start
7	Zone C	-	Start-End	Operated
8	KM11(Zone G)	-	Start-End	Operated
9	BKT (Old Mochit)	Start	End	Operated
10	BRT (Area Bus Service)	-	Start-End	Operated
11-1	SRT Land (Zone E1, E3)	Start-End	Operated	Operated
11-2	SRT Land (Zone E2)	Start	End	Operated
12	Zone F	-	Start-End	Operated
13	Zone H	-	-	Start
14	Zone I	-	-	Start-End

Note: Colored cells were proposed by the Japanese side. Red printed cells are different from the Thai side's original ideas.
Note: Red Line, Grand Station, and Airport Link inauguration timing is consistent with that of Thai side's existing plan.
Source: JST (Start: Groundbreaking, End: Inauguration)

7. Development Plan of Bang Sue Area

7.1 Basic Policies

A development plan for Bang Sue Area to achieve the realization of the vision was formulated based on various factors such as the content of the superior plans, the local conditions in the district, and the socioeconomic trends. It also referred to the contents of related plans that were developed under State Railway of Thailand (SRT) and Office of Transport and Traffic Policy and Plan (OTP), and introduced experience and know-how gained through past experiences of large-scale urban development projects in Japan. Basic policies for realizing such considerations are as shown in Table 10.

Table 10 Development Plan Formulation Policies

Policy	Matters for Care and Consideration
(1) To grow up to a new urban core in Bangkok Metropolitan Area which plays important roles in the international community	• To elaborate an integrated master plan for successful redevelopment of the entire area. • To place core facilities including a landmark tower building, smart city, etc. • To introduce attractive urban functions that boost development potential of the entire area.
(2) To create an eternally beloved new central district with full of various attractiveness.	• To introduce the main facility to connect and organize each zones • To develop infrastructure and public spaces that make the entire area more attractive. • To prepare a guideline to promote a well-balanced area development. • Introduce upgraded infrastructure and facilities that will contribute to increasing the potential of the district. • Place (and guide people to) applications and functions that will increase the potential of the entire area. • Introduce guidelines for driving planned urban development.
(3) To create a visitor-friendly traffic terminal area that is comfortable for everyone.	• To ensure comfortable transfer between railway stations and other transport modes. • To construct pedestrian decks and plazas. • To introduce a feeder transport mode (ex. BRT) and make the best use of ITS in the area.
(4) To step-by step implementation of the conceptual plan by both public and private sectors.	• To elaborate a stepwise implementation plan ensuring feasibility and viability. • Consider an appropriate division of labor to ensure a “win-win” To introduce vitality and resources of private sector. • To consider the best role-sharing system that ensure a win-win partnership for both public and private sectors.

Source: JST

7.2 Urban Infrastructure Development Plan

Development plan of basic urban infrastructure, environment and green network and transportation network are formulated. Major items planned are summarized in Table 11.

Table 11 Studied Items for Urban Infrastructure Development Plan

Large Category	Small Category
Basic urban infrastructure	Land Preparation Plan, Road Structural Plan, Storm Drainage Plan, Water Supply Plan, Sewage Plan, Power Supply Plan, Communication Plan, Energy Infrastructure (Cogeneration, District Cooling), Energy Management（CEMS）
Environment and green network	Measures against Floods (Disaster Prevention/BCP), Green Network, Landscape Creation
Transportation network	Road Plan, Sidewalk Plan, Public Transportation Plan (including bus terminal), Traffic Volume Survey
Grade up facility	Sky walk, Underpass, ITS

Source: JST

7.3 Land Use Plan

Land use is divided into three distinct categories: (1) Commercial land (the central core of the district), (2) Multi-purpose land (commercial and business as major land use, and residential as sub land use), and (3) Residential land (good quality residential zones).

A development plan is as shown in Figure 3. Images of future development based on the development

plan are as shown in Figure 4 and Figure 5.

Source：JST

Figure 3　Development Plan

Source：JST

Figure 4　Image of Future Development [Bang Sue Area]

Source：JST

Figure 5 Image of Future Development [Around Bang Sue Grand Station]

7.4 Volume Study/Cost Estimation

The area of floor for offices, commercial facilities, hotels, and residential buildings was c calculated based on the information collected from market research and interviews with real estate companies in Thailand. Based on the area of floor, the generated population and the construction cost were estimated as shown in Table 12 and Table 13. The maintenance cost was assumed to be 2% of the construction cost.

Table 12 Estimated Floor Area and Generated Population

Land Use	Content	Scale (m^2,room, people)
(1) Office	Exclusive Area	530,760 m^2
	Number of People in the Office	44,230 people
(2) Commercial Facilities	Tenant Area	365,350 m^2
	Number of Customers	292,280 people
(3) Hotel	Number of Rooms	31,735 rooms
	Number of People	9,373 people
(4) Residential Facilities	Number of Rooms	6,249 rooms
	Number of Residents	126,942 people

Source：JST

Table 13 Estimated Construction Cost for Bang Sue Area Redevelopment (Category)

Category	Small Category	Cost （USD 1,000）
Basic Urban Infrastructure	-	159,371
Transport Network	-	309,432
Green Network	-	6,100
Environment	-	103,127
Disaster Prevention	-	11,000
Upgrading Facilities	-	81,500
Buildings	Office	2,653,800
	Commercial Facilities	2,189,400
	Residential	10,880,700
	Hotel	1,093,500
	Cultural Facilities	550,000
	Public Offices	300,000
Total		18,337,930

Source：JST

8. Implementation Plan

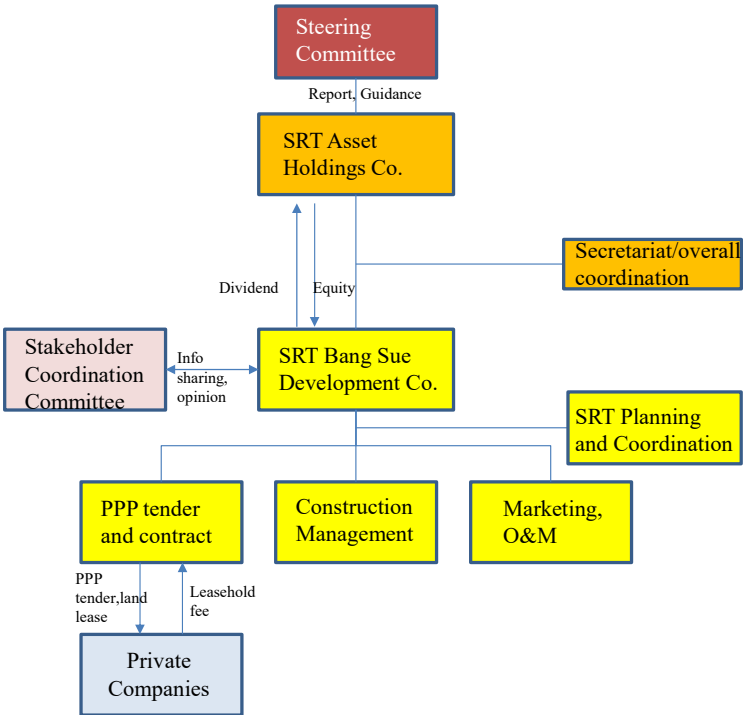
In order to implement the Bang Sue Redevelopment Project, organizational and funding arrangements are essential. In the present study, the project implementing organization and the project funding mechanism were proposed.

8.1 Project Implementing Organization

The Bang Sue Redevelopment Project is a massive project both in terms of size and complexity. It involves many stakeholders at each of the development layers. In the JICA Survey Team (JST) view, there are five layers of development: 1) Basic public infrastructure, 2) Green network and environment management, 3) Transportation network, 4) Upgrade facilities for transit-oriented development (TOD) and Smart city and 5) Commercial and magnetic facilities.

These development layers are all implemented on the land owned by State Railway of Thailand (SRT), which also adds complexity. For example, trunk road (in Layer 1) is typically developed on top of the land owned by the government. Trunk road development on SRT's land requires a memorandum of understanding (MOU) between SRT and Bangkok Metropolitan Administration (BMA), to clarify the responsibilities sharing of construction, operation and maintenance (O&M). Such coordination between SRT and each government department requires very strong coordination mechanism. Otherwise, the development will just take too much time and energy.

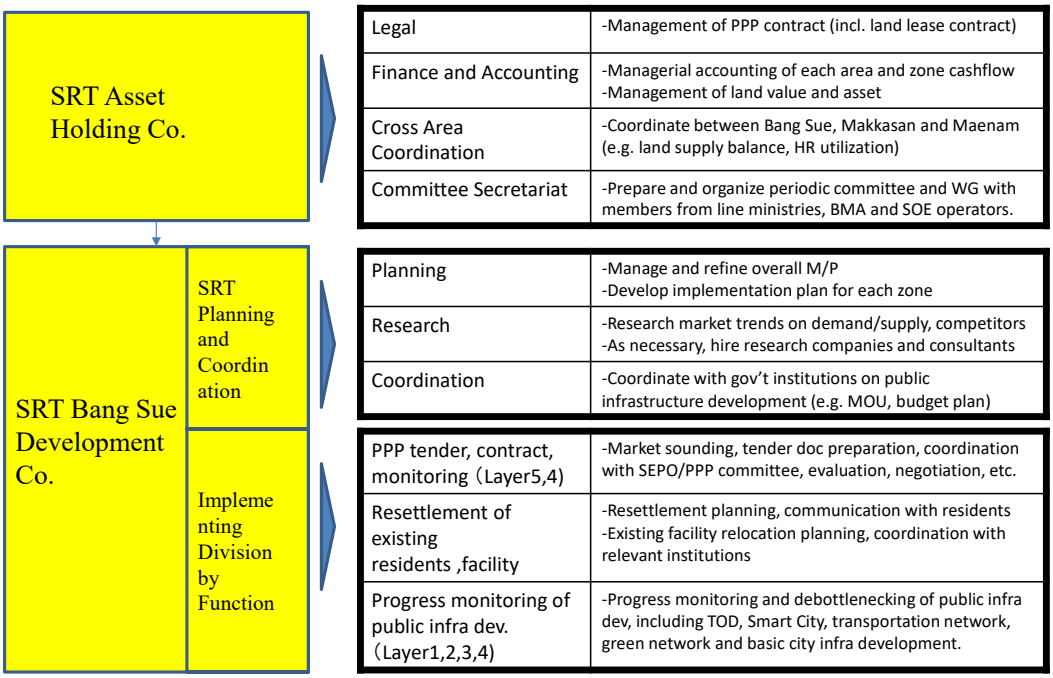
Therefore, government "top-down" implementation structure involving all key stakeholders is essential to successfully develop the Bang Sue Area. JST's suggested implementation structure is described in Figure 6. The key functions of this implementation structure are embedded in the following six key organizations: 1) Steering Committee, 2) SRT Asset Holding Company, 3) Secretariat/Overall Coordination, 4) SRT Bang Sue Development Company, 5) Planning and Project Coordination, and 6) Stakeholder Coordination Committee.



Source：JST

Figure 6 Project Implementation Organization

SRT Bang Sue Development Company should have the essential business functions described in Figure 7, and required to be the “Master Developer” and “Orchestrator” of the development project.

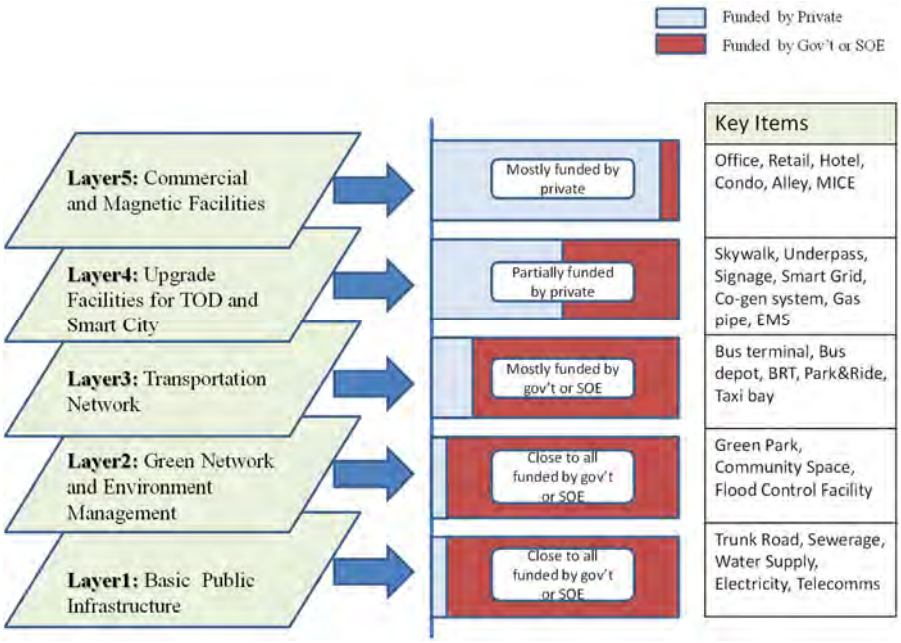


Source：JST

Figure 7　Required Functions within SRT Subsidiary Organizations

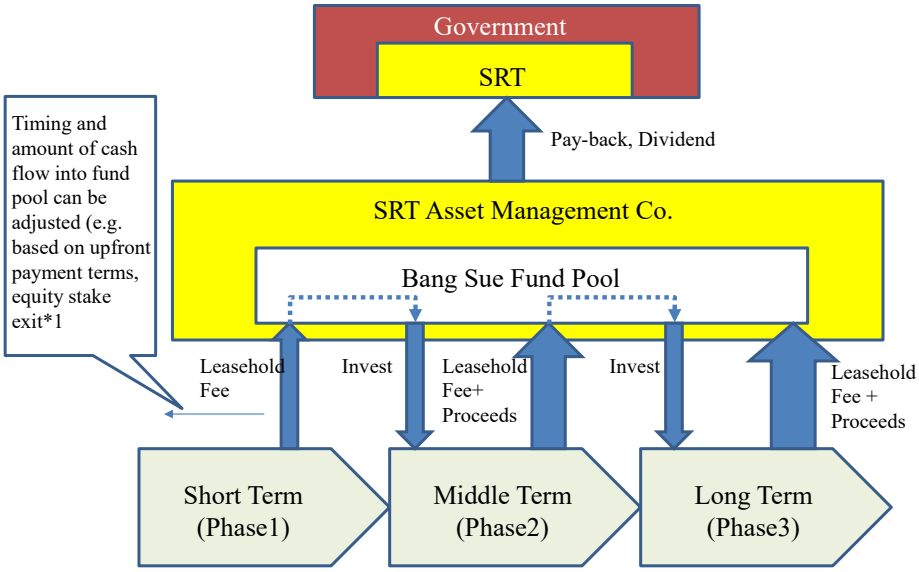
8.2　Funding Mechanism

Funding for this project shall inevitably be a combination of private funding via PPP, government funding, and state-owned enterprise (SOE) funding. This is because the project is not merely about developing commercial facilities on top of the SRT land. As described in 8.1, the project has five layers of development. Each layer shall have different funding characteristics. The basic fund allocation principles are described in Figure 8, the idea of phased usage of fund pool is described in Figure 9.



Source：JST

Figure 8　Basic Funding Allocation Principles



*1 SRT could convert leasehold rights into equity portion of SPC. Once SPC realizes stable operating cashflow, then, this could be sold to infrastructure fund (e.g. REIT)

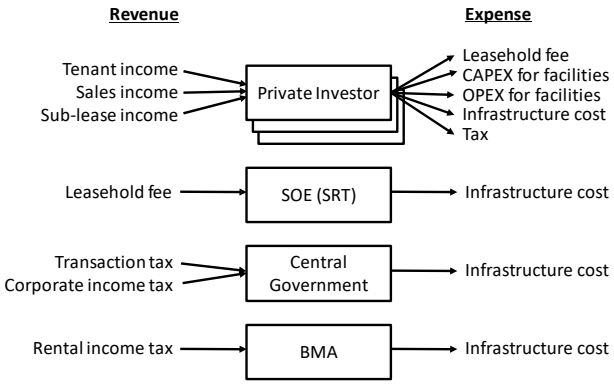
Source：JST

Figure 9 Phased Usage of Fund Pool

8.3 Financial Analysis

The objective of financial analysis is to check financial feasibility and affordability of the project. That must be critical factors for future success. It is assumed that there are four major players on the project: 1) Private investor, 2) State-owned Enterprise (SOE) operators, including State Railway of Thailand (SRT) and Electricity Generating Authority of Thailand (EGAT), etc., 3) Central Government (CG) including MOT, MOF, etc. and 4) Bangkok Metropolitan Administration (BMA).

The following sketch in Figure 10 shows the financial analysis scheme. Major parameters of Senario1 and Senario2 and other conditions are shown in the main report.



Source：JST

Figure 10 Financial Analysis Scheme

The output of the financial analysis is summarized as follows. The detailed results are shown in the main report.

1) Private investor

There is substantial difference between Scenario-1 and Scenario-2 where equity-IRR in Scenario-1 is less than 5% while the equity IRR in Scenario-2 is over 15% in most zones.

2) SOE

Land lease fee paid by private investors shall be gained during year 2019-2044 under the condition that the grace period is three years and pay-back term is set at ten years. The revenue of SOE would become THB 2.5 billion per year in net present value while maximum infrastructure cost would become THB 1.2 billion per year, so that the profit can reflux into the next phase investment.

3) Central Government and BMA

The tax revenue has a substantial impact in Scenario-2. On the other hand, in Scenario-1, the tax revenue is estimated only at 10% of Scenario-2. In Scenario 1, the land value would have increased not enough for private investors to gain profit, so that less private investors may join the project. As the result, the tax revenue based on profitability would not have increased much in Scenario 1.

8.4 Project Schedule

For the development of Bang Sue Area, a three-phase development program is recommended from the perspective of promoting well-planned, integrated development of the overall area. The three-phase consists of the Short Term (Phase 1: target year 2022), the Middle Term (Phase 2: target year 2027) and the Long Term (Phase 3: target year 2032).

9. Intention of Japanese Private Sector

A questionnaire survey on Bang Sue Area development was conducted to 1) member companies of the Japan Conference on Overseas Development of Eco-Cities (J-CODE), and 2) member companies of division of Engineering Work and Construction, the Japanese Chamber of Commerce, Bangkok, to understand the intention of Japanese companies to participate into urban development-related business and possibility of introducing qualified urban infrastructure.

Results of the questionnaire and interviews revealed that many Japanese firms are highly interested in business participation to the project, with the advantages in the position of Bang Sue Area in the superior plans, high public transport convenience, and the land of project area owned by one owner, the State Railway of Thailand (SRT). However, some requests were also clarified such as the extension of land lease period (50 to 70-year lease is desirable), and the basic infrastructure development by the government, etc.

10. Way Forward

Main actions to be taken at the very initial stage (until 2019) are as shown below.

1) The Government of Thailand

1) M/P Finalization, 2) Steering Committee Establishment, and 3) Clarification of menu of Government Assistance.

2) The State Railway of Thailand (SRT)

1) Establishment of Subsidiaries by 2017

2) Preparation for Short Term Development (until 2022): 2018 and after

3) Preparation for Middle Term Development (until 2027), 4) Smart City-related Planning, 5) TOD and Transport Networking-related Planning, 6) Basic Infrastructure-related Planning, 7) MICE-related Planning, and necessary coordination for every actions: 2019 and after

This is the end of the Executive Summary.

Chapter 1 Introduction

1.1 Background

The Bangkok Metropolitan Region, Bangkok and its five surrounding prefectures, currently, has a population of 10,730,000 people. In 2013, the gross regional domestic product (GRDP) per capita was recorded at THB 376,463 which is slightly less than twice the gross domestic product (GDP) per capita for the whole country at THB 193,394 on the same year. The Bangkok Metropolitan Region has the biggest population, and it is the center of economic and political activities in the country.

In order to solve heavy traffic and environmental problems in the Bangkok Metropolitan Region, the Ministry of Transport (MOT) started introducing mass transit system in the 1990s. As of January 2017, four urban mass rapid transit (UMRT) lines, i.e., BTS Sukhumvit Line, BTS Silom Line, MRT Blue Line, MRT Purple Line, and one airport line, i.e., Airport Rail Link (ARL) are operated in Bangkok. Furthermore, they have several ongoing plans and under construction projects to extend these existing lines, as well as to construct new lines, to enhance UMRT networks.

State Railway of Thailand (SRT) Red Line Project, including Bang Sue Grand Station, has a total extension length of 26.3 km. One of the financial resources of the project is the yen loan. As the implementing agency, SRT aims to start its operation in July 2020. Bang Sue Grand Station shall be the biggest terminal station in Bangkok. Several UMRT lines, including Red Line shall stop at Bang Sue Grand Station.

The survey area (hereafter called as Bang Sue Area) includes Bang Sue Grand Station and large land for railway facilities. Being located at the future transport hub in Bangkok, it has a high potential for urban development. Office of Transport and Traffic Policy and Planning (OTP) and SRT studied on the development concept plans and SRT intends to redevelop the area by public-private partnership scheme. However, they are confronted with difficulties such as “lack of step-by-step integrated development” and “lack of arrangement of each project based on a single comprehensive master plan”.

In this context, MOT requested the Japan Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) for support in developing an integrated master plan (MP) for Bang Sue Grand Station and the surrounding area. Accordingly, OTP, SRT, and MLIT established a Working Group for Urban Development (WG) in August 2016. Through the three WG sessions in August 2016, November 2016, and January 2017, OTP, SRT, and MLIT discussed the necessity of an integrated MP including an infrastructure plan and work items to be considered.

With this situation in mind, the Japan International Cooperation Agency (JICA) decided to take over the cooperation and assign a survey team to formulate an integrated MP. The objectives of the present survey are as follows:

1. Based on the discussions in the WGs and the former information gathering survey conducted by MLIT, the JICA Survey Team (JST) shall collect and analyze related information and data for redevelopment in Bang Sue Area. JST shall formulate the “Development Vision” and “Draft Concept Paper”, and facilitate stakeholders to reach a consensus for integrated development.
2. JST shall formulate all plans including project implementation scheme and fund allocation among stakeholders such as central government, local government, state-owned enterprise and private sectors, which shall contribute to project implementation framework for redevelopment

of Bang Sue Area.

1.1.1 Survey Period

The survey period is from March 2017 to November 2017.

1.1.2 Survey Area

The survey area is shown in Figure 1.1.1.

Source: JST

Figure 1.1.1 Bang Sue Area (Survey Area)

1.2 Working Groups/ Workshops

During the survey period (from March to November 2017), three sessions of WG on Urban Development were held by MOT and MLIT. JST reported the progress of the present study at the WGs to Thai stakeholders. In addition, nine workshops (WS) were held in Bangkok in order to discuss with Thai stakeholders and obtain their opinions.

(1) March 21, 2017 (Tuesday) Bangkok the 4th WG

(2) June 8, 2017 (Thursday) Bangkok the 5th WG

(3) August 29, 2017 (Tuesday) Bangkok the 6th WG

Source: JST

Figure 1.2.1 Coordination between the Government of Thailand and the Government of Japan

1.3 Seminar on Thailand – Japan Railway Cooperation for Connectivity Success

The seminar on Thailand – Japan Railway Cooperation for Connectivity Success was held by JICA and OTP on 17th November 2017 in Bangkok. A presentation on Bang Sue Area redevelopment project (the result of the present survey) was given by JST, and PR video for the project was unveiled. In addition, a brief introduction of the present survey was given through panels and a brochure.

(1) November 17, 2017 (Friday) Bangkok
Presentation on Bang Sue Redevelopment at the seminar

(2) November 17, 2017 (Friday) Bangkok
Exhibit panels at the seminar room

Figure 1.3.1 Seminar on Thailand – Japan Railway Cooperation for Connectivity Success

Chapter 2 Superior Plans

2.1 Urban Development Related Plans

The related factors between superior plans and Bang Sue Area development are as shown in Table 2.1.1.

Table 2.1.1 Related Factors between Superior Plans and Bang Sue Area Development

No.	Superior Plans	Factors related to Bang Sue Area Development
1	National Spatial Development Plan 2057	● Urban development policy (Strategy, Land Use, Tourism, Transport, and Energy etc.)
2	Bangkok Comprehensive Plan	● Land Use Plan (Zoning, FAR) ● Public contribution options for obtaining FAR bonus (Open space, parking, storage tank etc.)
3	Mass Rapid Transit Master Plan of Bangkok	● Public transport plan ● Urban development around a train station

Source: JST

2.1.1 National Spatial Development Plan 2057 of Thailand

(1) Outline

National Spatial Development Plan 2057 of Thailand was formulated by the Department of Public Works and Town and Country Planning, Ministry of Interior (DPT), in response to the cabinet order dated July 9, 2002. Directions and policies for national spatial development are formulated for a 50-year period, and the plan also includes strategic plans for a 5-year period, 10-year period, and 15-year period.

The national development vision stated in the plan is “Thailand will be a world leader in agriculture, agro-industry, food technology, health services, and tourism. Thai people will have a good quality of life in the pleasant environment. The country will be solidly established with sustainable growth.”

To achieve the vision by 2057, following plans are specified in the plan, as shown in Table 2.1.2.: “Development frameworks”, “Strategic position and future development trends”, “Major issues of national development policies”, and “Fields covered by the 50-year National Spatial Development Policy”.

Table 2.1.2 Outline of the National Spatial Development Plan 2057 of Thailand

No.	Item	Descriptions
1	National development vison	“Thailand will be a world leader in agriculture, agro-industry, food technology, health services, and tourism. Thai people will have a good quality of life in the pleasant environment. The country will be solidly established with sustainable growth.”
2	Development frameworks	1) Potential economic development zone 2) Growth distribution to all regions 3) Linkage to other ASEAN countries
3	Strategic position and future development trends	1) Giving priority to increase in urban balance and urban clusters development with comparable economic activities and progress. 2) Promoting rural centers to get more strength, be self-reliant, and benefit from regional linkage.
4	Major issues of national development policies	1) Populations and workforce distribution 2) Economic development 3) Urban-rural organization according to proper roles and functions 4) Most efficient land use 5)Development of transportation systems, technology and communication, and energy
5	Fields covered by	1) Land use and development, (2) Agriculture, (3) Urban and rural development, (4) Industry,

No.	Item	Descriptions
	the 50-year National Spatial Development Policy	(5) Tourism, (6) Social services, (7) Transportation, energy, IT, telecommunication, and (8) Prevention of natural disasters

Source: JST

(2) Regional Development Policies

The National Spatial Development Policy consists of both the national plan and wide-area regional plan (national-regional plan) of which six regions --- 1) Bangkok and its vicinity, 2) Eastern Region, 3) Central Region, 4) Northeastern Region, 5) Northern Region, and 6) Southern Region --- are assigned as the wide-area regions. Table 2.1.3 shows policies on the development of the six regions and Figure 2.1.1 shows a conceptual diagram of the National Spatial Development Plan. Figure 2.1.2 shows the conceptual map of "Bangkok and its Vicinity Regional Plan" as part of the National Spatial Development Plan 2057.

Table 2.1.3 Policies on the Development of the Six Regions in the National Spatial Development Plan 2057 of Thailand

No.	Region	Development Policy
1	Bangkok and its vicinity [Bang Sue Area]	• Developing this region as a world-leading metropolitan area to make it an Asian hub of economy and air transport. • Making it a livable, beautiful, attractive city, and stopping the urban sprawl. • Making the most efficient use of the urban area to enhance the urban functions of Bangkok and its vicinity linking it with a comprehensive, state-of-the-art public transport system so that the urban functions will cover the entire region.
2	Eastern Region	• Developing this region as an industrial center and a world-class, leading-edge port city to enhance its functions as Asia's economic gateway and center of transportation and distribution. • Providing support so that Chachoengsao, Chonburi, Pattaya, and Rayon, which are major cities, will become economic centers that will support the expansion of the metropolitan area.
3	Central Region	• Developing good agriculture, aiming to make this region a global food center and encouraging agricultural practice by positioning the region as the center of chemical-free farming techniques. • Managing world-class natural and historical tourist attractions and supporting clean industries. • Developing Ayutthaya, Saraburi, Ratchaburi, and Hua Hin as major cities that will support the economic expansion of the metropolitan area.
4	Northeastern Region	• Developing this region as the economic gateway for Indochina, conserving relics of ancient civilization and world heritage and maintaining good farmland. • Promoting the development of Nakhon Ratchasima, Khon Kaen, Udon Thani, Ubon Ratchathani, and Mukdahan as central cities that link the settlements.
5	Northern Region	• Developing this region as the economic center of countries along the Mekong River, developing road and railway networks, and developing Chiang Mai, Chiang Rai, Phitsanulok, and Nakhon Sawan as core cities of the Northern Region. • Maintaining the proportion of forests and water resources at 60% or higher in terms of area and creating settlements that are livable and maintain the characteristics of the Lan Na culture.
6	Southern Region	• Developing this region continuously as an economic bridge with other countries based on its cultural diversity and rich natural resources, and promoting the halal food industry to promote this region as a world-class tourist attraction. • Developing Hajai, Songkhla, Suratthani, Nakhon Si Thammarat, and Pattani as regional core cities.

Source: JST

(3) Major Features

The formulation of the National Spatial Development Plan 2057 was the first attempt in the history of urban planning in Thailand wherein it formulated official spatial policies at both the national and

regional levels.

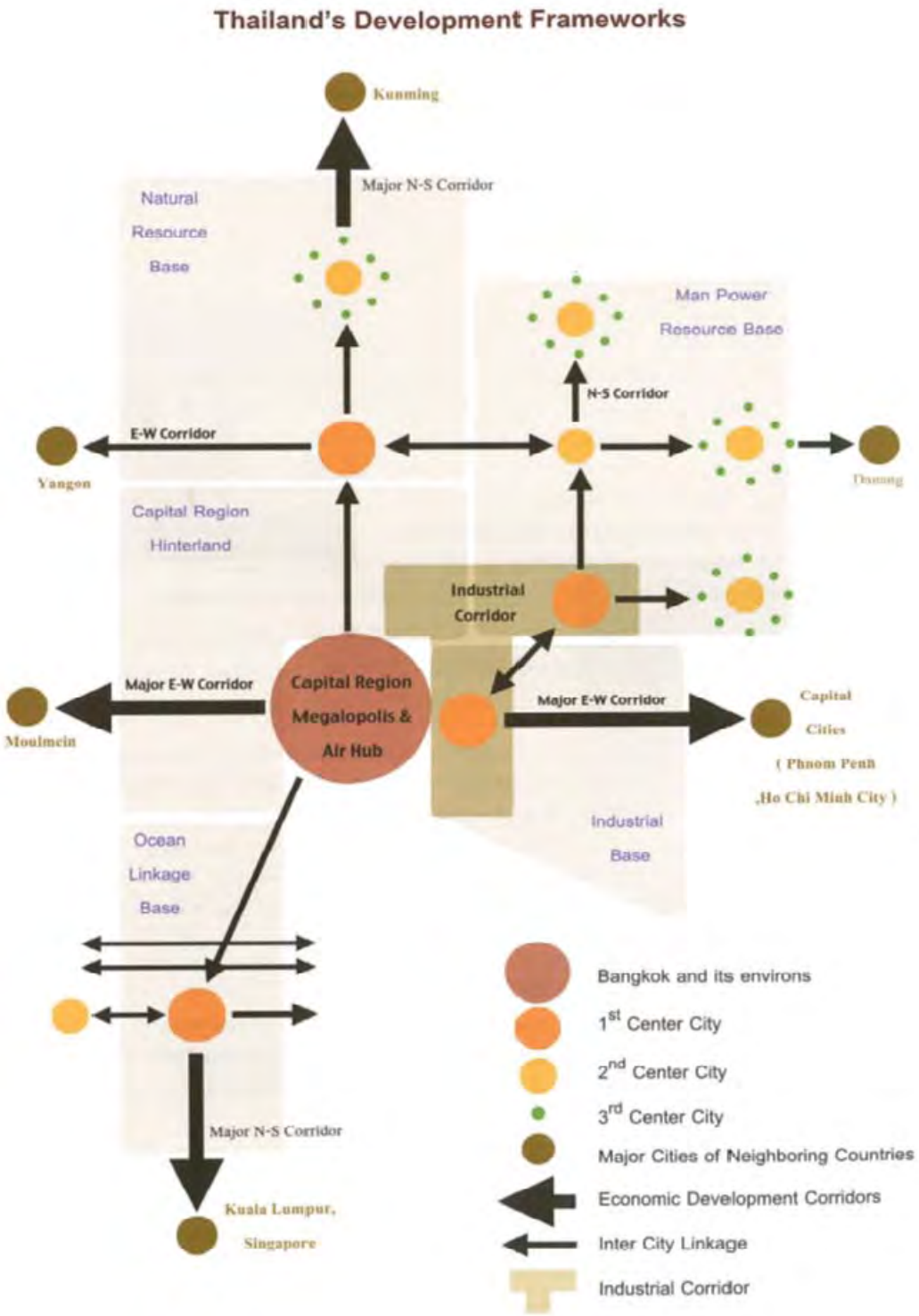
Thailand's former spatial development was done without official spatial policies, either at national or regional level, as explicit frameworks for leading, supervising, controlling, and integrating the urban-rural developments. In addition, development planning systems lacked united and efficient cooperation among agencies concerned resulting in numerous problems e.g. imbalanced developments of land use, society, and economy, improper natural resources management, urban and communities expansion in disorder, people's settlements in dangerous areas, diffusion of industrial plants and hazardous warehouses along with residential areas, natural resources and environments exacerbated, poverty problem, differences in growth and profits dispersal, insufficient public services and facilities for all urban and rural areas, etc. Other than a direct impact on people's quality of life, these problems also caused higher development costs and adversely affected national competitiveness and economic system[1].

The main purpose of the plan is to contribute such problems through followings:

1) Clarifying the vision of the national government on urban planning;
2) Formulating urban planning policies related to the development of the national strategic areas (major economic infrastructure, safe habitats, and good quality of life); and
3) Establishing policies, strategies, and measures for development areas, land use, infrastructure, and community structure.

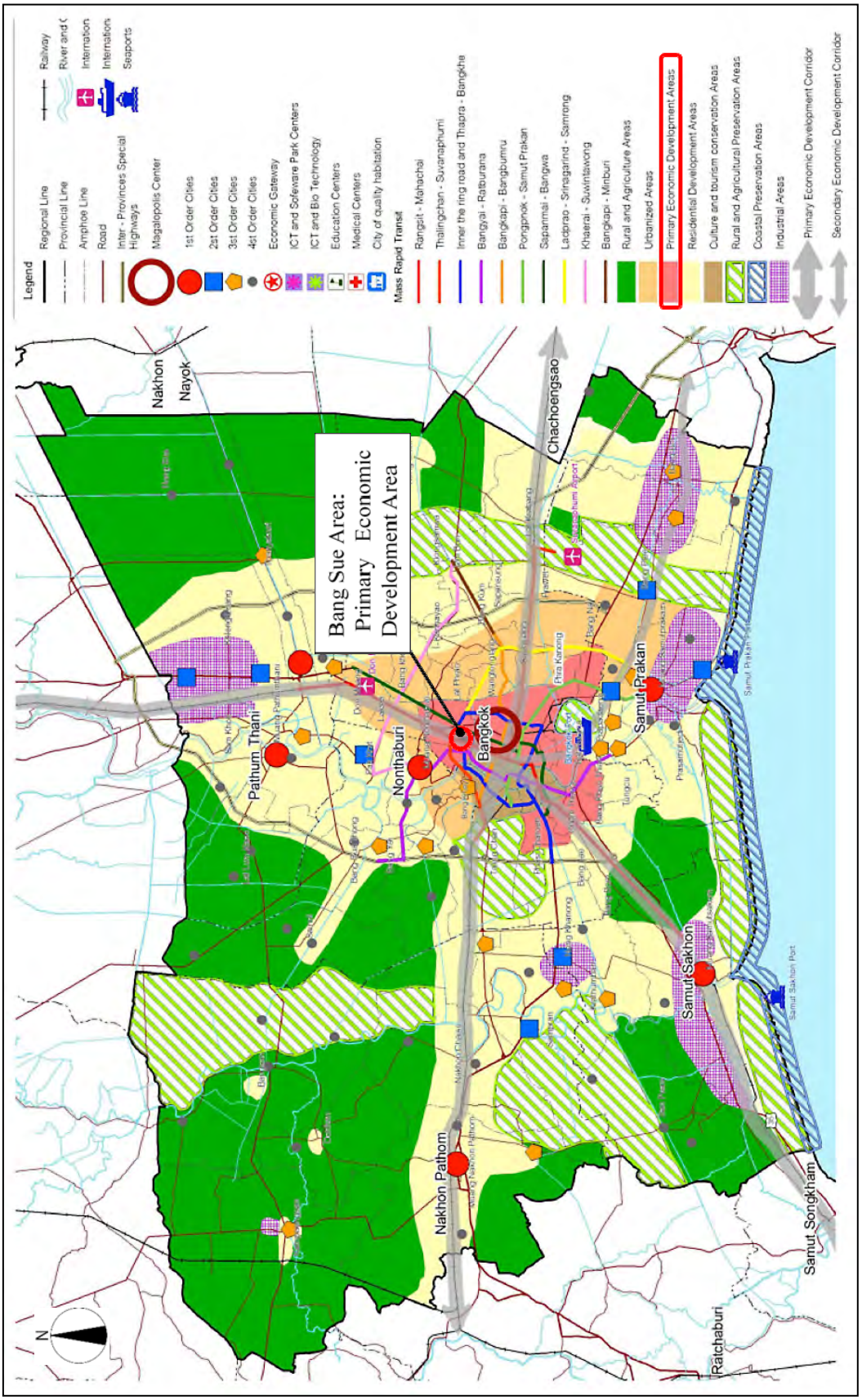
In addition, the plan positions Thailand as as the gateway to the Association of Southeast Asian Nations (ASEAN) countries and southern China, and defines economic corridors such as the South-North Economic Corridor, East-West Economic Corridor, and South Economic Corridor as a long-term development strategy.

[1] An Overview of Spatial Policy in Thailand (MLIT)



Source: DPT (2009) Thailand National Spatial Development Plan 2057

Figure 2.1.1 Conceptual Drawing of the National Spatial Development Plan



Source: DPT (2009) Thailand National Spatial Development Plan 2057

Figure 2.1.2 Bangkok and its Vicinity Regional Plan

2.1.2 Bangkok Comprehensive Plan

The first Bangkok Comprehensive Plan was issued in 1992. In principle, the plan will be revised every five years with maximum of two times of two-year extension. It was revised in 1999, 2006, and 2013. At present, the Bangkok Comprehensive Plan 2013 is in operation, but a revised plan for 2018 is under preparation.

The Bangkok Comprehensive Plan 2013 contains the Zoning Plan, the Open Space Conservation, the Transport System Plan, and the Infrastructure Development Plan. The land zoning is categorized in ten major categories and 26 minor categories.

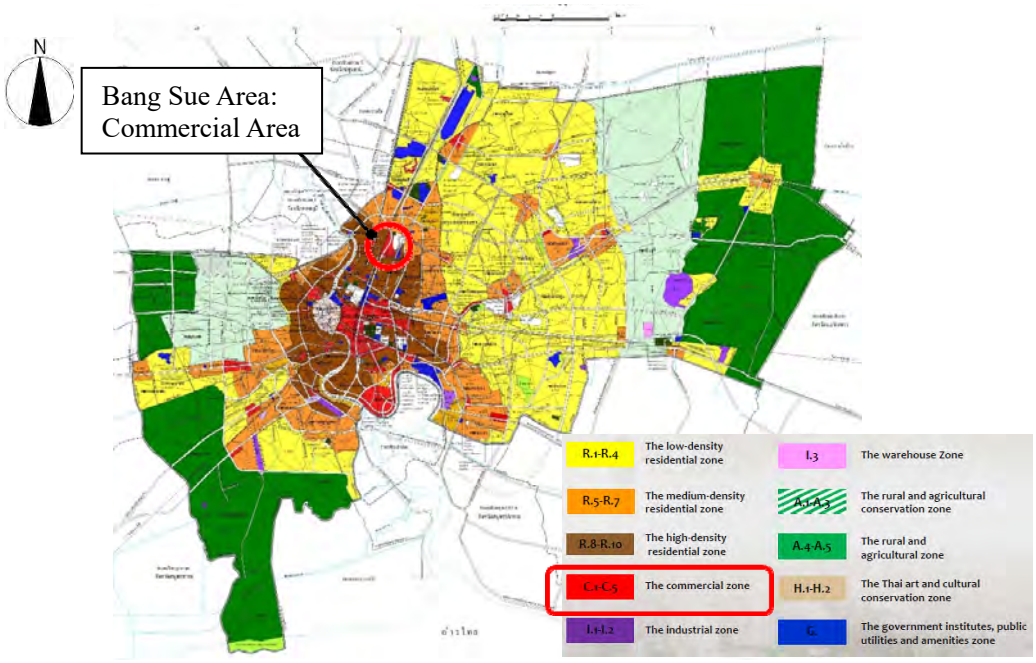
Since the Bangkok Comprehensive Plan 2006, Floor Area Ratio (FAR) and Open Space Ratio (OSR) as well as the idea of FAR bonus were introduced as new methods in order to control land use. Under these rules, land developers are able to obtain a maximum of 20% FAR bonus by satisfying certain conditions.

The land zoning categories and conditions for obtaining FAR bonus in the Bangkok Comprehensive Plan 2013 are as shown in Table 2.1.4. The land zoning in the Bangkok Comprehensive Plan 2013 is shown in Figure 2.1.3.

Table 2.1.4 Land Zoning Categories and Conditions to Obtain FAR Bonus in Bangkok Comprehensive Plan 2013

No.	Category	Content
1	Land Zoning (Ten major categories)	1) Residential (low density), 2) Residential (middle density), 3) Residential (high density), 4) Commercial, 5) Industrial, 6) Warehouse, 7) Conservation Zone for Agriculture, 8) Agriculture, 9) Conservation Zone for historical and cultural buildings, and 10) Government use.
2	Conditions for getting FAR bonus	Land developers can obtain a maximum of 20% FAR bonus by satisfying a minimum of one condition below. 1) Providing public open space, 2) Providing parking space, 3) Providing social housing, 4) Installing rainwater storage tank, and 5) Installing “green building” (energy saving).

Source: JST



Source: BMA (2013) The Bangkok Comprehensive Plan (2013)

Figure 2.1.3 Land Zoning in Bangkok Comprehensive Plan 2013

2.1.3 Mass Rapid Transit Master Plan of Bangkok

In 1994, Office of the Commission for the Management of Land Transport (OCMLT) prepared the Mass Rapid Transit Systems Master Plan (MTMP) proposing three mass transit lines with total distance of 238 kilometers. Later in 2001, OTP prepared the Urban Rail Transportation Master Plan in Bangkok and the Surrounding Area (URMAP) proposing seven mass transit lines with a total distance of 375 kilometers. The plan also proposed the development of three intermodal stations namely: Bang Sue, Makkasan, and Taksin.

In 2004, OTP prepared the Bangkok Mass Transit Master Plan (BMT) proposing eight mass transit lines with a total distance of 475 kilometers. Finally in 2010, OTP prepared the Mass Rapid Transit Master Plan in Bangkok Metropolitan Region (M-MAP) consisting of 12 mass transit lines with a total distance of 556 kilometers.

Table 2.1.5 Summary of the Mass Rapid Transit Master Plans in Bangkok

No.	Name of Plans	Year	Composer	Summary of Contents
1	Mass Rapid Transit Systems Master Plan （MTMP）	1994	OCMLT	• 3 lines with a total of 238 km in Bangkok Metropolitan Region
2	Mass Rapid Transit Systems Master Plan （MTMP）	2001	OTP	• 7 lines with a total of 375 km in Bangkok Metropolitan Region • Bang Sue, Makkasan, and Taksin are designed as intermodal nodes.
3	Bangkok Mass Transit Master Plan（BMT）	2004	OTP	• 8 lines with a total of 475 km in Bangkok Metropolitan Region • Bang Sue, Makkasan, and Taksin are continuously designed as intermodal nodes.
4	Mass Rapid Transit Master Plan in Bangkok Metropolitan Region （M-MAP）	2010	OTP	• 12 lines with a total of 556 km in Bangkok Metropolitan Region • Bang Sue, Makkasan, and Taksin are continuously designed as intermodal nodes.

Source: JST, based on M-MAP seminar document[2]

2.2 Policies and Plans for Economics and Industrial Promotion

2.2.1 Thailand 4.0

Thailand 4.0 formulated by National Economic and Social Development Board (NESDB) is the latest economic and industrial model of Thailand, which is advocated as linking the 20-year National Strategic Plan. It aims to shift from the current economy (Thailand 3.0) led by foreign investments with focusing on automobiles, electrical and electronics industry, petrochemicals, and others to an added-value economy based on knowledge, creation, and innovation focused mainly on the knowledge-intensive industry, the green industry, renewable energy, healthcare, and transport (see Figure 2.2.1).

Currently, Thailand is facing problems such as declining birthrate, aging population, shortage of advanced human resources, and income disparities, as well as middle-income trap. To solve these problems at the same time, the Government of Thailand deems it necessary to change the industrial structure by increasing the added-value of industries and products. The Government of Thailand has designated ten industries (five existing industries and five new industries) and five core technologies,

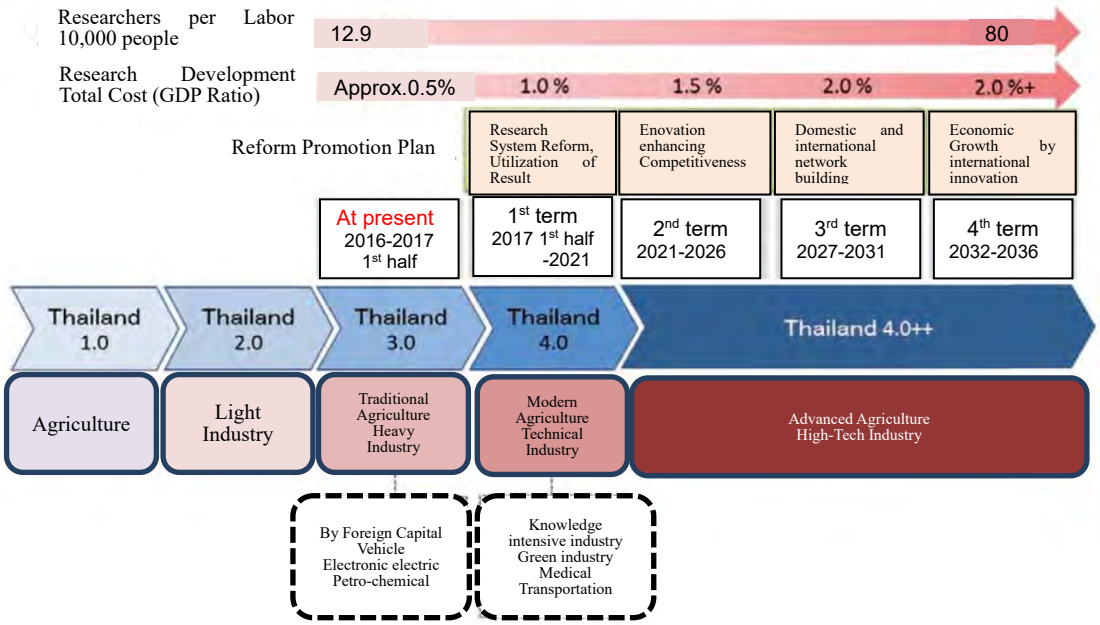
[2] The document of the second seminar of M-MAP, held in July 2009

which are listed in Table 2.2.1. as drives of Thailand 4.0 policy.

Table 2.2.1 Ten Industries and Five Core Technologies Designated in Thailand 4.0

No.	Category	Descriptions
1	Five existing industries (that maintain economic growth)	1) Automobiles including next-generation automobiles and automotive parts, 2) Smart electronics 3) High-quality tourism, 4) Agro and biotechnology, and 5) Next-generation food and food processing
2	Five new industries (that lead the economy to grow dramatically)	1) Robotics, 2) Transportation and aviation, 3) Bio industry, bioenergy, and biochemical, 4) Digital industry, and 5) Medical hub and medical and health industry
3	Five core technologies	1) Food technology, 2) Health technology, 3) Automation technology, 4) Digital technology, and 5) Cultural technology

Source: JST



Source: Toshio Ohta, 2017

Figure 2.2.1 Outline of Thailand 4.0

2.2.2 Twenty-year National Strategic Plan

NESDB has formulated a 20-year National Strategic Plan (2017-2036) as a long-term national plan created by the Government of Thailand. It consists of six areas, six primary strategies, and four supporting strategies as shown in Table 2.2.2. It is therefore also referred to as the "6-6-4 plan."

The plan clearly specifies "science and technology, research, and innovation" as one of the four supporting strategies.

Table 2.2.2 Outline of the 20-year National Strategic Plan

No.	Item	Descriptions
1	Six areas	1) Security 2) Competitiveness enhancement 3) Human resource development 4) Social equality 5) Green growth 6) Rebalancing and public sector development
2	Six primary strategies	1) Enhancing and developing the potential of human capital 2) Ensuring justice and reducing social disparities 3) Strengthening the economy and enhancing competitiveness on a sustainable basis 4) Promoting green growth for sustainable development 5) Bringing about national stability for national development towards prosperity and sustainability 6) Enhancing the efficiency of public sector management and promoting good governance
3	Four supporting strategies	1) Infrastructure development and the logistics system 2) Science and technology, research, and innovation 3) Urban, regional, and economic zone development 4) International cooperation for development

Source: JST

In addition, the plan sets the following targets for the ratio of the total research and development cost to the gross domestic product (GDP) and the number of researchers (Table 2.2.3).

Table 2.2.3 Ratio of Total Research and Development Cost to GDP and Number of Researchers per 10,000 Working People

Periods	Ratio of Total Research and Development Cost to GDP	Number of Researchers Per 10,000 Working People
Up to 2017	-	12.9
2017 - 2021	1.0%	-
2022 - 2026	1.5%	-
2027 - 2031	2.0%	-
2032 - 2036	2.0% or higher	-
By 2036	-	80
2036 onwards	4.0%	-

Source: JST

2.2.3 National Economic and Social Development Plan

(1) Outline

In Thailand, the National Economic and Social Development Plan is formulated as a five-year guidance of economic and social development for the whole country. The National Economic and Social Development Plan is a framework of national policy and also a guidance for policy makers and government officers to formulate and revise economic and social development policies.

The composer of the plan is NESDB and the plan is approved by the Cabinet. After the approval of the Cabinet, it is enforced as a cabinet order.

The latest plan is “The 12th National Economic and Social Development Plan” (NESDP) targeting 2017 to 2021. Under the vision of “A happy society with equality, fairness, and resilience”, the 11th plan targeting 2012 to 2016 formulated six major strategies including human resource development, security of food and energy, natural resource and environmental management, and so on. The 12th plan continues the major direction of the 11th plan and the newly formulates ten strategies toward reducing income differences; strengthen economy and competitiveness in international society.

The outline of the 12th plan is as shown in Table 2.2.4.

Table 2.2.4 Outline of the 12th Five-year National Economic and Social Development Plan

No.	Items	Summary of Contents
1	Goal	1) Income per people : USD 13,000 by year 2036 2) Average yearly growing rate of GDP: 5～6% 3) Strong competitiveness, which is in second position among ASEAN countries after Singapore 4) Gini coefficient to show income gap: 0.36 5) Reduce greenhouse gas emission volume: Reduce 20–25% 6) Lifelong learning 7) Income security for elderly citizen
2	10 Strategies	1) Human capital development, 2) Ensure fairness and reduce social disparities 3) Strengthening of Thailand's economy on a sustainable basis, 4) Green growth,5) Promote national stability, 6) Combat corruption and promote good governance, 7) Infrastructure and logistics development, 8) Develop science, technology, research, and innovation, 9) Urban and economic zone development, 10) International cooperation for development

Source: MITSUI & CO. GLOBAL STRATEGIC STUDIES INSTITUTE's report based on NESDB's documents

(2) Description on Urban Development

During the past decade, the National Economic and Social Development Plan did not clearly mention about the area and the contents of development along urban railway. The 10th plan 2007-2011 mentioned only "the development of mass transportation network in Bangkok and its vicinity for convenience, quickness, safety, time saving, and the decrease of energy consumption".

The following 11th plan 2012-2016 mentioned brief purpose only: "the development of the public transportation network so that it covers more areas and responds the expansion of urban areas and land use. An electric train network should be built for public transportation. The efficiency of current public transportation in Bangkok and other municipal areas should be increased. Facilities to support commuting patterns should be developed that serve both private cars and public transportation."

Recently, the 12th plan 2017-2021 firstly mentioned about "Bang Sue" and detailed contents of public transport development. It mentioned "The development of public transport in urban areas" by indicating "ten mass transit lines in Bangkok and its vicinity for a distance of 384 kilometers consisting of implementing projects. Mass Rapid Transit Authority of Thailand (MRTA) and State Railway of Thailand (SRT) shall be the major agencies to implement these transport projects.

The plan mentioned about "Development of Major Cities". In particular to Bang Sue, it has a detailed statement as follows:

"To promote Bangkok to be the center of international business hub; educational center; international health and medical center, with high standard information and communication technology, in intermodal nodes, e.g., Bang Sue. Cities should be developed with adequate allocation of land use, public utilities and facilities, social services, and housing. In order to respond to the demand from increasing population, it shall consider solving urban environmental problems such as traffic congestion, solid waste, wastewater, air pollution, as well as providing better townscape, green areas, and public parks."

2.2.4 Thailand's Eastern Economic Corridor

Thailand's Eastern Economic Corridor (EEC) is a project that was approved by the Government of Thailand in July 2016. It was proposed by NESDB. In this project, transport infrastructure shall be developed in the region along the corridor. The target areas are three eastern provinces: Chonburi, Rayong, and Chachoengsao. The project promotes investment in ten high-tech industry sectors

including electric vehicles, hybrid vehicles, healthcare, aviation, and robots.

This project shall also function as a part of the 12th Five-Year Plan and development shall be implemented from 2017 to 2021. As the first phase, the expansion and improvement of U-Tapao International Airport which is located between Chonburi Province and Rayong Province, is planned to take place. In addition, the expansion of Laem Chabang Port and Mab Taphut Port and plans to develop high-speed railways are also positioned as parts of the project.

2.2.5 Cluster-based Special Economic Development Zones Policy

Cluster-based Special Economic Development Zones Policy (hereafter, the "Cluster Policy") formulated by the Board of Investment of Thailand (BOI) is aimed at creating clusters (Table 2.2.5), where interconnected businesses and related institutions are concentrated and operated within the same geographic areas. The aim of promoting business clusters is to boost the level of support and cooperation in all facets of business, both vertical and horizontal, in order to strengthen the industrial value chain, enhance Thailand's investment potential and competitiveness, and expand Economic and Social development to regional and local levels. The Cluster Policy came into effect on September 16, 2015 after being approved by the Cabinet and Thai Board of Investment.

Table 2.2.5 Outline of the Cluster Policy

No.	Category	Field (Examples)
1	Super Cluster	1) Automotive and parts cluster 2) Electrical appliances, electronics, and telecommunication equipment cluster 3) Digital-based cluster 4) Eco-friendly petrochemicals and chemicals 5) Food innopolis 6) Medical hub
2	Other clusters	1) Agro-processing products 2) Textiles and garments

Source: JST

2.2.6 Border Special Economic Zone Policy

In July 2014, BOI formulated a large-scale policy to develop special economic zones (SEZ) in its national borders, that is called as "border SEZ policy". As a background, there is the Greater Mekong Sub-region Development Program (hereafter, "GMS"), a framework of international cooperation in which five Mekong countries including Thailand and China have been involved since 1992.

In November 2014, a proposal to develop five SEZs, including ones along the major economic corridors specified in GMS, was confirmed as the first phase of the policy. Five other candidate areas were also selected for the second phase. This proposal is distinctive wherein it has specified industrial fields to be promoted in each SEZ, thereby encouraging the development of industrial clusters. The target business activities, which are specifically encouraged in each SEZ, are categorized into 13 industrial groups, and each SEZ has different industrial groups as targets. (Table2.2.6)

Table2.2.6 Candidates for Border SEZs

Phase	No.	Target Province	Country On The Other Side of the Border	Economic Corridor	Major Industrial Fields Where The Policy Aims To Develop Clusters

Phase	No.	Target Province	Country On The Other Side of the Border	Economic Corridor	Major Industrial Fields Where The Policy Aims To Develop Clusters
First Phase	1	Tak	Myanmar	East-West	Distribution, labor-intensive industry
	2	Mukdahan	Laos	East-West	International trade, multi-modal transport, electrical and electronics industry, warehousing
	3	Sa Kaeo	Cambodia	South	Agro-processing, multi-modal transport/transport and regional wholesale, retail
	4	Trat	Cambodia	South Coastal	Ecotourism, multi-modal transport, setting of tax-free cross-border trade zone
	5	Songkhla	Malaysia	-	Rubber industry, fishery and fishery processing, halal food processing, distribution
Second Phase	6	Chiang Rai	Myanmar and Laos	South-North	Details unknown
	7	Kanchanaburi	Myanmar	South	Details unknown
	8	Nong Khai	Laos	-	Details unknown
	9	Nakhon Phanom	Laos	South Coastal	Details unknown
	10	Narathiwat	Malaysia	-	Details unknown

Source: JST based on data from JETRO

2.3 Other Strategies and Policies

2.3.1 Ninth National Research Policy and Strategy (2017 - 2021)

National Research Policy and Strategy formulated by National Research Council of Thailand is an action plan toward the goals illustrated in 20-year National Strategic Plan and the National Economic and Social Development Plan. Under the vision of "Formation of a knowledge-based, innovation nation ", the Ninth National Research Policy and Strategy (2017-2021)" consists of the following four strategies:

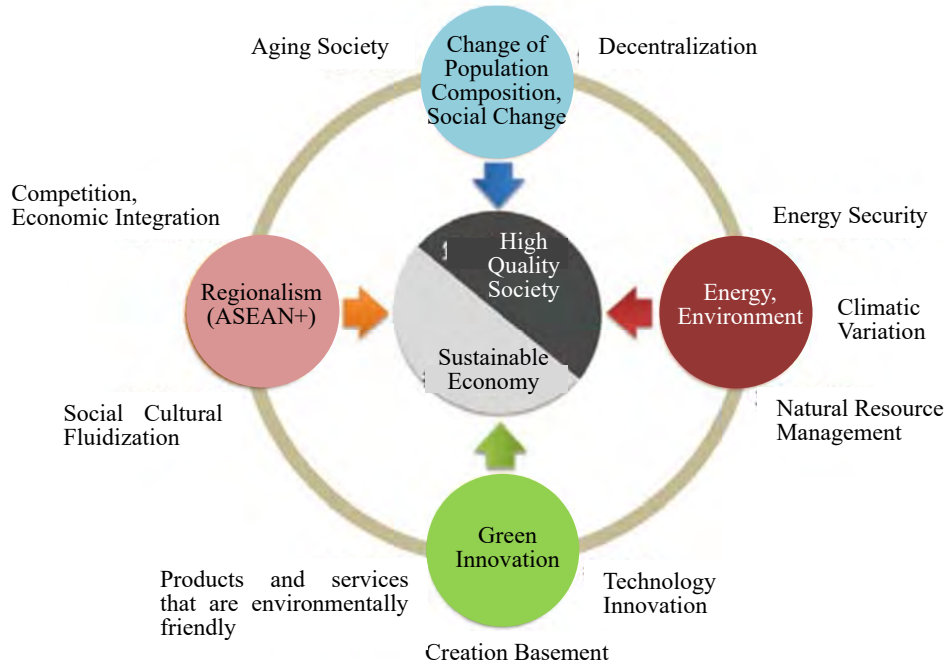
1) Promotion of research and development and utilization of innovations for economic growth and social development;
2) Increasing research and development investments made by the government and the private sector;
3) Reforming the national research system for the integration and efficiency improvement of research; and
4) Developing infrastructure and fostering human resources for research and development.

2.3.2 National Science, Technology, and Innovation Policy Plan

The National Science, Technology, and Innovation Policy Plan is a ten-year plan (2012 - 2021) that was announced by National Science, Technology, and Innovation Policy Office (STI). It was formulated with the aim of taking initiatives for "the development of science, technologies, and innovations" and for "the systematic introduction of innovations." As keywords for the pillars of the framework, it stipulates: 1) Demographic and Social Changes; 2) Energy and Environment; 3) Green Innovation; and 4) Regionalism (ASEAN+).

The framework of the National Science, Technology, and Innovation Policy Plan is as shown in

Figure 2.3.1.



Source: Toshio Ohta, 2017

Figure 2.3.1 Framework of the National Science, Technology, and Innovation Policy Plan

2.3.3 MICE Strategy in Thailand

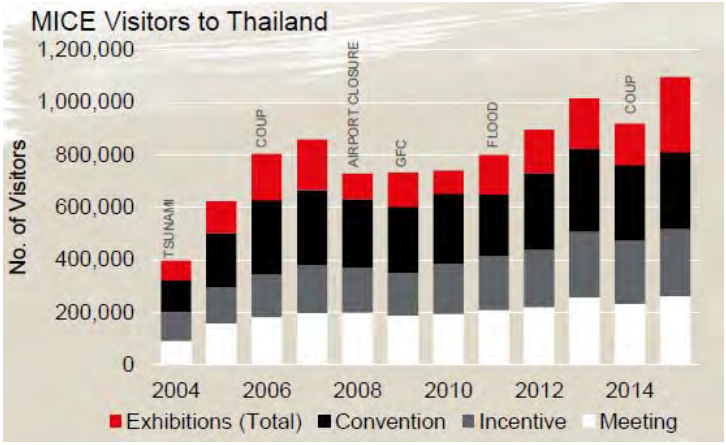
In Thailand, Thailand Convention and Exhibition Bureau (TCEB) is in-charge of undertaking marketing activities in the global market and promoting the development of Meetings, Incentives, Conferences and Exhibitions (MICE) in Thailand since 2004. Thailand has been promoting MICE because it shall produce a significant economic impact and is expected to bring a synergetic effect with tourism. TCEB was established as a part of a policy aiming at developing a value-creating economy to improve international competitiveness. Furthermore, human resource development is also promoted by attracting training programs implemented by international organizations in the MICE field such as Global Association of the Exhibition Industry (UFI) and International Association of Exhibitions and Events (IAEE).

As a result of these initiatives under public and private cooperation, the number of foreign tourists who traveled to Thailand for MICE purposes exceeded 1.2 million in FY2016. The average annual growth rate of international MICE tourist for 11 years from 2004 to 2014 exceeds 11.10%. Source: Jones Lang Lasalle

Figure 2.3.2 shows the number of international MICE tourist to Thailand by purpose from 2004 to 2014. In addition, the average expenditure of MICE tourist during their visit is THB 87,478 and it tends to be 2 or 3times of that of leisure tourist. In FY 2016, international MICE brought a revenue of THB 103 billion.

Thailand has thus become a driving force of the MICE market in the ASEAN region. Advantages of Thailand (Bangkok) are considered as 1) Good accessibility from other countries, 2) Good accessibility in city (pubic transportation, Urban Mass Rapid Transit), 3) Strong inithiative by the government, 4) Internatinal grade MICE facilities and hotels, 5) Tourist distinations, 6) International

cuisine, 7) Shopping etc. Especially, the advantage of Thailand in good accessibility from ASEAN region, East-Asia region, South-Asia resion seems to be overtaking Singapore which is a strong competitor in ASEAN.



Source: Jones Lang Lasalle

Figure 2.3.2 Number of MICE tourist to Thailand by Purpose (2004-2014)

Table 2.3.1 shows MICE-related organizations in Thailand and Table 2.3.2 and Figure 2.3.3 show MICE facilities in Bangkok.

Table 2.3.1 MICE-related Organizations in Thailand

MICE-related Organizations	
Thailand Convention and Exhibition Bureau (TCEB)	Public
Thai Exhibition Association (TEA)	Private
Thai Incentive Convention Association (TICA)	Private
Sightseeing-related Organization	
Tourism Authority of Thailand (TAT)	Public

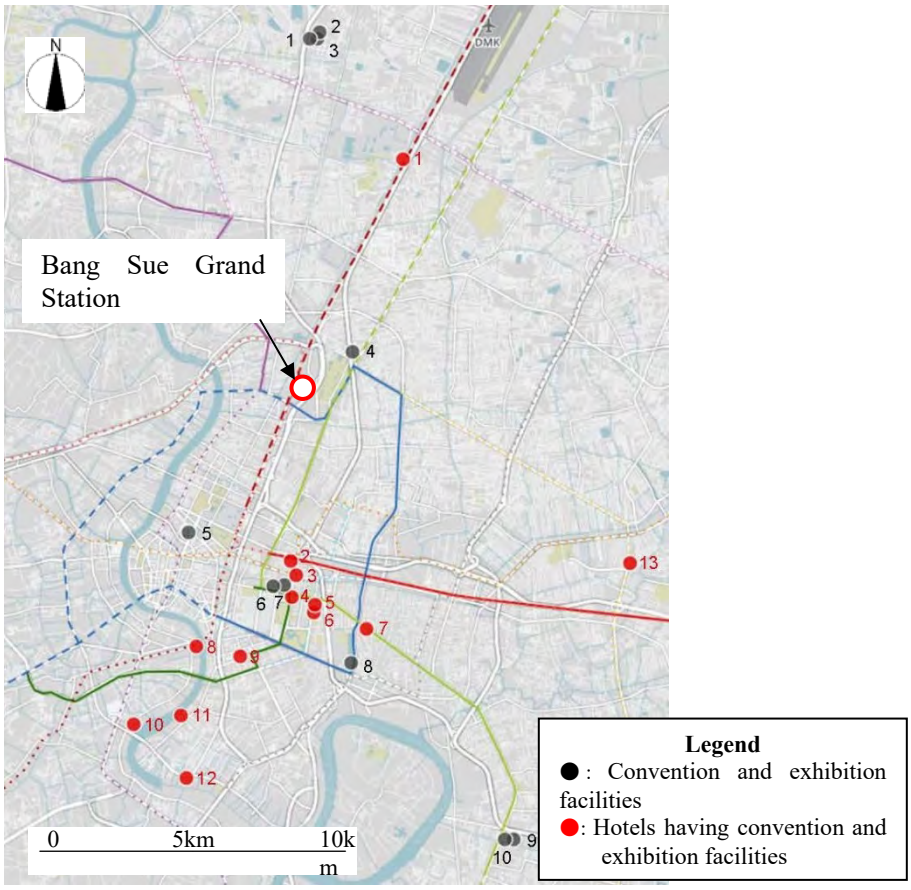
Source: JST

Table 2.3.2 Convention and Exhibition Facilities in Bangkok

Convention and Exhibition Facilities			**Hotel (Number of Room)**
No.	**Convention and Exhibition Facilities**	**Area of Facility Use (㎡)**	
1	IMPACT Challenger Hall	60,000	Novotel Bangkok IMPACT (380) ibis Bangkok IMPACT (587)
2	IMPACT Convention Centre	18,000	
3	IMPACT Exhibition Centre	47,000	
4	Centara Grand at Central Plaza Ladprao	9,000	Centara Grand (565)
5	United Nation ESCAP	6,125	—
6	Royal Paragon Hall	12,000	—
7	Bangkok Convention Center at CentralWorld	9,200	Centara Grand at CentralWorld (505)
8	Queen Sirikit National Convention Center	65,000	—
9	BITEC Bangna	50,400	—
10	BITEC Bangna Expansion	37,800	—
No.	**Hotels Having Convention and Exhibition Facilities**	**Area of Facility Use (㎡)**	**Nomber of Room (Accomodation)**
1	Miracle Grand Convention Hotel	6,830	270
2	Baiyoke Sky Hotel	1,540	658
3	The Berkeley Hotel Pratunam	3,190	788
4	Grand Hyatt Erawan	3,100	380
5	Plaza Athenee Bangkok	5,600	374

6	Conrad Hotel Bangkok	4,600	391
7	Hotel Windsor Suites and Convention	5,700	458
8	Millennium Hilton Bangkok Hotel	3,000	533
9	Narai Hotel	1,590	475
10	Avani Riverside Bangkok	1,500	251
11	Ramada Plaza Bangkok Menam Residence	8,000	525
12	Montien Riverside Hotel	2,700	462
13	The Grand Fourwings Convention Hotel	2,500	466

Source: JST based on data provided by Jones Lang Lasalle, Trip Advisor (number of room)



Source: JST based on data provided by Jones Lang Lasalle

Figure 2.3.3 Location of Convention and Exhibition Facilities in Bangkok

2.3.4 Trends of Medical and Health- and Longevity-related Matters

(1) Health Promotion and Tourism

In 2004, the Government of Thailand implemented a policy of becoming the “Medical Hub of Asia”. Since then, the Ministry of Public Health and various related organizations have been cooperating to formulate and implement systems for promoting medical tourism. The Tourism Authority of Thailand (TAT) organized the Thailand Health and Wellness Tourism Showcase, which was held from September 14 to 17, 2015, and unveiled the concept of “Anti-aging Tourism” as the concept for the next medical tourism. The purpose of this trade show was to provide a marketing opportunity for business operators in Thailand, allowing them to discuss future deals with (foreign) medical tourism operators and travel agencies interested in medical tourism.

(2) Future Trends of Medical-related Policy

The Government of Thailand has established “National Biotechnology Policy Framework” to make the country to be the center of the medical sector in the ASEAN region by 2020. Having established National Health Authority, the government has been promoting initiatives related to the strengthening of the advanced biotechnology business and industry, the promotion of biotechnology research, and the development of engineers. In addition, Ministry of Industry have been promoting the medical products industry strategy for 2012 to 2016 and initiatives such as the promotion of medical-related industry have been promoted proactively.

2.4 Role of the Bang Sue Area in Thailand

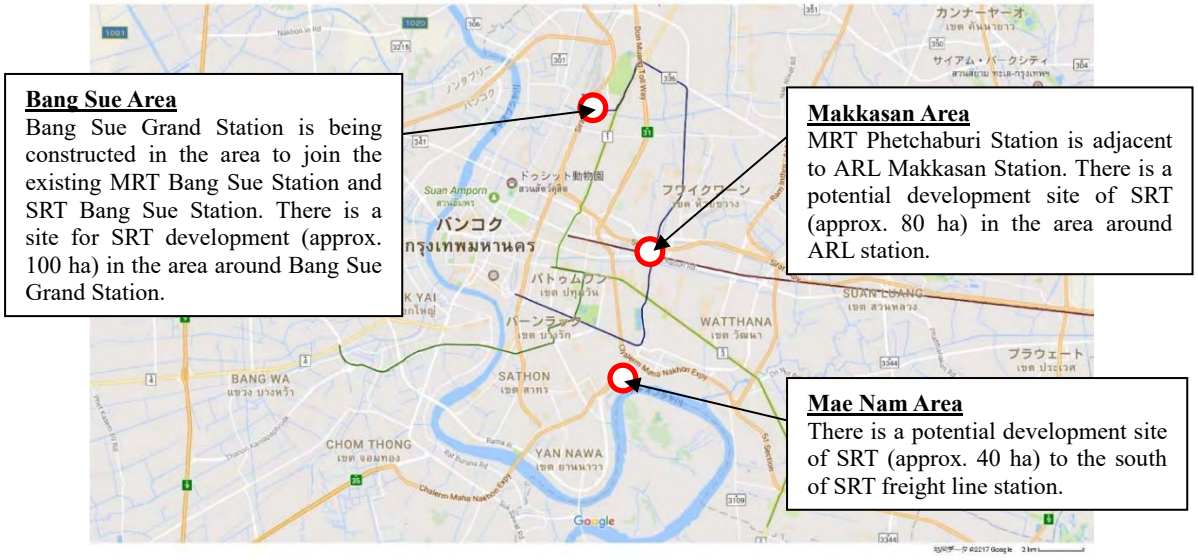
(1) Role of Bangkok in Thailand

As the capital of the country, Bangkok is aimed to become a world-leading metropolis as well as the Asian hub of economy. It is also expected to be a leading example of sustainable urban development by introducing public transport systems and improving the quality of life of people.

(2) Role of the Bang Sue Area in Bangkok

In the M-MAP formulated by OTP, Bang Sue Area is counted as one of the multi-modal transport nodes in Bangkok, as well as and Makkasan Area. In addition, in the Bangkok Comprehensive Plan 2013, land use in Bang Sue Area is categorized as commercial zone, and FAR is set as the second highest in Bangkok after Silom area. Accordingly, Bang Sue Area is expected to develop as urban Transit Oriented Development (TOD) core, as it shall be a transportation hub in the future.

Notably, in addition to the Bang Sue Area and Makkasan Area, Mae Nam Area is a candidate for development. SRT has huge land in these three locations (Figure 2.4.1). It is necessary to classify urban functions to be introduced to each area, so that urban functions should not compete with each other. The proposed urban functions for each area are as shown in Table 2.4.1 with consideration of superior plans, location, and surrounding environments.



Source: JST

Figure 2.4.1 Locations of the Three Candidate Areas for Development

Table 2.4.1 Urban and Transport Functions for Three Locations Owned by SRT

Area	Required Urban Functions	Required Transport Functions
Bang Sue	• Office facilities accumulated around Bang Sue Grand Station • Interaction, tourism, and hotel facilities linked to existing tourism resources such as Jatujak Market and parks • Other urban functions including commercial and residential facilities	• Good connectivity among Bang Sue Grand Station, MRT Bang Sue Station, and SRT Bang Sue Station. • Relocation of Mochit Bus Terminal and local bus stops • Intra-area transport such as BRT • Walkways
Makkasan	• Office facilities accumulated around Makkasan Station • Functions as national and international information center • Functions for visitors such as conferences rooms and hotels	• Boosting demand for Airport Rail Link (ARL), land use, and population distribution along ARL • Ensuring walkway connecting Makkasan Station and buildings • Controlling traffic in the area
Mae Nam	• Residential, office and commercial facilities with an image of water front for branding • Commercial function for the people living around the stations • Open space for interaction	• Improvement of connectivity to SRT Mae Nam Station and BTS Gray Line Station • Ensuring walkway connecting Mae Nam Station and buildings

Source: JST

(3) Approach to Attract Industries to Bang Sue Area

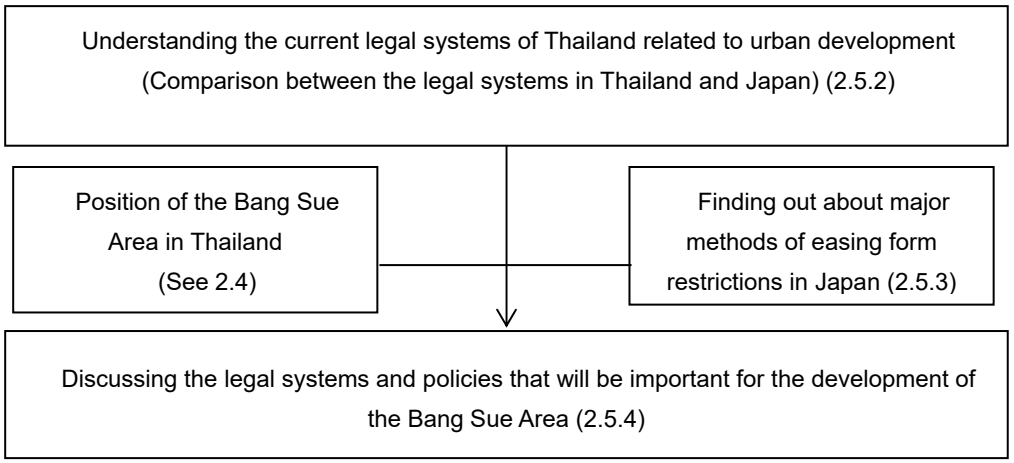
To attract industries to Bang Sue Area, the following points should be considered:

1) Good accessibility to the airports and the existing central business district (CBD).
2) Specific fields to be focused on, such as MICE, tourism, medicine and health, and research and development, which are emphasized in the superior plans.

2.5 Legal Systems and Policies Related to Urban Development

2.5.1 Process of Research on Legal Systems and Policies Related to Urban Development in Thailand

The process of research on legal systems and policies related to urban development in Thailand is shown in Figure 2.5.1.



Source: JST

Figure 2.5.1 Process of Research on Legal Systems and Policies

2.5.2 Current Legal Systems Related to Urban Development in Thailand

The legal systems related to urban development in Thailand and its structure outline are described in Appendix 2-1 “List concerning the legal structure of Japan related to urban planning and similar plans of Thailand”. Among the legal systems in Thailand, the following laws and regulations are especially important to implement a large-scale redevelopment in Bang Sue Area:

1) Town Planning Act 1975
2) Building Control Act 1979
3) Land Readjustment Act 2004
4) Land Subdivision Act 2000
5) Enhancement and Conservation of National Environmental Quality Act 1992
6) Comprehensive Planning Criteria and Standards 2006
7) Bangkok City Planning Standards 2010

(1) Town Planning Act 1975

The outline of Town Planning Act 1975 is as shown in Table 2.5.1.

Table 2.5.1 Outline of Town Planning Act 1975

Content	Preparation and implementation of the comprehensive plans and specific plans
Objective	For the control of land uses and the development of infrastructure, i.e., transportation, public utilities, and facilities in urban area. For the implementation of urban renewal and development projects.
Definition	"Town Planning" means the preparation and implementation of a comprehensive plan and a specific plan to build or develop a new town or redevelop a damaged town. It shall consider the following points: providing or improving sanitation, amenity and convenience, beauty, public safety, and social security, of improving economy, social affair, environmental conservation, art, architecture, history or antiquity, natural resources, landscape, and so on. "The comprehensive plan" is used as guidance in a development and maintenance of a town and related areas. It shall contain plans on communication, transport, public service, and environment. "specific plan" means a detailed plan to develop or redevelop a specific area.
Implementation	The comprehensive plans are prepared and enforced in more than 200 localities in the country. Specific plans were prepared in three localities and implemented in two localities, i.e., Lam Chabang in Chon Buri Province and Mab Taphut in Rayong Province.
Other	The City Planning Act 1975 has been proposed for the amendment.

Source: JST

(2) Building Control Act 1979

The outline of Town Building Control Act 1979 is as shown in Table 2.5.2.

Table 2.5.2 Outline of Town Control Act 1979

Content	The control of building construction
Objective	For the purpose of archiving stability, safety, prevention of fire, public health, maintenance of the quality of the environment, town planning, architecture, and rendering of facilities to traffic as well as other activities necessary for compliance with the Act.
Definition	"Building" means house, shop, raft, warehouse, office, and other construction which people may live or utilize, and shall also include: A grandstand or other construction for public assembly. A dam, bridge, tunnel, waterway or drain, dockyard, waterside pavilion, pier, fence, wall, or gate built next to or near the public place or construction for general public use. A signboard or construction for fixing or holding signboard. On or standing on a public land with more than one square meter size, or weigh, including its structure, of exceeding ten kilograms. On or standing near the public land, which horizontal distance from public land is less than the height of such signboard measuring from the ground level, and with the size or weight exceeding those prescribed in the Ministerial Regulation. An area or construction to be used as car parking space, car reversing space, and car entrance and exit for the building prescribed under Article 8(9) of the Act. Other constructions prescribed in the ministerial regulation. Provided that the parts of those buildings shall also be included therein. "Building control area" means an area which designated by the local government to enforce specific control ordinance of construction. The local government is able to enact local ordinances to control the shape, height, volume, material, and design of buildings in the area.
Implementation	The Department of Public Works and Town and Country Planning (DPT) and local governments are cooperating to enforce this law on construction of buildings and structures all around Thailand. There have been 66 ministerial regulations enforced throughout the country. Also, many local governments enact local ordinances on construction of buildings and structures in localities, e.g., BMA, municipalities, Pattaya City, etc.

Source: JST

(3) Land Readjustment for Area Development Act 2004

The outline of Land Readjustment for Area Development Act 2004 is as shown in Table 2.5.3.

Table 2.5.3 Outline of Land Readjustment for Area Development Act 2004

Content	The implementation of land readjustment projects for urban development in Bangkok and other provinces of the country.
Objective	For undertaking land readjustment projects relating to urban planning principles or the comprehensive plans, and providing public benefits suiting to community contexts and future urban development.
Definition	"Land Readjustment" means the implementation of development of many plots of land by land replotting, improving or constructing infrastructure, and jointly bearing the burdens and equitably distributing the returns. To this end, there shall be cooperation between private sectors, or between the private sector and the public sector, with the objective of utilizing land more appropriately with regard to transportation, economics, social, environment, and communities, and so as to be in line with urban planning.
Implementation	Persons who may proceed with land readjustment are as follows: (1) Land readjustment associations; (2) Department of Public Works and Town and Country Planning, National Housing Authority, and local administration organizations; (3) State organizations or any other juristic persons established by the state for the purposes of land readjustment; (4) Any other state organizations as provided in the ministerial regulations. The Organization of Land Readjustment Project has to have an agreement from 2/3 of landlords. The organization has to submit a project plan to the provincial land readjustment committee, then starts developing infrastructure and replotting. There have been land readjustment projects undertaken in Bangkok and other provinces.

Source: JST

(4) Land Subdivision Act 2000

The outline of Land Subdivision Act 2000 is as shown in Table2.5.4.

Table2.5.4 Outline of Land Subdivision Act 2000

Context	Land subdivision control for residential, commercial, industrial, and agricultural purposes.
Objective	For the purpose of public health, environmental protection, transportation, traffic, safety, public utilities, and urban planning including other necessities in land subdivision suited to the conditions of the province.
Definition	"Land Subdivision" means the sale of plot of land that has been divided into ten plots upwards with property or other remuneration in return regardless whether it is divided from one or many adjacent plots. It also refers to the execution that the land has been divided less than ten plots and thereafter, within three years, it has been divided in total into ten plots onwards.
Implementation	There have been land subdivision regulations for residential, commercial, industrial, and agricultural purposes for Bangkok and all provinces of the country.

Source: JST

(5) Enhancement and Conservation of National Environmental Quality Act 1992

The outline of Enhancement and Conservation of National Environmental Quality Act 1992 is as shown in Table 2.5.5.

Table 2.5.5 Outline of Enhancement and Conservation of National Environmental Quality Act 1992

Content	The preparation and submission of Environmental Impact Assessment (EIA) reports.
Objective	(1) To encourage people and private organizations for participating in the environmental promotion and protection. (2) To arrange the environment management system in environmental management principles. (3) To identify the power and responsibility of public organizations, public enterprises, and local governments in collaboration with environmental promotion and protection and to identify guidelines for missions of which responsible authority is not yet clarified. (4) To identify pollution control measures by providing air pollution treatment system, waste water treatment system, waste treatment system, and tools and instruments for solving pollution problems. (5) To identify duty and responsibility of the polluters. (6) To provide incentive measures, e.g., funding and other supports for convincing the acceptance of environmental protection duties.
Definition	"Environment" means physical and biological human surroundings created by nature and man-made. "Environmental Impact Assessment (EIA)" is the study for forecasting the environmental impacts, both negative and positive impacts from development projects or significant activities.
Implementation	Public and private projects which may create environmental impacts will have to submit EIA reports to Office of Natural Resources and Environmental Policy and Planning (ONEP) for development permission. ONEP has an internal committee to check EIA report and issue development permission. Project developers need to have a development permission from ONEP before applying for a construction permission to the local authority.
Other	The responsibility for the approval of the environmental impact assessment reports has been transferred from Office of Natural Resources and Environment Policy and Planning (ONEP) to BMA and pilot provinces.

Source: JST

(6) Comprehensive Planning Criteria and Standards 2006

The outline of Comprehensive Planning Criteria and Standards 2006 is as shown in Table 2.5.6.

Table 2.5.6 Outline of Comprehensive Planning Criteria and Standards 2006

Content	The specification of criteria and standards for comprehensive planning under the Town Planning Act 1975
Objective	To provide comprehensive planning criteria and standards for Department of Public Works and Town and Country Planning (DPT) as a central government, Provincial Public Works and Town and Country Planning Office as a provincial government and local governments, i.e., BMA, municipalities, Pattaya City, etc.
Definition	Referred to Town Planning Act 1975 and ministerial regulations enforcing comprehensive plans. "Town Planning" means the preparation and implementation of a comprehensive plan and a specific plan in the area of a town and related areas or in the country in order to build or develop a new town or to replace a damaged town for the purpose of providing or improving sanitation, amenity and convenience, orderliness, beauty, use of property, public safety, and social security, of improving economy, social affair, and environment, of preserving a place and an object of interest or value in the field of art, architecture, history or antiquity, or of preserving natural resources, landscape of beauty or natural interest. "The Comprehensive Plan" means a plan, policy, and project including a measure of general control, to be used as guidance in the development and maintenance of a town and related areas, or of the country in the fields of use of property, communication and transport, public service, and environment, for the purpose of achieving the objective of town planning.
Implementation	To be used for the preparation of the comprehensive plans under the Town Planning Act 1975 by Department of Public Works and Town and Country Planning (DPT), Provincial Public Works and Town and Country Planning Office, local administrations, and consulting companies since 2006.
Other	DPT is preparing a "Comprehensive Planning Criteria and Standards for Towns/Communities" for replacing the Comprehensive Planning Criteria and Standards 2006.

Source: JST

(7) Bangkok City Planning Standards 2010

The outline of Bangkok City Planning Standards 2010 is as shown in Table 2.5.7.

Table 2.5.7 Outline of Bangkok City Planning Standards 2010

Content	The specification of standards for BMA comprehensive planning under the Town Planning Act 1975.
Objective	To provide standards of land uses and infrastructures, i.e., transportation, public utilities, and facilities for BMA comprehensive planning.
Definition	Referred to Town Planning Act 1975 and the ministerial regulations enforcing BMA comprehensive plans. "Town Planning" means the preparation and implementation of comprehensive plan and a specific plan in the area of a town and related areas or in the country in order to build or develop a new town or to replace a damaged town for the purpose of providing or improving sanitation, amenity and convenience, orderliness, beauty, use of property, public safety, and social security, of improving economy, social affair, and environment, of preserving a place and an object of interest or value in the field of art, architecture, history or antiquity, or of preserving natural resources, landscape of beauty or natural interest. "Comprehensive Plan" means a plan, policy and project including a measure of general control, to be used as guidance in the development and maintenance of a town and related areas, or of the country in the fields of use of property, communication and transport, public service, and environment, for the purpose of achieving the objective of town planning.
Implementation	The standards were used for the preparation of BMA Comprehensive Plan (third revision) which has been enforced by the ministerial regulation enforcing BMA comprehensive plan 2013.
Other	The standards shall be integrated to the "Comprehensive Planning Criteria and Standards for Towns/Communities" prepared by the Department of Public Works and Town and Country Planning (DPT).

Source: JST

(8) Other Legal Systems Related to Real Estate Development

Other laws related to real estate development that are similar to Japan's Civil Code (real rights, usufruct, real rights obtained by security, claims, and others) and Real Property Registration Act include the Laws and Regulations Concerning Lands 1954. Department of Lands of the Ministry of Interior holds jurisdiction over land registration, registration of ownership of condominiums, site division, and other matters related to land registration.

Laws that are similar to Japan's Act on Land and Building Leases and Act on Real Estate Appraisal include the Civil and Commercial Code and the Act on the Lease of Immovable Property for Commercial and Industrial Purposes. The latter stipulates that immovable properties shall be leased for commercial or industrial purposes for a period of longer than 30 years and up to 50 years. It also stipulates that when the lease period has expired, the lessor and lessee may agree to extend the lease period by up to 50 years from the date of the agreement.

A law that is similar to Japan's Act on Building Unit Ownership and Act on Facilitation of Reconstruction of Condominiums is the Condominium Act 1979.

2.5.3 Major Methods for Relaxation of Regulations on Urban Development

As described in "2.4 Position of the Bang Sue Area in Thailand," in the future, the Bang Sue Area will be the new transport node of Bangkok where diverse urban functions will be concentrated. It is aimed to develop a good city that will improve the quality of life, and introducing public transport systems. An efficient, effective, high-level use of lands is necessary for achieving this vision. One example of methods for easing form restrictions is transferring of excess floor area ratio, to secure privately-owned public spaces or green spaces and otherwise protecting the good urban environment.

The use of such methods for easing form restrictions in Thailand will be extremely meaningful in case the project is highly beneficial for the public and also contributes to create a good urban environment.

An outline of the floor area transfer in major methods of easing form restrictions in Japan is summarized in Table2.5.8. (For details, see Table2.5.9 “Comparison Chart of Major Methods of Easing Form Restrictions”)

Table2.5.8 Floor Area Transfer in Major Methods of Easing Form Restrictions in Japan

Method	Possibility of Floor Area Transfer			Example
	Between Adjacent *lot*	Between Adjacent *block*	Betweek remote *lot*	
District for intensive land use (development promotion districts)	OK	NO	NO	・Daikanyama Address (2.2ha, Shibuya-ward) ・Roppongi-Ark Hills (8.8ha, Minato-ward)
Special District	OK	OK (multi block)	NO	・Nihonbashi-Mitsui tower (1.4ha, Chuo-ward) ・COREDO Nihonbashi (0.82ha,Chuo-ward)
Floor area ratio relaxiation districts	OK	OK	OK	・Dai MaruYu-area (116.7ha, Chiyoda-ward)
Special urban renaissance districts	OK	OK	OK	・Marunouch Trust Tower (1.2ha, Chiyoda-ward, Chuo-ward)
District plans that specify redevelopment promotion districts	OK	OK	OK	・Toranomon-Hills (13.8ha, Minato-ward)
District plans with adequate floor area ratio distribution	OK	OK	OK	・Ponte Porta at Senju-Ohashi (69.3ha, Adachi-ward)
District plans for intensive use	OK	OK	OK	・Suzuran Station District (1.2ha, Kobe City, Kita-ward)
Integrated design measurement for a whole estate	OK	OK	OK	・Osaka ANA Hotel (4.6ha, Osaka City, Kita-ward)

Source: JST

Table2.5.9 Comparison Chart of Major Methods of Easing Form Restrictions

Method of Easing Form Restrictions	Outline	Floor Area Ratio	Road Setback Line Restrictions	Adjacent Property Setback Line Restrictions	North Side Setback Line Restrictions	Absolute Height of Low-rise Residential Zone	Shade Restrictions	Exterior Wall's Setback Distance in Low-rise Residential Zone	Building Coverage Ratio
1) High-level use districts (development promotion districts)	Districts in which the integration of sites, of buildings is promoted, small-scale buildings are controlled, and open spaces in the sites are to be secured, and where the floor area ratio eased for the high-level use of land and the renewal of urban functions.	The additional floor area ratio is determined through a gradual decrease of the building coverage ratio, specification of the wall setback distance, or by other means.	Eased by having the district designated under an urban plan and securing a privately-owned public space, which is adjacent to the road on the site.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.
2) Specified blocks	Districts in which urban areas are developed and improved by constructing buildings with good environments and sound forms, while at the same time easing the floor area ratio, of buildings with open spaces.	The additional floor area ratio is determined in accordance with the ratio of privately-owned public spaces.	Eased by specifying the height of each part of a building in accordance with its horizontal distance from the outer boundary of the site and from the center line of the road.					Eased by specifying the restrictions on the wall's position separately.	Controlled separately based on the open space ratio.
3) Special urban renaissance districts	Districts in urgent areas for urban renewal, where plans with a high degree of freedom are formulated by exempting them from regulations, such as uses based on the existing use districts and regulations on the floor area ratio.	The floor area ratio is determined in accordance with the level of contribution to urban renaissance.	Eased	Eased	Eased	Easing is impossible.	Exempted (Article 56, 2.4 of the law is applied.)	Easing is impossible.	Easing is impossible.
4) District plans that specify redevelopment promotion districts	District plans in areas with lands whose usage is changing significantly and that will lead to good projects, if public facilities are constructed in the districts and restrictions on the uses of buildings, floor area ratio, are eased.	The floor area ratio is increased on the condition that public facilities are constructed.	Eased on the condition that open spaces are secured on the site, etc.			The height limit is eased with an upper limit of 20 meters if the site area is 300 square meters or wider.	Easing is impossible.	Easing is impossible.	Eased by securing an open space of an appropriate size, with an upper limit of 60%.
5) District plans with an adequate distribution of floor area ratios	Plans to distribute floor area ratios in areas within the scope of the floor area ratios specified in the zoning plans for use so as to form or protect a good environment while also promoting the rational use of lands.	Determined by redistributing floor area ratios in a district where public facilities have been built appropriately.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.
6) District plans for high-level use	Plans to ensure the high-level use of lands and renew urban functions by promoting the integration of sites, of buildings, thereby controlling the construction of small-scale buildings, and securing open spaces on sites of buildings in areas where there are lands with public facilities of appropriate sizes and locations.	Eased by specifying contents that are same as those of high-level use districts and securing the contents with an ordinance.	Eased by securing an open space on the site that is adjacent to the road or by similar means.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.	Easing is impossible.
7) Integrated design measurement for a whole estate	A system under which regulations such as restrictions on floor area ratio, are applied in an integrated manner to multiple buildings that were designed in an integrated manner in districts on a specific land, by regarding them as being on a single site.	The ratio can be planned for the entire site in an estate instead of each site.	Setback line restrictions are eased because rules on the easing of two or more front roads are applied.	Mutual setback line regulations are eased for sites on an estate.		Easing is impossible.	Mutual shade regulations are eased for sites on an estate.	The distance can be planned for the overall sites on an estate, instead of individual sites.	Eased in low-rise residential zones that are also districts of residential facilities on a single estate.

*Created based on *Dai 8-ban toshi keikaku unyou shishin* (urban planning procedural guidelines, 8th edition) published by the Ministry of Land, Infrastructure, Transport, and Tourism in January 2015 and *Theory of Urban Development, Architecture and Real Estate 2014-15*

*Exceptional floor area ratio districts were omitted because the details are not designated in government ordinances, *toshi keikaku unyou shishin* (urban planning procedural guidelines), etc.

Source: JST

2.5.4 Laws and Regulations Related to the Development of Bang Sue Area

(1) Outline of the Existing Laws and Regulations in Thailand

In Bang Sue Area, several development plans were formulated by OTP, SRT and PTT Public Company Limited (PTT), they are planned based on Town Planning Act and Building Control Act.

To formulate an integrated master plan, it shall be based on BMA Comprehensive Plan 2013 and BMA Building Control Regulation. The outlines of the systems and points to be applied to Bang Sue Area are as shown in Table 2.5.10 and Table 2.5.11.

Table 2.5.10 BMA Comprehensive Plan 2013

Content	The preparation and enforcement of BMA Comprehensive Plan under the empowerment of Town Planning Act 1975
Title	The Ministerial Regulation Enforcing BMA Comprehensive Plan 2013
Responsible Agency	Department of City Planning, BMA
Major Concern	The preparation of future land use plan in relation to the development of mass transportation system.
Relating to Bang Sue Development Area	The proposition of the SRT's land around Bang Sue Station to be used for sub-central commercial district (C.4, FAR 800%) and for government institutions, public utilities and facilities, i.e., Chatuchak Park, Her Majesty Queen Sirikit Park, and Vachirabenjatas Park. BMA Comprehensive Plan 2013 has designated that private development project, which makes some benefit for public, can get FAR bonus of 20% in maximum. It means that Bang Sue Area will have FAR of 960% if development of the area can make some benefits for the public, e.g., having public park, public parking, and semi-public space. Land use control ordinance says that it is forbidden to have a power plant in Bang Sue Area so it is necessary to do construction plan of smart infrastructure carefully. In case of changing land use defined by BMA Comprehensive Plan 2013 in Bang Sue Area, SRT as the land owner need to propose to BMA and take necessary procedures.

Source: JST

Table 2.5.11 BMA Building Control Regulation 2001

Content	Building control by Building Control Act 1979
Title	BMA Building Control Regulation 2001
Responsible Agency	Department of Public Works and BMA district offices
Major Concern	To regulate: (1) Type, proportion, size, and area of building. (2) Weight loading, resistance, durability, as well as nature and quality of material used. (3) Weight loading, resistance, durability of building and supporting ground. (4) Fixing system of waterworks, gas, electricity, machinery, safety from fire or other disasters, and prevention of danger from chaotic situation. (5) Number of bathroom and lavatory. (6) System of building management, i.e., system of illumination, air ventilation, air conditioning, air purification, drainage, wastewater treatment, and waste and sewage disposal. (7) Level, height, space area outside the building, or boundary of building. (8) Distance or level between each building or land boundary of other person, or between the building and the road, lane, alley, pedestrian, route or public land. (9) Space area or construction for use as car parking or reversal, and car entrance and exit for certain kind or category of building, as well as the nature and size of such space area or construction.
Relating to Bang Sue Development Area	The development in Bang Sue Area has to follow Bangkok's construction control regulation. Especially, control of building height, building coverage, distance between buildings and streets, and the provision of car parking is an important input for development planning.

Source: JST

Project methods other than the above include projects for land readjustment under the Land

Readjustment Act mentioned in 2.5.2 “The current legal systems related to urban development in Thailand.” With regard to this, SRT is the only landowner in the Bang Sue Area. To implement a land readjustment project with SRT as the executor, SRT needs to be specified as the executor in the ministry ordinance in accordance with the provisions of the Land Readjustment Act. (This law stipulates that the executor of a land readjustment project shall be either the Land Readjustment Association, DPT, National Housing Authority (NHA), a local government, a public organization established as the executor of a land readjustment project, or any other organization designated by a ministry order.) If there is only one landowner, there is no need to reach an agreement with the other landowner(s). Accordingly, in this case, it is believed to be more realistic to develop roads and other infrastructures and residential lands as an act of development solely by SRT in accordance with the comprehensive urban planning standards of Bangkok than to adopt a land readjustment project implemented after legal procedures such as the approval of the project and the approval of the replotting plan. However, if there are multiple landowners with the inclusion of lands other than those owned by SRT, the possibility of a project to be implemented by the Land Readjustment Association or a local government also needs to be considered.

(2) Use of Methods of Easing Form Restrictions in Japan (Transfer of Floor Area Ratio)

It is expected that Bang Sue Area will be segmented more finely into high-density zones and low-density zones in the future planning of land use in the area. It is likely that this process will involve the use of methods of easing form restrictions (transfer of floor area ratio) described in “2.5.3 Outline of major methods of easing form restrictions in Japan.” As it is mentioned in 2.5.3, the use of such methods for easing form restrictions in Thailand will be extremely meaningful in case the project is highly beneficial for the public and also contributes to create a good urban environment.

From among the methods, the following are selected from two points of view: 1) the integrated development of roads and other public facilities and buildings, and 2) the development of buildings in districts with roads and other public facilities of appropriate sizes and locations.

1) Integrated development of roads and other public facilities and buildings

District plans that specify redevelopment promotion districts aim to be applied for a solid blocks of substantial underused/unused lands.

Table 2.5.12 District Plans that Specify Redevelopment Promotion Districts

Item	Description
Name	District plans that specify redevelopment promotion districts
Government office in charge	Ministry of Interior, Bangkok Metropolitan Administration
Outline	These district plans aim to develop urban infrastructure and buildings, in an integrated manner for high-level use of lands and enhancement of urban functions to promote efficient conversion of land use in districts with substantial lands, such as solid blocks of underused/unused lands. These plans enable the floor area ratio to be eased by securing open spaces and supplying facilities that contribute to the local communities.
Key points in application to the development of the Bang Sue area	The plan enables comprehensive development of underused/unused lands in the Bang Sue Area and the development of urban infrastructures such as roads in an integrated manner. The plan enables the transfer of the floor area ratio between adjacent sites, between adjacent blocks, and between non-adjacent lands. It is expected that a specific plan will be formulated based on the Town Planning Act.

Source: JST

2) Development of buildings in districts with roads and other public facilities of appropriate sizes and locations

District plans with an adequate distribution of floor area ratio and integrated design measurement for a whole estate are applied for a case to develop buildings in an area where roads and other public facilities are already developed.

Table 2.5.13 District Plans with Adequate Distribution of Floor Area Ratios

Item	Description
Name	District plans with adequate distribution of floor area ratio
Government office in charge	Ministry of Interior, Bangkok Metropolitan Administration
Outline	These district plans aim to create a good urban environment and ensure the rational use of lands with roads and other public facilities are developed, by applying regulations on floor area ratios in a detailed manner in accordance with the characteristics of each district. Floor area ratios are distributed within the scope of the total specified floor area ratios in the district.
Key points in application to the development of the Bang Sue Area	The plan enables the transfer of floor area ratios between adjacent sites, between adjacent blocks, and between non-adjacent lands in districts in the Bang Sue Area where the development of urban infrastructures such as roads have been carried out. It is expected that a specific plan will be formulated based on the Town Planning Act.

Source: JST

Table 2.5.14 Integrated Design Measurement for the Whole Estate

Item	Description
Name	Integrated design measurement for a whole estate
Government office in charge	Ministry of Interior, Bangkok Metropolitan Administration
Outline	This type of development aims to rationalize the application of various regulations and the development and improvement of the urban environment by recognizing that multiple buildings on a single estate or in a district of lands on a single estate are located on a single site. The floor area ratio can be eased by creating a construction plan that will secure a specific proportion of open spaces on the site (integrated design measurement).
Key points in application to the development of the Bang Sue Area	It enables the transfer of floor area ratio between adjacent sites, between adjacent blocks, and between non-adjacent lands in districts in the Bang Sue area where the development of urban infrastructures such as roads have been carried out. It is expected that a district with architectural regulations will be designated under a ministry order or ordinance based on the Building Control Act. Currently, a similar system (Plan Unit Development) is being studied in Bangkok. It is planned to be institutionalized in approximately two years.

Source: JST

2.5.5 Other Laws and Regulations to be Considered for the Development of Bang Sue Area

(1) Regulations for Property Leasing

Thailand has two legal restraints regarding property leasing as of August 2017. One is the Civil and Commercial Code (1992) and the other is the Lease of Commercial and Industrial Property Act (1999). The outline of each law is as shown in Table 2.5.15.

The duration of both private and public property leasing is not more than 30 years; there could be an extension of not more than 30 years enforced by Article 540 of the Civil and Commercial Code. However, after the economic crisis of Thailand in 1998, the Lease of Commercial and Industrial Property Act 1999 was enacted with a reason that “the regulation of property leasing under the Civil and Commercial Code is not responsive to the economic situation and a long-term investment of

commercial or industrial development, which requires a security of right in leasing contract. Consequently, it is necessary to enact a law supporting a long-term commercial and industrial property leasing, which will provide more security for leasing right. The promotion of a long-term commercial and industrial property leasing will be a measure for recovering the whole country's economy."

Consequently, according to this act, the leasing contract for both public and private commercial and industrial properties will have a duration of not more than 50 years and can be extended for not more than 50 years or a total of 100 years. In addition, there has been a proposal for extending the property leasing period to 99 years and it is under the consideration of the government.

Table 2.5.15 Major Points of Regulations for Property Leasing

Law	Article and Major Points	Remarks
Civil and Commercial Code (1992) [Office of the Council of State]	Article 540 : • The duration of a lease of immovable property cannot exceed thirty (30) years. If it is made for a longer period, such period shall be reduced to thirty (30) years. • The aforesaid period may be renewed, but it must not exceed thirty (30) years from the time of renewal	In general, land lease hold contract consists of 30 years leasing period with first right of contract renewal, based on the Civil and Commercial Code (1992).
The Lease of Commercial and Industrial Property Act (1999) [Department of Lands, Ministry of Interior]	Article 3 : • The act has defined that "leasing" means "the lease of commercial or industrial property for more than 30 years but not more than 50 years." Article 4 : • The lease according to this act must be written and registered to the officer, otherwise it will be invalid. • When the leasing period is due, the lessor and the lessee may agree to extend the lease duration for not more than 50 years from the day of the agreement and register to the officer, otherwise it will be invalid.	Conditions to be applied for "the Lease of Commercial and Industrial Property Act" • Condition 1: The land shall be located at one of the following areas: - Commercial or industrial use defined in the comprehensive plan. - Industrial parks which appointed by the Industrial Estate Authority of Thailand • Condition 2: Commercial or industrial project can use the land if it shall cover at least one of the following conditions: - A commercial project with over THB 20,000,000 - A project which can be applied to Investment Promotion Act - A project, which is approved by the cabinet, will make contribution to the national economy and industry. • Condition 3: Investor/developer should prepare all of the following documents: - Business plan including land use, fund source, business period, and employment. - Environmental Impact Assessment Report based on Enhancement and Conservation of National Environmental and Quality Act. - Official confirmation document issued by the Provincial City Planning Department or Industrial Estate Authority of Thailand to confirm that the land use of target area is commercial or industrial. - Project approval documents issued by related agencies. - Documents on financial arrangement both of investor and lender. • Condition 4: If the target land is over 16 ha, the project shall cover at least one of the following conditions: - The project enhances export value or promotes domestic employment. - The project shall be innovative and/or supply does not meet the demand. - The project utilizes the latest technology and/or production method - A project which is approved by the cabinet to make contribution to national economy and industry.

Source: JST

(2) Position of Cogeneration Plant in the Zoning Ordinance of BMA Comprehensive Plan

The Ordinance in the Ministerial Regulation Enforcing BMA Comprehensive Plan 2013 under C.4 Commercial Zones has prohibited "all types of industries under laws related to industrial control, except the types of industries specified in the annex of the ministerial regulation, which do not cause nuisances under laws related to public health, or do not have impacts under laws related to national environmental promotion and protection to community or environment, and are not shop-house industries, as well as not more than 500 m^2.

Thus, item 88 in the annex of the ministerial regulation has allowed the operation of power plants only in I.2 Industrial Zones (operated by the Industrial Estate Authority of Thailand), and in A.4 Agricultural Zones. Therefore, the construction of cogeneration plant in C.4 commercial zones will require a proposal from concerned authorities, i.e., State Railway of Thailand, submitting through the local authorities, i.e., BMA, Department of Public Works, and Town and Country Planning, and finally to City Planning Board for approving the partial amendment of BMA Comprehensive Plan according to Article 26/1 of Town Planning Act 1975 and its amendment by Town Planning Act (No. 4) 2015.

Table 2.5.16 Major Points Relating to Installment of Cogeneration Plant

Law	Article and Major Points
Ordinance in the Ministerial Regulation Enforcing BMA Comprehensive Plan 2013 （2013）[Ministry of Interior]	The C.4 Commercial Zones has prohibited "all types of industries under laws related to industrial control, except the types of industries specified in the annex of the ministerial regulation. The conditions are as follows: - It does not cause nuisances under laws related to public health, - It does not have community or environmental impacts, - It is not shop-house industries, and - It is not more than 500 square meters.
Ordinance in the Ministerial Regulation Enforcing BMA Comprehensive Plan 2013 Appendix （2013）[Ministry of Interior]	Item 88: The operation of power plants is allowed only in : - I.2 Industrial Zones (operated by the Industrial Estate Authority of Thailand), and - A.4 Agricultural Zones.

Source: JST

(3) Connection between Buildings and Railway Stations including Underpass

1) Facilities belonging to MRTA

Regarding direct connection between buildings and underground passage in Bangkok, connecting buildings to MRT stations/underpasses probably the most popular case. To connect a building to an underpass, a building owner should take necessary procedures which are set by Mass Rapid Transit Authority of Thailand (MRTA). It supposes that the detailed conditions are negotiated and mentioned in each contract. The procedures are as follows:

1) Submission of the proposal
2) Architectural and engineering inspections
3) Consideration of terms and agreements
4) Approval from the authorized bodies
5) MRTA's contract signing

2) Facilities belonging to BMA

In case of Bangkok Mass Transit System (BTS) and State Railway of Thailand (SRT) stations, although their properties are usually not underground facilities, they have their own rules in connecting buildings to their facilities.

In case of BTS, the connection between buildings and stations is regulated under “the BMA Announcement of the Permission Criteria and Fee for the Construction of Connecting Passages between Extended BTS Lines and Private Buildings (2012)”. The document identifys the following:

1) Submission of proposal
2) Consideration of the proposal
3) Connecting fee
4) Permission conditions
5) Miscellaneous

It supposes that the detailed conditions are negotiated and mentioned in each contract.

3) Facilities belonging to SRT

In case of SRT, the connection between buildings and mass transit stations is under the permission for the use of air right. Therefore, the construction of posts for hanging wires across the railway lines, the construction of pipes under the railway lines, the construction of roads, drain lines, landscaping, public parks, children playgrounds, medical gardens, etc., require to ask for permission based on the criteria and methods set by SRT.

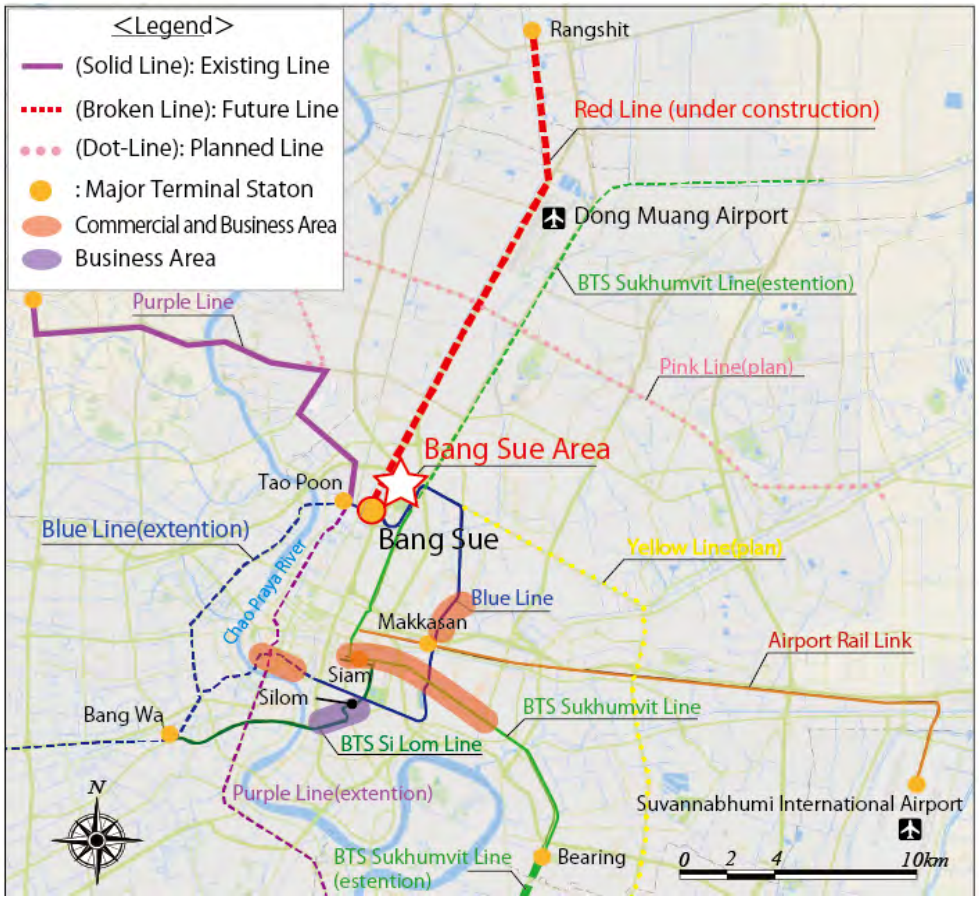
Chapter 3 General Conditions and Related Plans in Bang Sue Area

3.1 Status in Bang Sue Area

3.1.1 Location and Geographic Features

(1) Location

Bang Sue Area is located at approximately 10 km to the north from the central business district (CBD). It is located at approximately 35 km from the Suvarnabhumi International Airport and 14 km from Don Muang Airport which is a base for domestic and low-cost carrier (LCC). The area shall be a future transportation hub. The area has the Metropolitan Rapid Transit (MRT) Bang Sue Station and Kamphaeng Phet Station (Blue Line), Mo Chit Station (Bangkok Mass Transit System (BTS)), and Bang Sue Grand Station (State Railway of Thailand (SRT)). Tao Poon Station of MRT Purple Line located at approximately 1 km to the west of Bang Sue Area. 1 year behind to the opening of MRT Purple Line, MRT Blue Line has been extended to the Tao Poon Station in August 2017.



Source: JST

Figure 3.1.1 Location of Bang Sue Area

(2) Geographical Features

Bang Sue Area belongs to the watershed of the Chao Praya River. Ground elevation in Bang Sue Area is lower than the highwater level of the river. Therefore, it is necessary to use pumps to drain rain water from Bang Sue Area to the river, when the water level of the river is high.

3.1.2 Administrative Boundary, Area, and Current Land Use

(1) Administration Boundaries

Bang Sue Area（Figure3.1.2）belongs to both Chatuchak District and Bang Sue District.

(2) Area

The area of Bang Sue Area is approximately 100 ha.

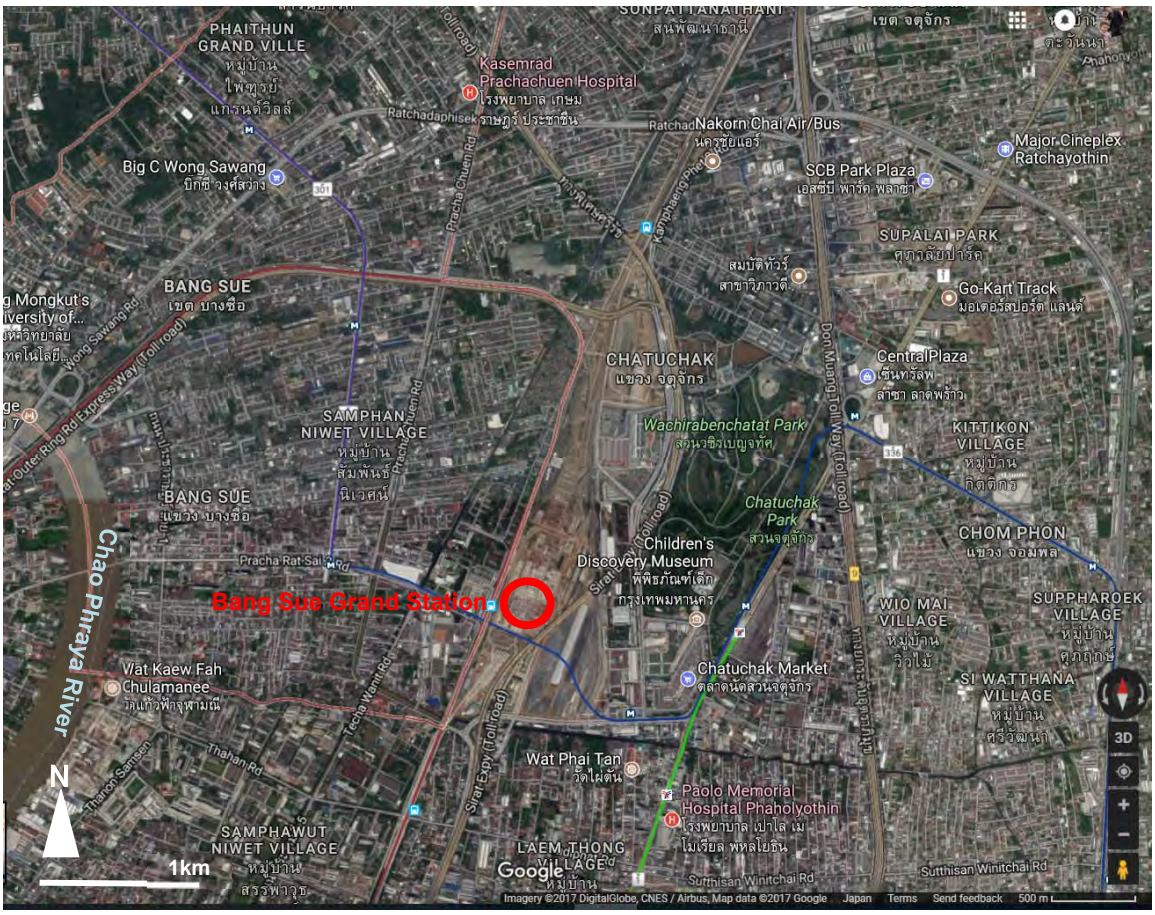
Source: JST

Figure3.1.2 Bang Sue Area (Survey Area)

(3) Current Land Use

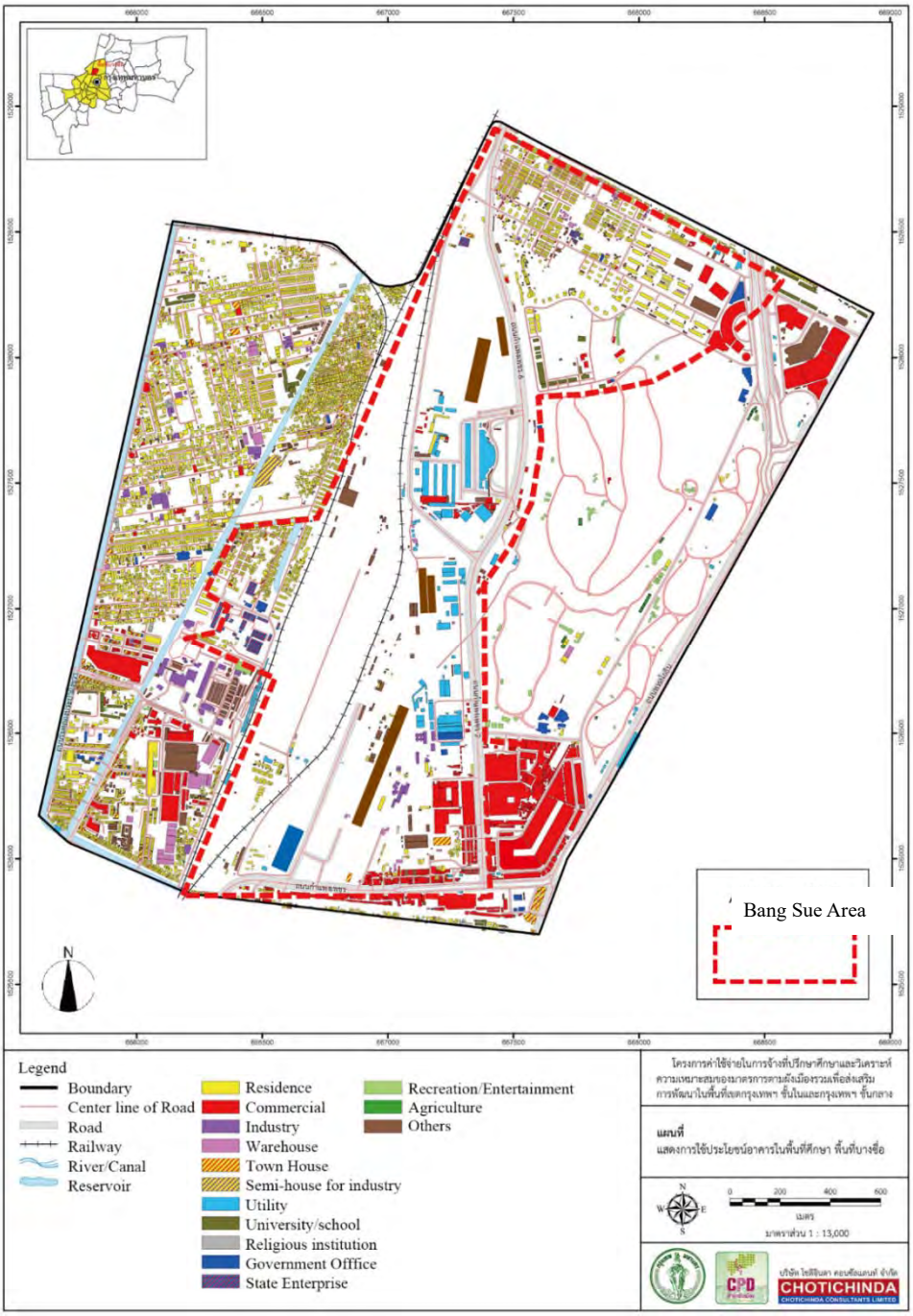
The satellite image around Bang Sue Area is as shown in Figure3.1.3. Bang Sue Area is located 2 to 3 km east to Chao Phraya River. The are a is surrounded by buil-up area. Western side of the area seems less density than eastern side.

The latest available data of land use including Bang Sue Area (year 2013) is as shown in Figure3.1.4. The area has a bus terminal and railway facilities, and Red Line construction zone. The area has commercial complexes i.e., JJ mall and small shops in the southeast part, next to Chatuchak Market. The area also has PTT energy complex which is a mixed used office and commercial complex at the northeast corner. In contrast, at the west side to the existing Bang Sue Station, the land is densely packed with low-rise houses. Since 2013 the land use of Red Line construction zone has changed for the progress of Red Line and railway facilities (depot etc.) construction.



Source: Google Map

Figure3.1.3 Satellite Image Around Bang Sue Area (2017)



Source: JST based on BMA reference

Figure3.1.4 Land Use Map Around Bang Sue Area

3.1.3 Population

(1) Demographic Trend

The population transition in Bangkok is as shown in Table 3.1.1. The rate of population growth from 2006 to 2011 is as shown in Figure 3.1.5. and Figure 3.1.6. In whole Bangkok, the population remains at almost the same size. In details, the population of the central area including Rattanakosin is decreasing, while the population of the suburban areas is increasing.

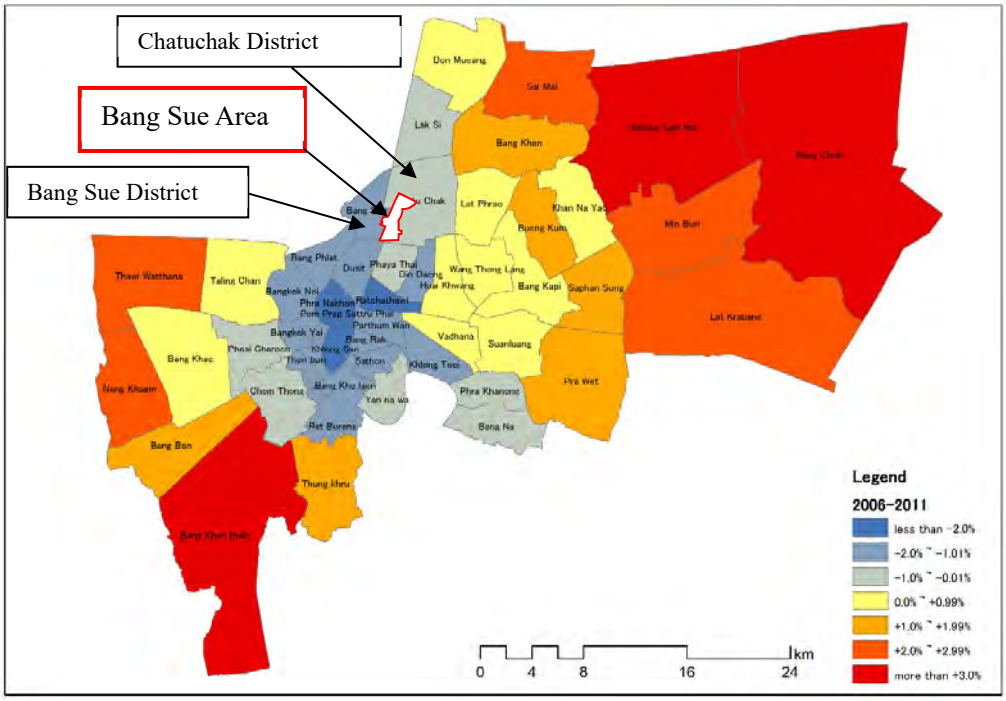
(2) Social Increase and Decrease in Population in Bangkok Metropolitan Area

Social increase and decrease between 2005 and 2015 in Bangkok Metropolitan Area is as shown in Figure 3.1.7 and Figure 3.1.8. In the central area, the number of out-migrants is superior to that of in-migrants, while suburban areas such as Nonthaburi Province and Pathum Thani Province have more in-migrants than out-migrants. The trend shows that the registered population moved to the suburban areas.

Table 3.1.1 Population Transition in Bangkok

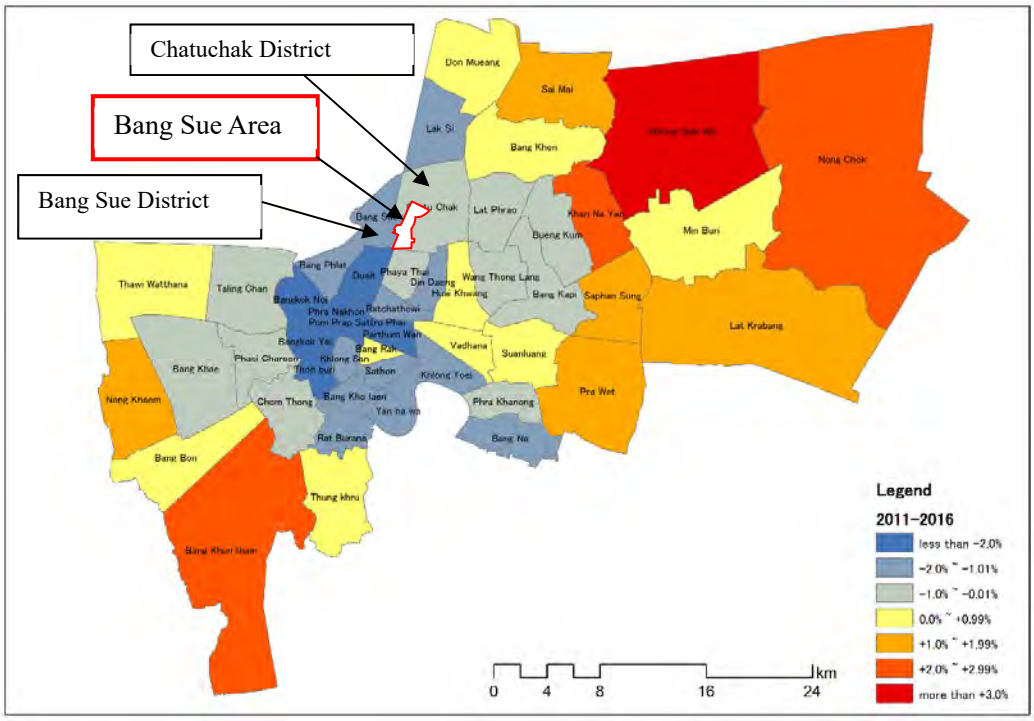
	Area (km2)	Population Year 2006 (person)	Population Year 2011 (person)	Population Year 2016 (person)	Population Growth Rate/Year (2006～2011)	Population Growth Rate/Year (2011～2016)
Bangkok	1,568.7	5,658,953	5,701,394	5,686,646	+0.01%	-0.01%

Source: JST based on the data from the Department of Provincial Administration, Ministry of Interior, Survey and Mapping Division, City Planning Department, BMA



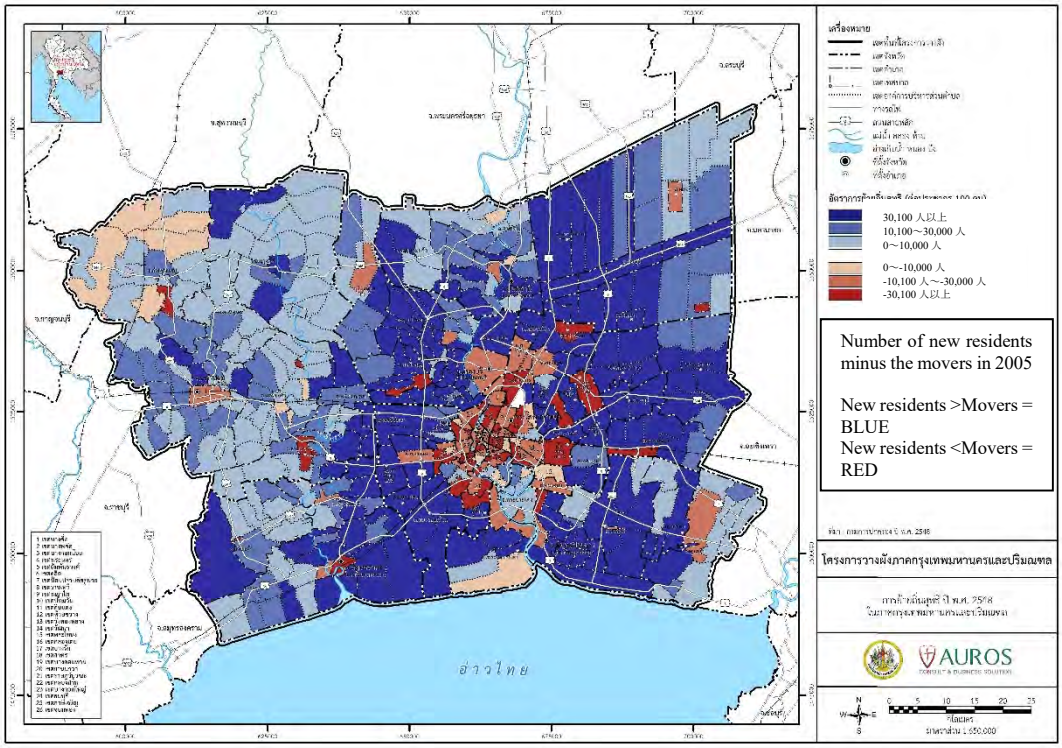
Source: JST based on the data from the Department of Provincial Administration, Ministry of Interior, Survey and Mapping Division, City Planning Department, BMA

Figure 3.1.5 Rate of Population Growth in Bangkok (2006-2011)



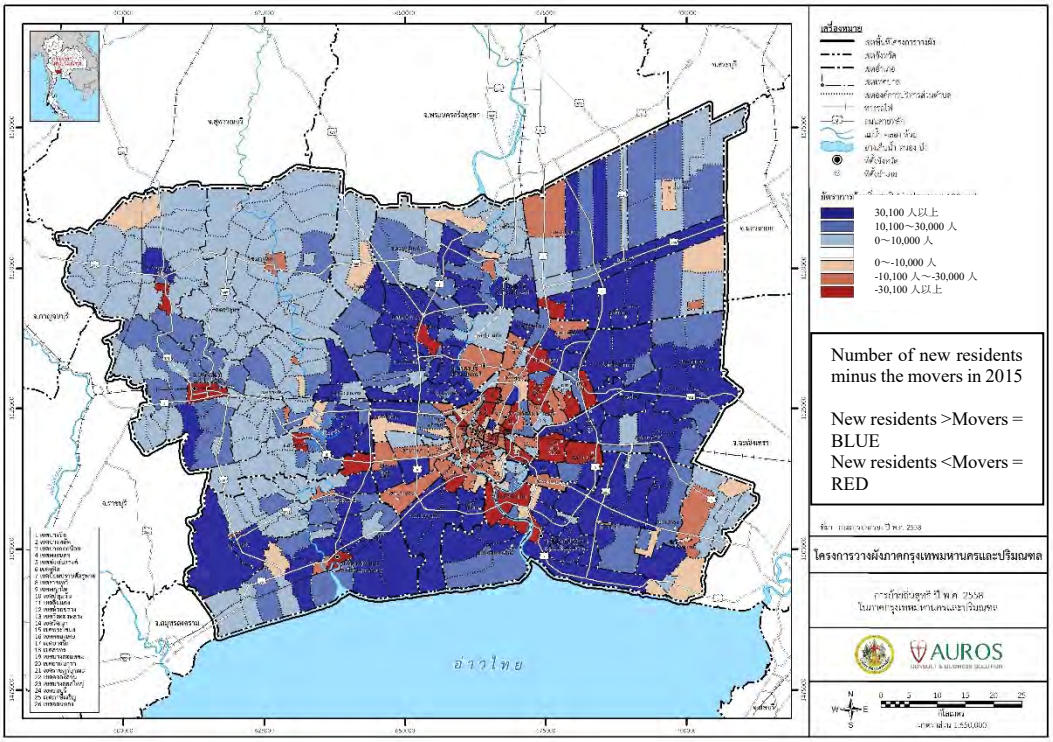
Source: JST based on the data from the Department of Provincial Administration, Ministry of Interior, Survey and Mapping Division, City Planning Department, BMA

Figure 3.1.6 Rate of Population Growth in Bangkok (2011-2016)



Source: Department of Public Works and Town and City Planning, Ministry of Interior

Figure 3.1.7 Social Increase and Decrease in Bangkok Metropolitan Area (2005)



Source: Department of Public Works and Town and City Planning, Ministry of Interior

Figure 3.1.8 Social Increase and Decrease in Bangkok Metropolitan Area (2015)

(3) Population in Bang Sue Area

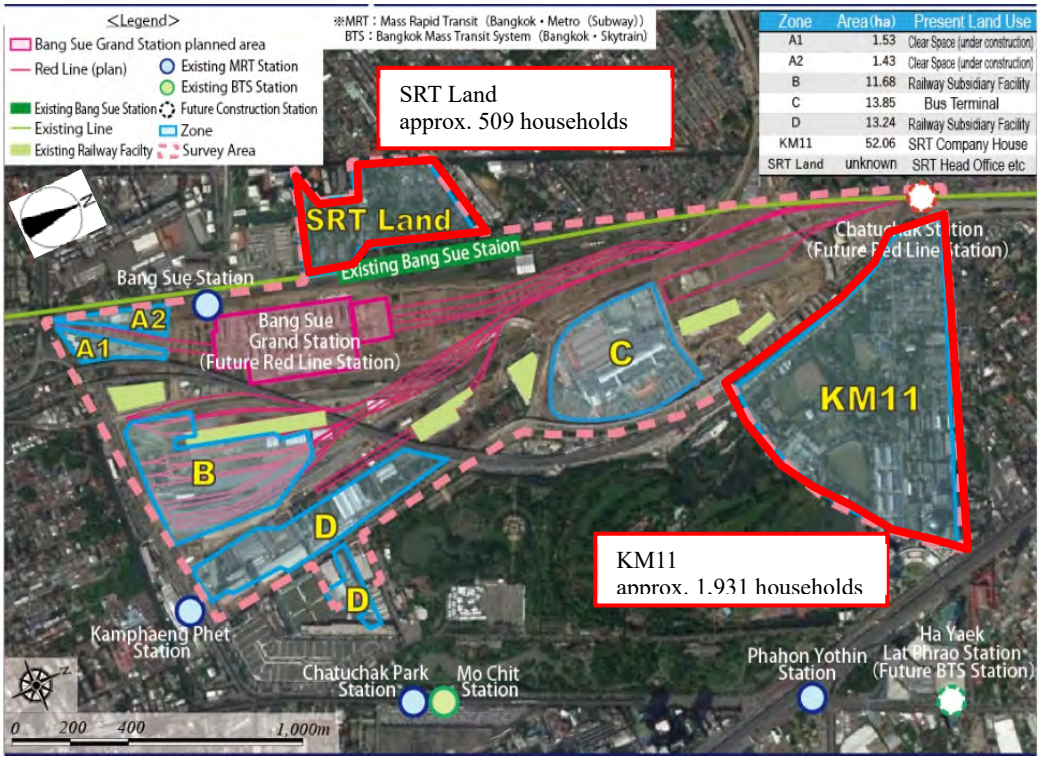
The population of Bangkok has been stagnated since 2006 as shown in Table 3.1.2. The population of Chatuchak District and Bang Sue District has been decreasing slightly. Almost all of Bang Sue Area is owned by SRT and utilized as facility area for the Red Line project. Thus, the area has relatively less residents compared with its land area of 33 km^2.

According to SRT, the number of households in KM 11 and SRT Land in Figure 3.1.9 are 1,931 and 509, respectively. As the average number of people per household in urban areas is 3.5[1], it is estimated that there are approximately 7,000 and 2,000 residents in KM 11 and SRT Land, respectively.

Table 3.1.2 Population around Bang Sue Area (Administrative District)

	Area (km^2)	Population Year 2006 (Person)	Population Year 2011 (Person)	Population Year 2016 (Person)	Population Growth Rate/Year 2006～2011	Population Growth Rate/Year 2011～2016
Bangkok	1,568.7	5,658,953	5,701,394	5,686,646	+0.01%	-0.01%
Bang Sue District	11.5	151,788 (2.7%)	138,653 (2.4%)	126,136 (2.2%)	-0.18%	-0.19%
Chatuchak District	33.0	169,113 (3.0%)	162,838 (2.9%)	158,130 (2.8%)	-0.08%	-0.06%

Note：% in above cell shows the percentage of Bang Sue District and Chatuchak District to Bangkok.
Source: JST based on the data from the Department of Provincial Administration, Ministry of Interior, Survey and Mapping Division, City Planning Department, BMA



Source: JST

Figure 3.1.9 Location of Residential Zone in Bang Sue Area

[1]Thailand National Statistics (2005)

3.1.4 Situation on the Residential Zone in Bang Sue Area

The townscape of SRT Land and KM11 is shown in Figure 3.1.10.

SRT Land	
 Wooden and flat buildings.	 Some residents have cars.
KM11	
 A well-maintained community road.	 Narrow pathway between congested flat buildings.
 Small-scale groceries stores can be found in the residential area.	 Mid-rise apartment.

Source: JST

Figure 3.1.10 Residential Zone in Bang Sue Area

3.2 Situation of Existing Studies

Office of Transport and Traffic Policy and Planning (OTP) and State Railway of Thailand (SRT) studied on a development plan of Bang Sue Area in 2016. The cover areas of existing studies are as shown in Table 3.2.1.

SRT studied on a development plan for ZoneA, B, C and KM11 incuding development concept for each zone, land use and development phasing. Land use and location of urban fuction could be reconsidered as well as the development schedule. It is necessary to make the latest conditions cleared.

OTP studied on mainly ZoneD and Inter-area transportation. Networking of roads and bus service might be reconsidered based on land use.

Table 3.2.1 Cover Area of Existing Studies

Studied by	Cover Area						
—	ZoneA	ZoneB	ZoneC	ZoneD	KM11	Transport	Others
SRT	○	○	○	—	○	—	○
OTP	—	—	—	○	—	○	○

Source: JST

3.3 Development Plan by OTP

3.3.1 Target Area

The target area studied by OTP (2016) is Zone D in Bang Sue Area.

3.3.2 Development Concept

In Zone D, the following concepts are proposed to realize the future vision of "New Bangkok as the Association of Southeast Asian Nations (ASEAN) CBD":

- Development concept with pedestrian priority as the center of transit-oriented development (TOD);
- Promotion of the mixed-use development (commercial and residential);
- Pedestrian-friendly road network;
- Bicycle parking area and surrounding amenities;
- Bus rapid transit (BRT) connecting activities within walking distance to Bang Sue Grand Station; and
- Green Network.

3.3.3 Development Plan

In accordance with the OTP Report, Zone D is divided into three sub zones (Figure 3.3.1, Table 3.3.1, and Table 3.3.2).

Source: OTP

Figure 3.3.1 Classification in Zone D

Table 3.3.1 Development Direction of Zone D

Sub Zone	Development Direction, Function
D1	・ Connectivity with Bang Sue Grand Station should be kept ・ Collaboration with Zone A development should be considered ・ Office, retail, rental office ・ Open space for event
D2	・ Sub Zone D2 consists of 2 blocks ・ Shopping mall, service facility, parking area ・ Rental office, fitness food and drink along Kamphaeng Phet 2 Road
D3	・ Retail and facility for entertainment ・ Food and drink, show center, sport arena, hotel, office condominium

Source: OTP

Table 3.3.2 Area in Zone D

No.	Land Lots	Total Area (rai)	Total Area (m^2)	Total Floor Area (m^2) (FAR 8:1)	Total Open Space (m^2) (OSR 4%)	Total Building Coverage [BCR] (m^2)
Zone D		80.86	129.375	-	-	-
1	Zone D1	25.04	40,075	350,800	14,032	29,818
2	Zone D2	40.49	64,795	488,000	19,520	41,480
3	Zone D3	15.31	24,505	227,120	9,085	19,305

Source: OTP

3.4 Development Plan by SRT

3.4.1 Purpose of the Study

SRT implemented a feasibility study to create additional land value in Zone A (35 rai), Zone B (78 rai), and Zone C (105 rai).

3.4.2 Purpose of the Development

The purpose of the development is to enhance TOD of Bang Sue Grand Station and surrounding area where is expected to become one of the major ASEAN hubs.

Source：SRT

Figure 3.4.1 Zoning Plan in Bang Sue Area

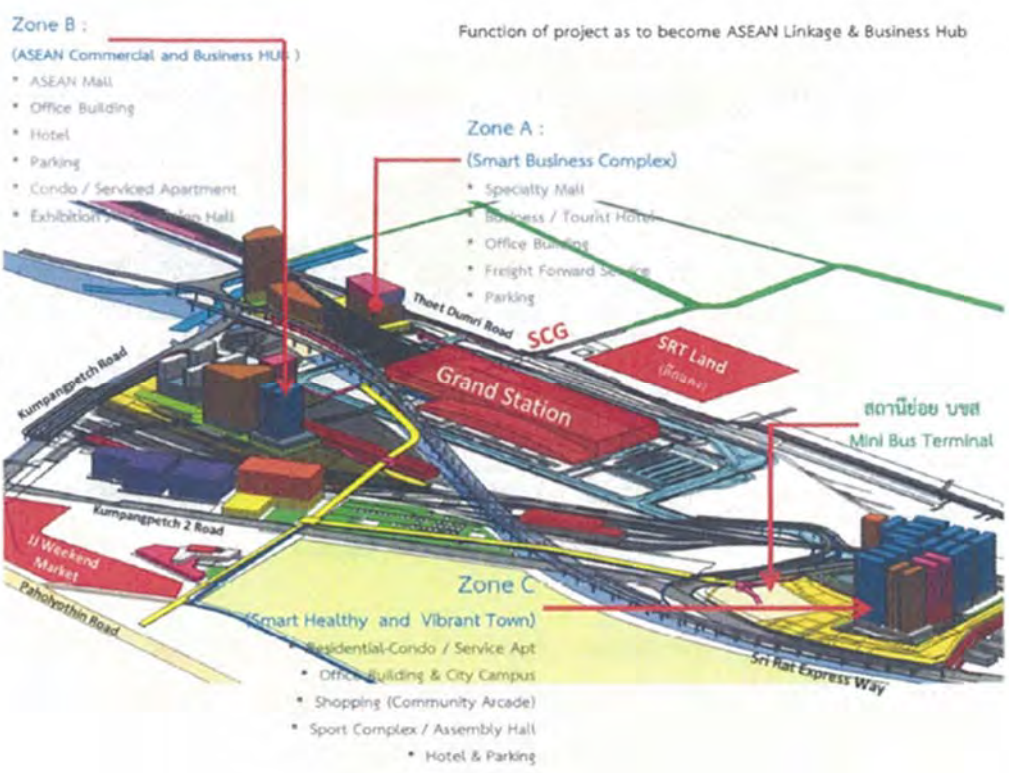
3.4.3 Development Concept

According to the report of SRT, the outline of the major projects is as shown in Table 3.4.1. It considers the concept of TOD and lifestyle in Thailand. The potentials and visions in each zone are summarized in Table 3.4.2.

Table 3.4.1 Outline of Major Projects

Item	Outline of Major Project
Concept	Connectivity with Asia, business hub
Center of Four Railway Systems	1. City link railway, 2. Red Line 3. Express railway, 4. Airport rail link
Mass Transit Station	MRT Blue Line, (Purple Line) BTS Green Line
Zone A (Smart Business/Complex)	・Mall・Business/hotel ・Office・Cargo ・Parking
Zone B (ASEAN Commercial and Business Hub)	・ASEAN Mall・Office ・Hotel・Parking ・Mansion/service apartment ・Exhibition/hall
Zone C (Mart Healthy Vibrant Town)	・Residence ・Office and city campus ・Shopping ・Sport complex ・Hotel and parking

Source：SRT



Source：SRT

Figure 3.4.2　Development and Projects in Each Zone

Table 3.4.2　Potentials and Visions in Each Zone

Zone Concept	Outline of Main Project
Zone A （Smart Business/Complex）	・ Retail, restaurant, office, hotel, logistics service to support tourism ・ Collaboration between urban development and Bang Sue Grand Station as a nationwide transportation hub
Zone B （ASEAN Commercial and Business Hub）	・ Collaboration with Chatuchak Market to build a central retail center ・ ASEAN Mall, modern office, hotel to attract tourists ・ Convention hall for MICE, residence and service apartment
Zone C （Smart Healthy Vibrant Town）	・ Residence and office in creative and comfortable environment ・ Collaboration of parks ・ Office, international headquarters, city campus, hotels ・ Residence and serviced apartment for foreign visitors ・ Sport complex, community mall to upgrade quality of life

Source：SRT

3.5　Traffic Plan by OTP

3.5.1　Vision

In the report of OTP, the main purpose of inter-area transport is to enhance the connectivity and accessibility of the Bang Sue Area. The following are the major development policies:

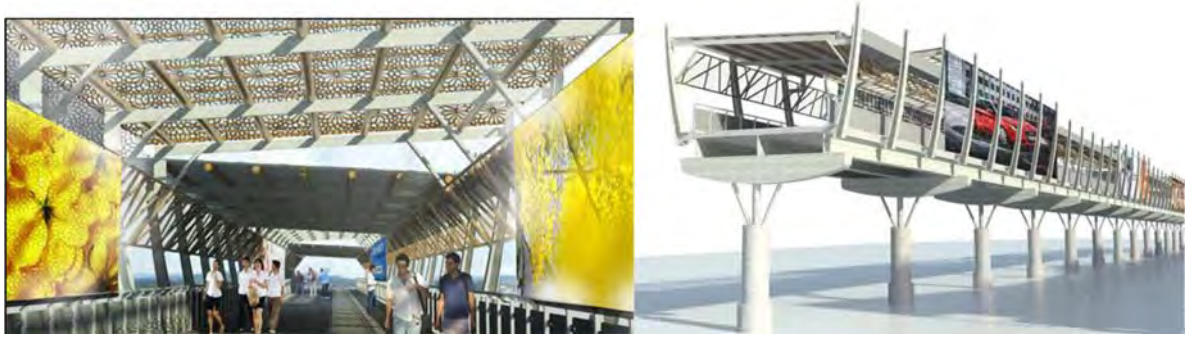
- Enhancing the potential and overcome the physical limitations.
- Making Bang Sue Grand Station as the focal point of TOD to promote pedestrian-friendly development.
- Providing easy and convenient access from arterial roads, rail stations, and major activities.

- Creating a livable neighborhood surrounded by good natural environments.
- Utilizing the existing public parks and commercial areas.
- Reducing through-traffic volume coming from outside Bang Sue Area.

The details of each transport component in the plan are summarized below.

3.5.2 Pedestrian

Considering the huge area of development, it is planned to install a skywalk from Bang Sue Grand Station to BTS Mo Chit Station and Chatuchak Station as east–west direction. A part of the skywalk is being planned to be constructed under the Sirat Expressway (Figure 3.5.1). Regarding the north–south direction, a pedestrian road is planned to be constructed from Kamphaeng Road to Zone C via Zone D. According to the demand forecast, pedestrian volume is predicted to be 4,778 people per day for the south–north direction and 36,982 people for the east–west direction (Table 3.5.1).



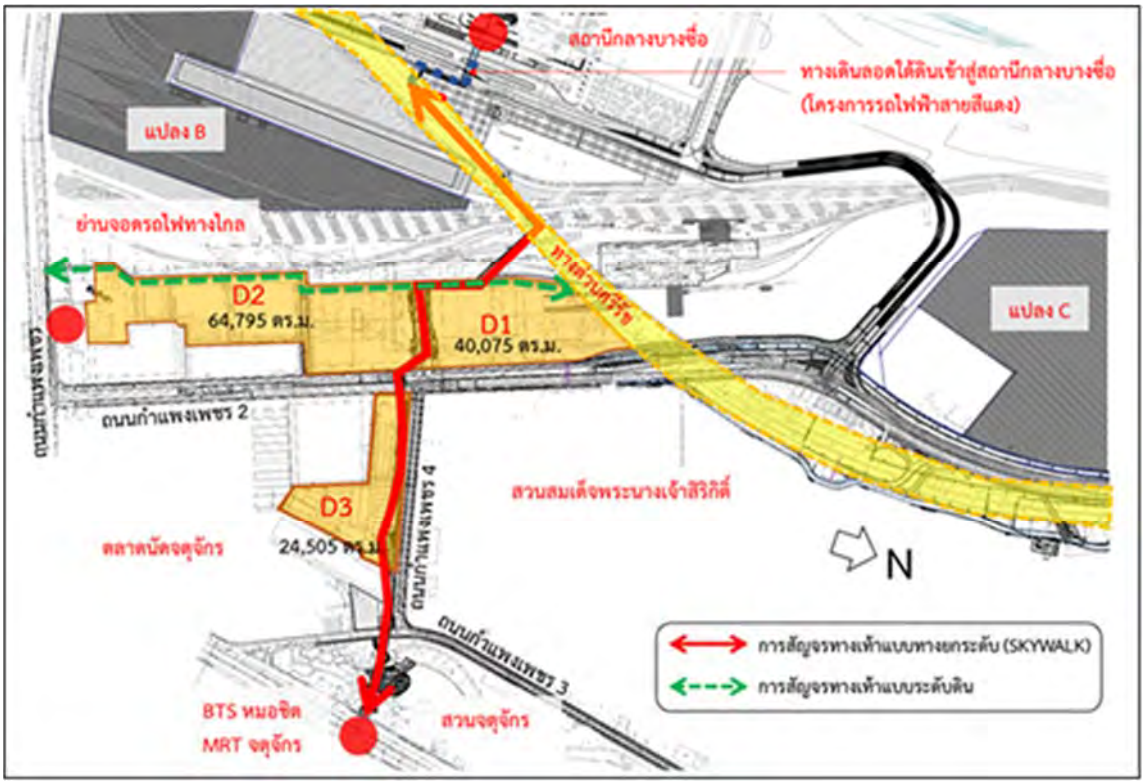
Source: OTP Report

Figure 3.5.1 Image of Skywalk

Table 3.5.1 Demand Forecast for Pedestrian Volume

Year	Number of Pedestrian (People/Day) East – West Direction	Number of Pedestrian (People/Day) South – North Direction
2022	14,977	1,673
2032	29,395	3,099
2037	36,982	4,778

Source: OTP



Source: OTP

Figure 3.5.2 Development Plan for Pedestrian Road

3.5.3 Non-motorized Transport (NMT)

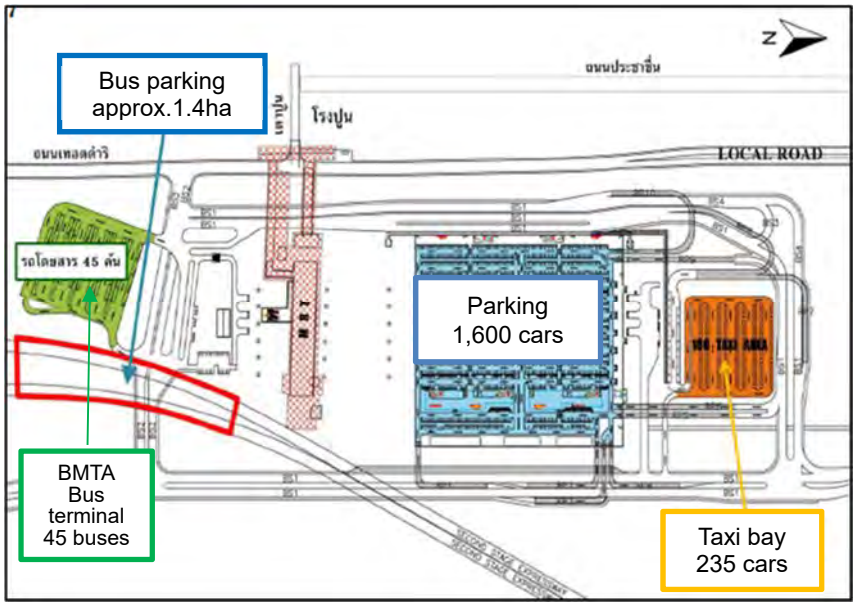
OTP's plan suggests promoting bicycle use in Bang Sue Area considering the needs for modal shift in Bangkok. In the plan, cycling roads are proposed along with the BRT route and the boundary of Zone B and Zone D. The width of the cycling road is 3 m. In addition, cycle parkings are planned at every BRT stations and main train stations and commercial buildings.

3.5.4 Automobile

In their study, OTP conducted a traffic demand forecast by counting intersection traffic volume, amount of pedestrian, and collecting origin-destination information. Based on the traffic demand forecast, improvement of several roads is proposed such as Kamphaeng Phet 6 Road, Phahon Yothin Road, and Terddamri Road. Each lane has 3.5 m in width in the plan. As for parking space, a parking for 1,600 vehicles is planned in Bang Sue Grand Station (Figure 3.5.3). Likewise, a parking space for 235 taxis is also introduced in Bang Sue Grand Station.

Source: OTP

Figure 3.5.3 Road Plan of Bang Sue Area



Source: OTP

Figure 3.5.4 Parking Space in Bang Sue Grand Station

3.5.5 Bus

As for inner-city bus, Bangkok Mass Transit Authority (BMTA) Terminal shall be relocated to Zone A after the opening of Bang Sue Grand Station. It shall accommodate around 45 buses. However, according to OTP, the planned bus terminal in Zone A may be planned as a bus terminal for tour buses (as of August 2017).

The inter-city bus terminal is currently located in Zone C as Mo Chit 2 Bus Terminal that has a land area of about 11 ha. OTP suggests relocating and downscaling the bus terminal to the south of Mo Chit 2 Bus Terminal, same as the current BMTA Terminal (2.6 ha). Since the land area for the planned BTMA Terminal is less than the current one, one-third of the passengers are expected to use another planned

bus terminal in Rangsit (6.4 ha).

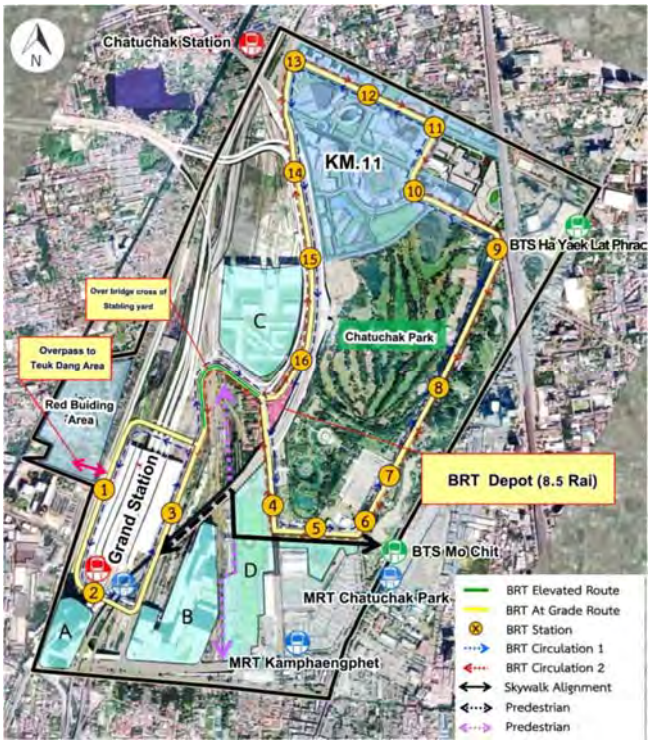
The traffic volume around Mo Chit 2 Bus Terminal is expected to be saturated if Mo Chit 2 Bus Terminal is relocated to the area of current BMTA Terminal. OTP calculates the volume/capacity (V/C) of Kamphaeng Phet 2 Road and it revealed that V/C will be over 1.0 for north direction due to large buses. In general, over 1.0 means over the design capacity, thus, traffic congestion is supposed to occur in peak hours.

In addition to inter-city bus and inner-city bus, Bus Rapid Transit (BRT) development plan is also proposed. The objective of introducing BRT is to utilize it as intra-zonal mode in Bang Sue Area. The BRT passes through BTS Mo Chit Station, MRT Chatuchak Park Station, Ha Yaek Lat Phrao Station, and Bang Sue Station. The route is bidirectional. The fare is set at THB 15 regardless of distance and operation starts in 2022. The fare is decided considering current fare for walking distance is THB 8 to 12 and future price escalation. Future BRT passenger is expected to be 105,700 people per day in 2037 as shown in Table 3.5.2. To develop the BRT system, exclusive lane and Public Transportation Priority Systems (PTPS), elevated road, and depot will be introduced. Depot is planned at the area of 1.4 ha, where currently gas facilities of PTT are located at, and maintenance facility, filling station, parking space, and office are planned in the same place (Figure 3.5.5.)

Table 3.5.2 Demand Forecast for BRT Passengers (Fare is set at THB 15)

Year	Passengers/Day (people)	Maximum Passenger/Hour (people)
2022	33,400	992
2032	63,600	2,693
2037	105,700	4,258

Source: OTP



Source: OTP

Figure 3.5.5 BRT Development Plan

3.5.6 Traffic Demand Forecast

In the study, OTP conducted traffic demand forecast through intersection traffic count, origin and destination interview, and travel speed survey. Traffic demand forecast was conducted for year 2022, 2032, and 2037. In 2037, OTP predicts approximately 1.42 million passengers per day using Grand Bang Sue Station in total (Table 3.5.3).

Table 3.5.3 Demand Forecast for Grand Bang Sue Station and Other Stations Passengers

Station		Year 2022 (people)		Year 2032 (people)		Year 2037 (people)	
		Boarding	**Alighting**	**Boarding**	**Alighting**	**Boarding**	**Alighting**
Grand Bang Sue Station	Dark Red	105,600	106,100	185,200	185,100	217,100	218,000
	Light Red	65,400	65,900	89,000	88,500	96,900	96,900
	Long Distance Train	29,300	29,600	86,100	86,100	106,500	106,100
	HSR	38,600	38,600	69,200	69,100	85,700	86,100
	ARL Ext	30,700	30,800	48,400	48,600	60,300	60,100
	Blue	56,700	56,500	121,500	121,300	145,400	144,600
Subtotal		**326,300**	**327,500**	**599,400**	**598,700**	**711,900**	**711,800**
Kamphaeng Phet Station		33,000	33,100	67,000	67,300	82,900	82,900
Chatuchak Station		78,200	77,900	169,400	170,000	195,600	195,500
Mo Chit Station		95,600	95,500	170,600	171,200	184,900	185,700
Total		**533,100**	**534,000**	**1,006,400**	**1,007,200**	**1,175,300**	**1,175,900**

Source: OTP

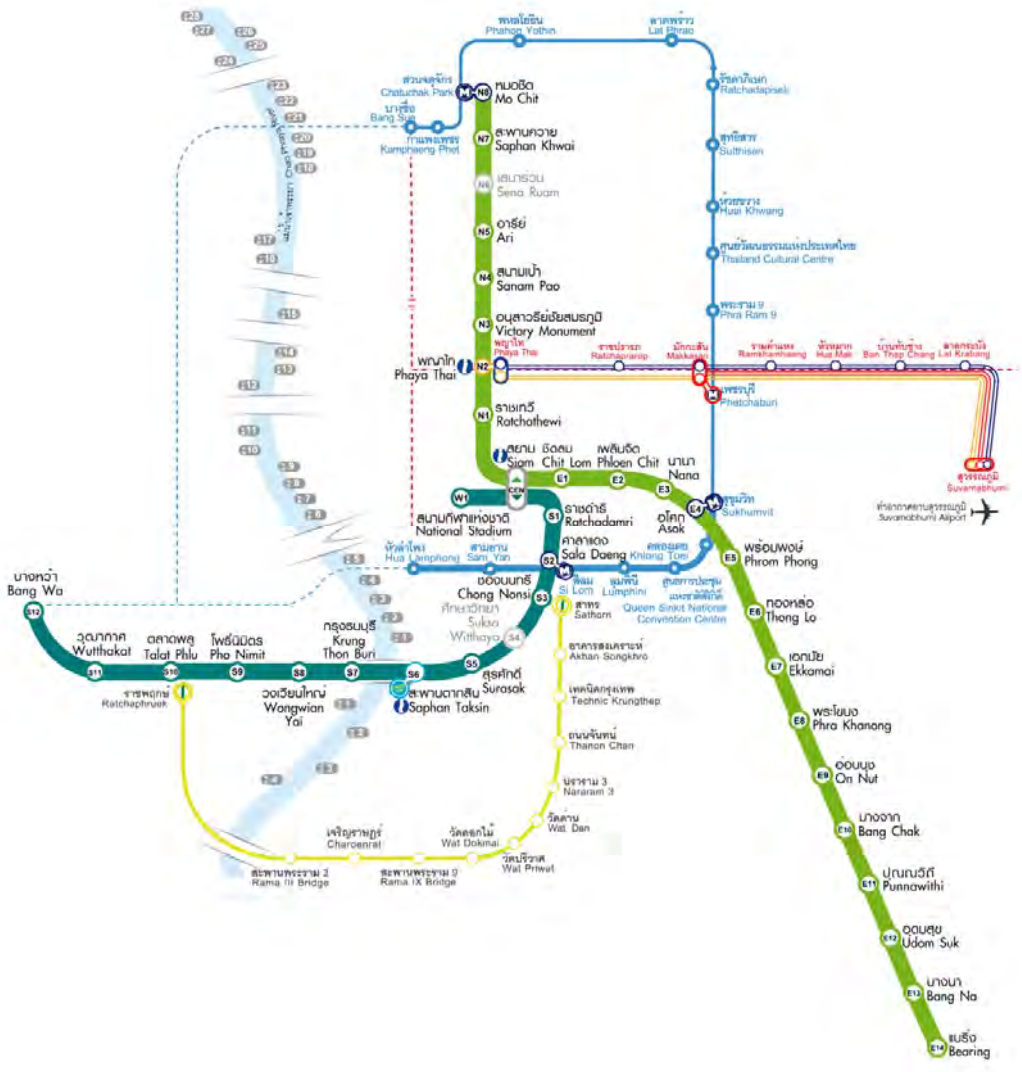
Chapter 4 Current Status of Infrastructure

4.1 Railway

In Bangkok, the congestion at major arterial roads is a common issue. BTS Sky train isnow widely used by passengers. They have are acknowledged that Skytrain is a convenient mode of transport which can help them to avoid running into a traffic jam. Current Urban Mass Rapid Transit (UMRT) in Bangkok consists of five lines in total including; two (2) lines of BTS (Light Green Line - Dark Green Line), two (2)lines of MRT (Blue Line - Purple Line) and ARL (Airport Rail Link). Status of existing and planed railway based on transit systemsis shown below.

4.1.1 BTS (Light Green Line - Dark Green Line)

Existing network of BTS (Light Green Line - Dark Green Line) is as shown inFigure 4.1.1.



Source：BTSC

Figure 4.1.1 Existing Network of BTS（Light Green Line - Dark Green Line）

(1) BTS Sukhumvit Line (Light Green Line)

BTS Sukhumvit Line has 22 stations with a total length of 22.1 km from Mo Chit Station (North Terminal) to Bearing Station (South Terminal). The entire line is aboveground. It runs along Sukhumvit Street, one of the main streets in Bangkok, to Thong Lo Station – Phromphong Station – Asok Station (an interchange with Sukhumvit Station of MRT Blue Line) – Nana Station – Chit Lom Station – Siam Station (an interchange with BTS Si Lom Line).

At present, the extension of 13 km consisting nine (9) stations to the East from Bearing Station to Samut Prakan is under construction and it is expected to be opened in 2018 (In April 2017, Samrong Station, next to Bearing Station, was newly opened).

These existing stations are in the downtown areawhich isfilled with office buildings and commercial buildings. As shown in Figure4.1.2, there are largedepartment stores (Enporium, Siam Paragon etc.) and shopping malls (Terminal 21, Siam Square 1 etc.) which are connected to stations by pedestrian bridges or pedestrian decks along BTS Sukhumvit Line. It can be considered as the typical example of TOD in Thailand, in context of commercial development.

Source：Asia Travel Note

Source：Bangkok Navi

Figure4.1.2 Commercial Facilities Connecting to Stations of BTS Sukhumvit Line

(2) BTS Si Lom Line (Dark Green Line)

BTS Si Lom Line has 13 stations with a total length of 13.8 km from National Stadium Station (CBD Terminal) to Bang Wa Station (West Terminal). It is the main line connecting the left and right bank of Chao Praya River. The entire line is aboveground.

This line runs from National Stadium Station, the terminal in CBD to Siam Station (interchange station with BTS Sukhumvit Line) which is probably the most popular shopping area, to Ratchdamri Station which is surrounded by green spaces in the middle of Bangkok, the Royal Bangkok Sport Club which includes Lumphini Park, horse racecourses and luxury golf courses, to Sala Daeng station (connecting with Si Lom Station of MRT Blue Line) where CBD of Bangkok has been formed, to Chong Nonsi Station, Surasak Station and to Saphan Taksin Station on the left bank of Chao Praya River. It then passes the river, to several stations on the right bank and terminates at Bang Wa Station.

BTS Si Lom Line is not only connected to MRT Blue Line but also to other public transport modes. It is also possible to transfer to BRT terminal by elevated pedestrian bridgesfrom Chong Nonsi Station. It is also possible to use water transport on Chao Praya Riverat Saphan Taksin Station. Prices of real estates around new stations of BTS Si Lom has been increasing 33% since the past 2 years.

4.1.2 MRT（Blue Line - Purple Line）

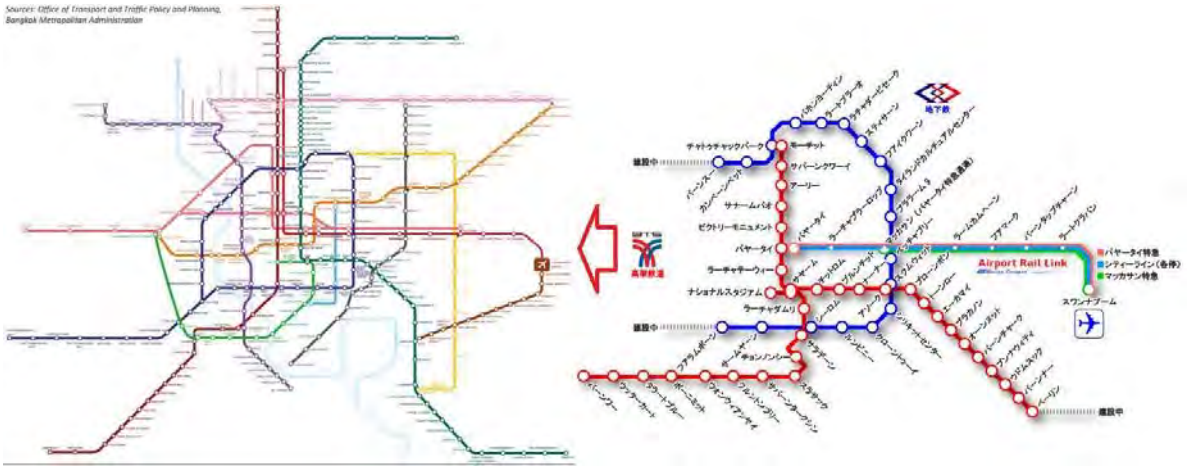
The existing network of MRT is as shown in Figure4.1.3.

(1) MRT Blue Line

MRT Blue Line was financed by Japanese Official Development Assistance (ODA) and opened in 2004. As of NovemberJune 2017, it is the single subway line in Bangkok. It runs from Hua Lamphong Station locates at near to CBD to Bang Sue Station with total 18 stations in 20.8 km length. It is connected to BTS Si Lom Line at Si Lom Station, to BTS Sukhumvit Line at Sukhumvit Station, to ARL at Phetchaburi Station, and again to BTS Sukhumvit Line at Chatuchak Station. Along the route of MRT Blue Line, which runs through city center, recently, urban development has been activated by private capital, especially for area surrounding Phra Ram 9 Station.

(2) MRTPurple Line

MRT Purple Line, built by Japanese ODA, runs from Khlong Bang Phai Station (Northwest side of the downtown area) to Tao Poon Station (North side of the central downtown area) with 16 stations in 23 km. It was opened in 2016. The existing downtown area is sprawling along the route of Purple Line, and condominiums are being built by private developers. Bang Sue Station of Blue Line is located in one (1) km to the East of Tao Poon Station. Blue line was extended to Tao Poon Station in August 2017, so that passangers can transfer Blue Line and Purple Line at Tao Poon Station.



Source：Urban Transportation Plan of Bangkok 2017

Figure4.1.3 Existing network of MRT

4.1.3 SRTRed Line

SRT Red Line is underconstruction partically by Japanese ODA. It shall be operatedfrom Bang Sue Station (North side of central downtown area) to Rangsit Station (Northern suburban area) with ten(10) stations in 26.3 km. It is expected to be completed in 2020. Red Line is planned to be integrated with the existing inter-city railway that runs alongside and to be elevated to ease the congestions caused by at ground intersections. The network of SRT Red Line is as shown in Figure4.1.4.

4.1.4 Pink Line - Yellow Line - Orange Line

Pink Line, Yellow Line and Orange Line will connect central area to suburban area to the east.

planned contents of each line Esare as as shown in Table 4.1.1. These lines are under bidding or planning stage, and has not been construction as of November 2017.

Table 4.1.1 Existing Railway around Survey Area

Line	Outline
Pink Line	Monorail, total length of 34.5 km with 30 stations Nonthaburi (Northern suburban area) to Min Buri (Eastern suburban area)
Yellow line	Monorail, total length of 30.4 km with 23 stations Ratchada (Northeast side of central area) to Samrong (Southeast side of central area)
Orange Line	Heavyrail, total length of 39.6 km with 30 stations Taling Chan (West side of central area) to Min Buri (Eastern surburban area)

4.1.5 ARL (Airport Rail Link)

ARL is the elevated railway that connects Suvarnabhumi Airport (eastern suburb), to CBD with eight (8) stations in 28.6 km. It opened in 2010. There is a candidate location for TOD at the surrounding area of Makkasan Station. Makkasan Station is connected to Phetchaburi Station of MRT Blue Line. At the time of opening in August 2010, it was operated in two (2) modes: express train (direct from Airport to Makkasan) and local train. However, the express service has been stopped since 2014. In the future, there is a plan to extend this line to Don Muang Airport by passing through Bang Sue Station. The existing network of ARL is as as shown in Figure4.1.4.

Source

Figure4.1.4 SRT Route Map

4.1.6 High-speed Train (Plan)

In 2016, a memorandum was signed on applying Japansese technology for the high-speed train

connecting Bangkok and Chiang Mai. Total length is approximately 670 km. Including other planned routes, total 5 routes are being considered to be developed.

1st route：Bangkok – Phitsanulok - Chiang Mai

2nd route：Bangkok – Ubon Ratchathani

3rd route：Bangkok - Nakorn Ratchasima - Nong Khai

4th route：Bangkok - Hua Hin - Padang Besar

5th route：Bangkok - Rayong

Planned network of highspeed train is as as shown in Figure4.1.5.

Source：SRT

Figure4.1.5 Planning Routes of High-speed Trains

4.2 Road Transport and Bus Terminal

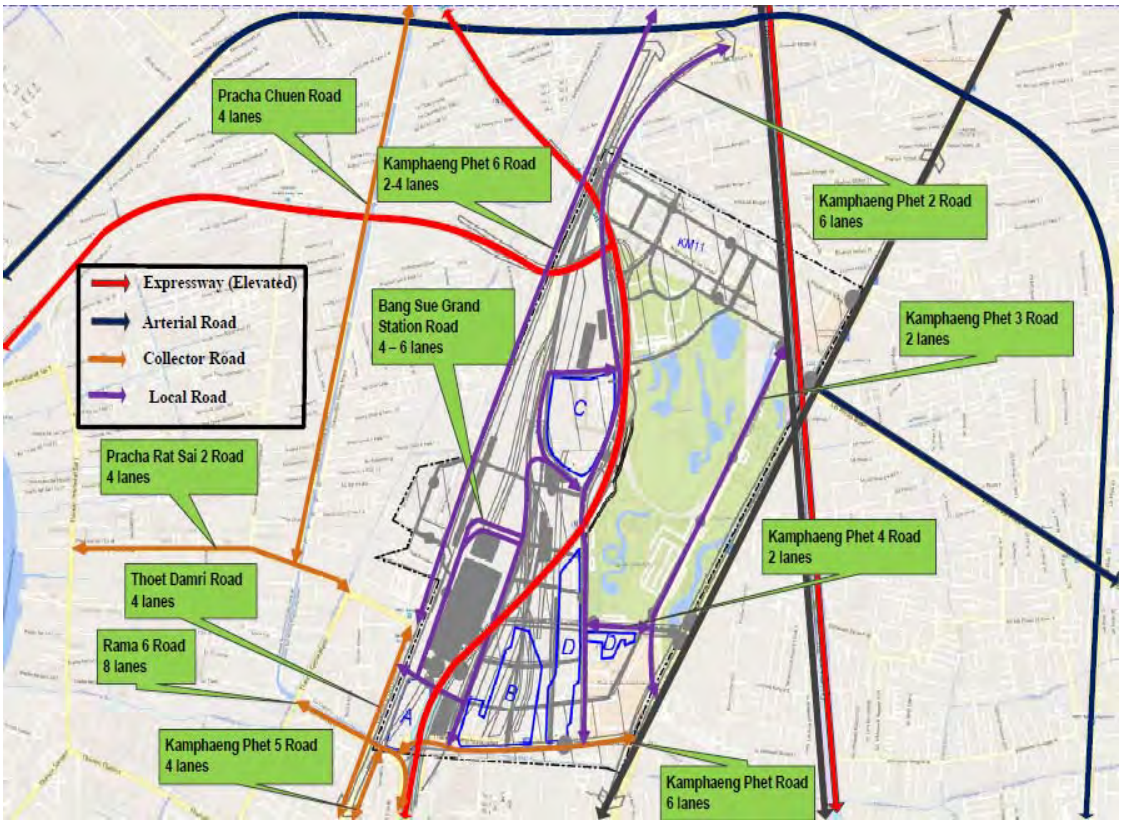
4.2.1 Road Transport

Status of surrounding road network is as shown inTable 4.2.1, Figure4.2.1 and Figure4.2.2.

Table 4.2.1 Existing Roads in Surrounding Bang Sue Area

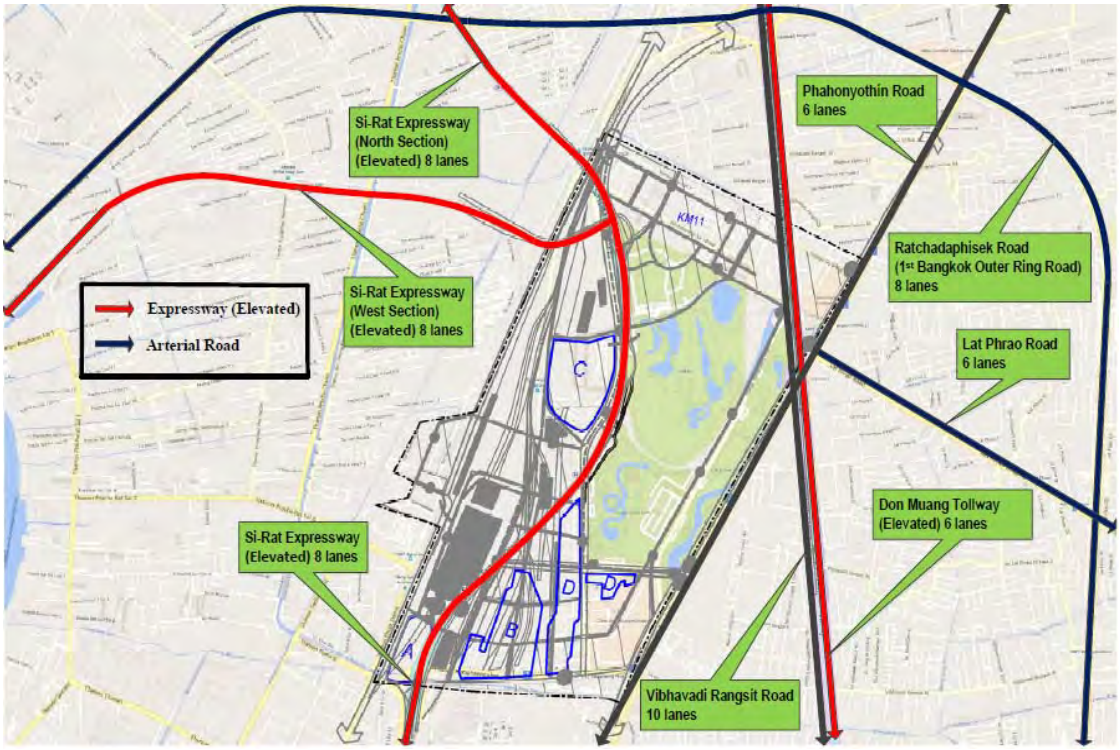
No.	Name	Type of road	Authority
1	Don Muang Expressway	Toll Expressway	Private Operation Company/Expressway Bureau of MOT
2	Si-Rat Expressway	Toll Expressway	Private Operation Company/Expressway Bureau of MOT
3	Si-Rat Expressway - Bangkok Outer Ring Road	Toll Expressway	Private Operation Company/Expressway Bureau of MOT
4	Vibhavadi Rangsit Road	Major Trunk Road	Expressway Bureau of MOT
5	Phahonyothin Road	Expressway	Expressway Bureau of MOT
6	Rachadaphisek Road	Trunk Road	Bangkok Public Works Bureau
7	Lat Prao Road	Trunk Road	Bangkok Public Works Bureau
8	Kampheang Phet Road	Major Collective Road	Bangkok Public Works Bureau
9	Rama 6 Road	Major Collective Road	Bangkok Public Works Bureau
10	Thoet Damri Road	Collective Road	Bangkok Public Works Bureau
11	Kampheang Phet 5 Road	Collective Road	Bangkok Public Works Bureau
12	Pracha Rat Sai 2 Road	Collective Road	Bangkok Public Works Bureau
13	Pracha Chuen Road	Collective Road	Bangkok Public Works Bureau
14	Kampheang Phet 6 Road	Collective Road	Bangkok Public Works Bureau
15	Kampheang Phet 2 Road	Local Road	Bangkok Public Works Bureau
16	Kampheang Phet 3 Road	Local Road	Bangkok Public Works Bureau
17	Kampheang Phet 4 Road	Local Road	Bangkok Public Works Bureau
18	Road around Bang Sue Grand Station	Local Road	Thai National Railway（SRT）

Source: JST



Source: JST

Figure4.2.1 Expressway in Surrounding Bang Sue Area



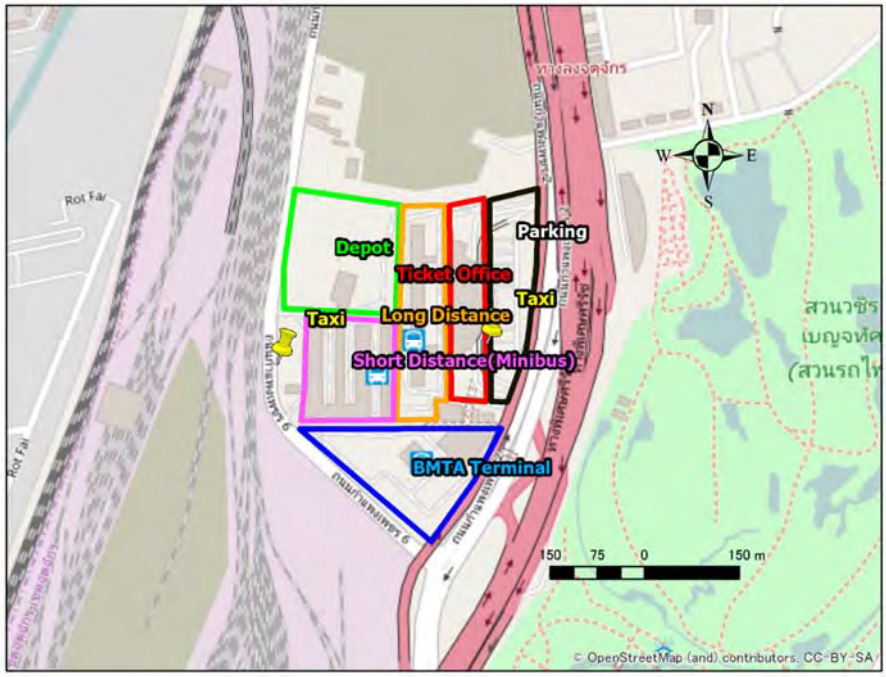
Source: JST

Figure4.2.2 Elevated Roads in Surrounding Bang Sue Area

4.2.2 Bus Terminal

The bus terminal in Bang Sue Area is called Mo Chit 2 Bus Terminal, operated by Transport Co., Ltd., a state enterprise under Ministory of Transport (MOT). The company also operates long-distance bus service. Mo Chit 2 Bus Terminal is a terminal station for buses mainly going from Bangkok to the northern and northeastern Thailand and to neighboring countries such as Cambodia and Laos. In the statistical data from October 2015–September 2016, the terminal served 2.3 million buses and 38 million passengers annually.Besides Mo Chit 2 Bus Terminal, inner-city bus terminal is also located. Inner-city buses and its terminal are operated by Bangkok Mass Transit Authority (BMTA).

The plan view of Mo Chit 2 Bus Terminal and BMTA Bus Terminals is as shown in Figure 4.2.3. Mo Chit 2 Bus Terminal has an area of 14 ha facilitated with bus parking area, platforms, ticket offices, a depot, and an office building of Transport Co., Ltd.



Source: JST

Figure 4.2.3 Layout of Bus Terminal

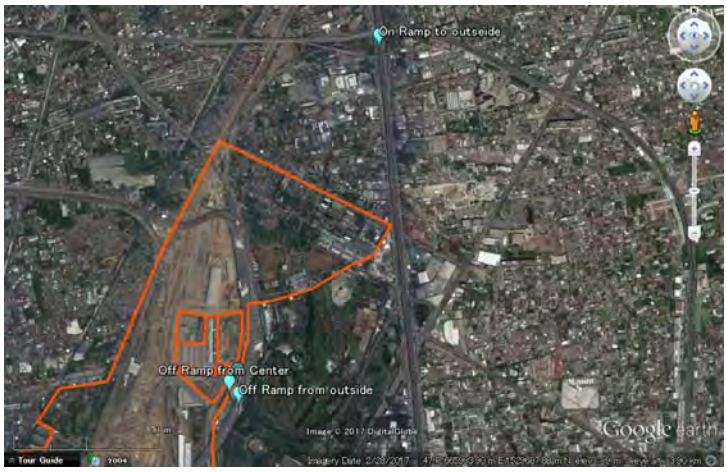
Source: JST

Figure 4.2.4 Platforms (Left: Medium Distance Bus; Right: Long Distance Bus)

(1) Inter-city Bus Service

There are two types of inter-city buses, i.e.: large bus (coach) for long distance trips to cities in norther and northeastern Thailand or to foreign countries, and van-type bus for medium distance trip. Each platform is located at Mo Chit 2 Bus Terminal separatedly. It has 130 platforms for long distance buses and 133 platforms for medium distance buses. However, each platform for medium distance bus can only serve two buses, so the number of medium distance buses is larger than that of long distance. The inter-city buses use the expressway. Buses, which come to Bangkok use Sirat Expressway which passes just next to Mochit 2 Bus Terminal. For those heading to other cities, they use Don Muang Expressway via a ramp located in the northeast of Bang Sue Area.

Roads in the surrounding area of Mo Chit 2 Bus Terminal are as shown in Figure 4.2.5.

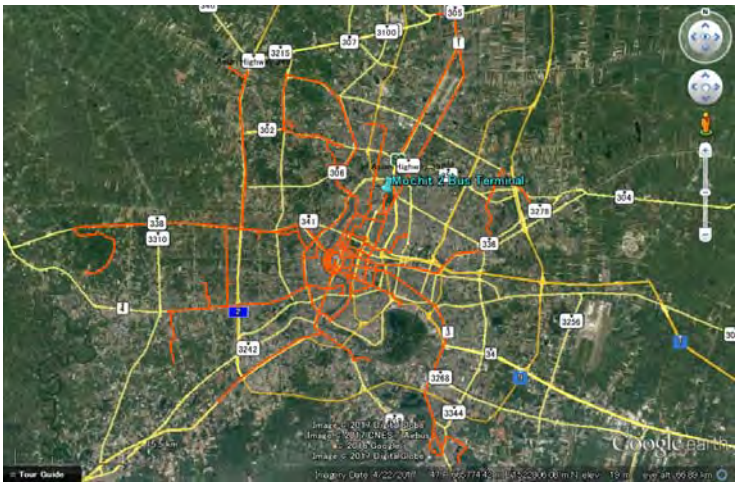


Note: Red lines show the roads in the surrounding area of Mo Chit 2 Bus Terminal
Source: JST

Figure 4.2.5 Roads in the Surrounding Area of Mo Chit 2 Bus Terminal

(2) Inner-city Bus Service

Inner-city bus service is managed by BMTA. In 2017, 209 routes are operated. In Bang Sue Area, 14 routes depart from BMTA Bus Terminal. However, there are some bus routes which do not stop at BMTA Bus Terminal. BTMA bus routes are as shown in Figure 4.2.6.



Note: Orange lines show inner-city bus routes

Source: BMTA

Figure4.2.6 Inner-city Bus Routes

(3) Traffic Survey on Mo Chit 2 Bus Terminal

1) Outline of the Traffic Survey

OTP reports the current ocation of the Mochit 2 Bus Terminal affects to traffic flow in surrounding roads, and it causesthe traffic congestion. The objective of the traffic survey is to study adequate bus location and operational plan by clarifying current traffic flow and tendency of bus users' trips. In the present survey, the traffic volume survey and the interview survey are implemented.

Table 4.2.2 Traffic Survey Component

Items	Survey Component
Traffic Volume Survey	・Current traffic volume ・Traffic signal cycle
Interview Survey	・OD information of bus users ・Stated preference for traffic mode

Source: JST

2) Traffic Volume Survey

The traffic volume survey was conducted at the intersection near Mo Chit 2 Bus Terminal as shown in Figure4.2.7. The traffic count was conducted manually for 12hours, by directions and by nine (9)car types. The survey was conducted from 7a.m. to 7p.m. on 7th June, 2017. An intersection near Mo Chit 2 Bus terminal is selected as traffic survey point since all vehicles must pass the intersection to access the Mo Chit 2 bus terminal. Thefore it is considered an ideal location to analyze the affection of the bus terminal.

Source: JST

Figure4.2.7 Location for Intersection Traffic Count Points

Source: JST

Figure4.2.8 Traffic Count Survey

Passenger Car Unit (PCU) factors were defined by OPT as following in Table 4.2.3.

Table 4.2.3 PCU Factor

Type of vehicle	PCU factor
Motorcycle	0.333
Car, Taxi	1.000
Small bus, Van, Pickup	1.500
Medium Bus	1.5000
Large Bus	2.100
Light Truck<2 axis	1.000
Medium Truck 3 axis	1.500
Large Truck 5 axis	2.500
Trailer	2.500
Cycle	0.000
Type of vehicle	PCU factor

Source: OTP

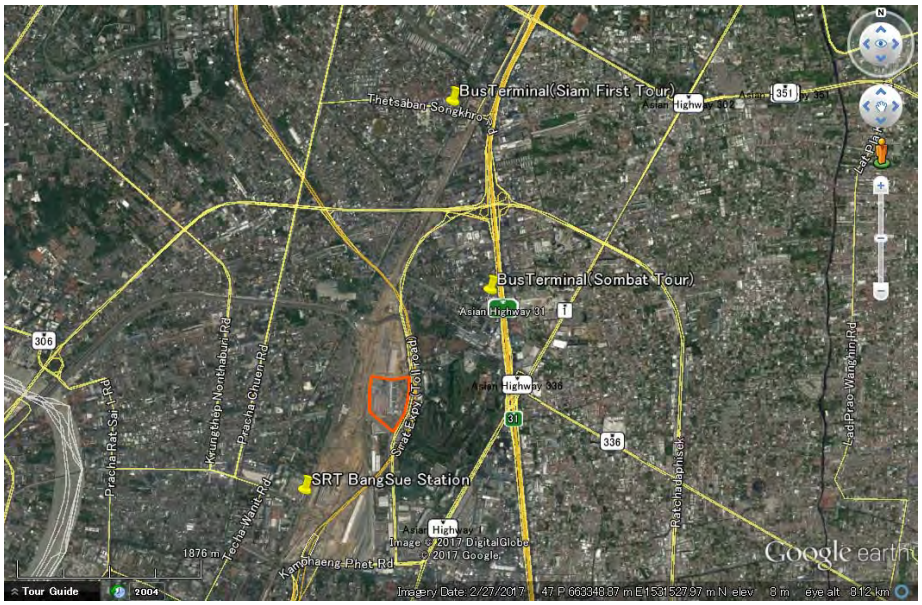
3) Interview Survey

The interview survey was conducted to collect attributes of bus users, Origine and Distination (origin and destination (OD)) information and stated preference. As for OD information, it is figured out from tendency of transshipment from bus to other modes. As for stated preference, it is asked that possibility of changing current traffic mode, if Mo Chit 2 Bus Terminal would be relocated and improved connectivity to other traffic mode. The interview was conducted at two private bus stops which are which locate atnear Mo Chit 2Bus Terminal and SRT Bang Sue Station. Questions are as as shown in Table 4.2.4.

Table 4.2.4 Questions in the Interview Survey

Category	Items
Attribute	・Gender ・Age ・Vehicle ownership ・Residence
Trip Information	・Trip Purpose ・Origin and destination
Bus Usage Situation	・Frequency of use ・Transhipment to railway
Stated Preference	・Maximum walk distance ・Stated preference for each traffic mode

Source: JST



Source: JST

Figure4.2.9 Interview Location

Table 4.2.5 Interview Schedule

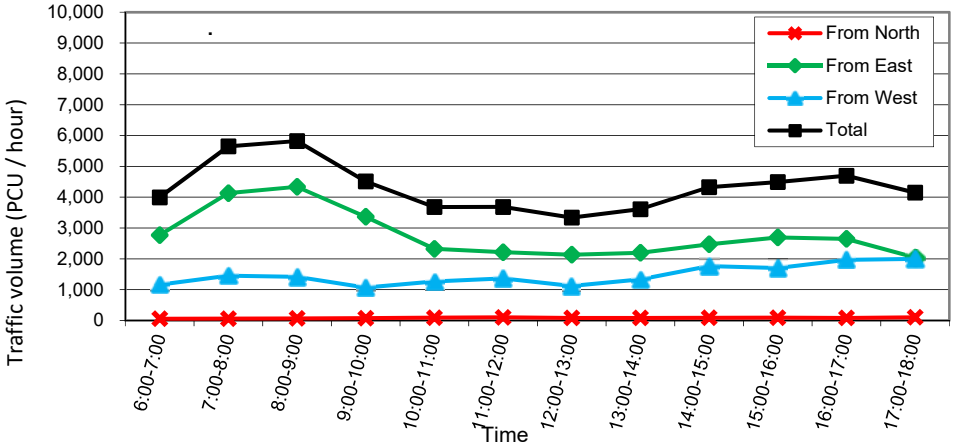
Date	Time	Location
7th June	10:00 – 19:00	SRT Bang Sue Station
	18:00 – 21:00	Bus terminal (Siam First Group)
9th June	5:00 – 9:00	Bus terminal (Sombat Tour)
	15:00 – 19:00	Bus terminal (Sombat Tour)
10th June	5:00 – 9:00	Bus terminal (Siam First Group)
	5:00 – 9:00	Bus terminal (Sombat Tour)
	17:00 – 21:00	Bus terminal (Siam First Group)
	17:00 – 21:00	Bus terminal (Sombat Tour)

Source: JST

According to OTP, Mo Chit 2 Bus Terminal is planned to relocate by 2023 to toMOF's property is located at next to MRT Chatuchak Park Station and BTS Mo Chit Station. Its total area is 112,000m^2, is used to be operated as a bus terminal before. New bus terminal will be developed along with commercial development. To consider an adequate place for relocation, JICA survey team refers the traffic survey result. Also the result should be considered in the planning stage of the development plan and the business plan.

Result of Traffic Volume Survey

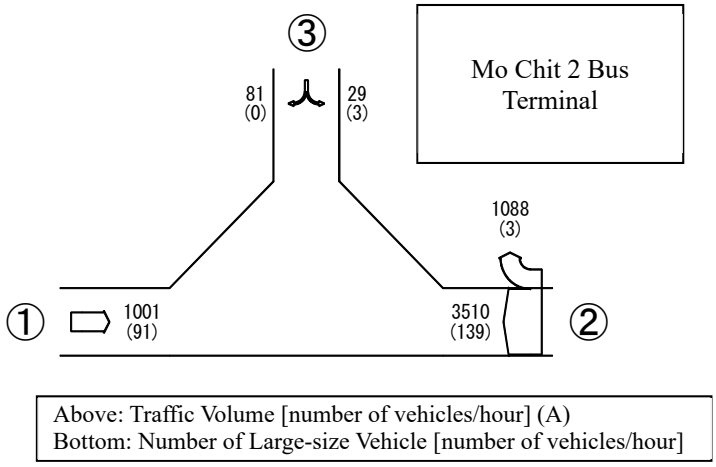
In terms of the traffic volume by time, the traffic flow from east direction has more volume than other directions throughout 12 hours, as shown in Figure4.2.10. A ramp will be developed near future in the north of the intersection. Therefore, the traffic volume from north direction is considered to be bigger in the future.



Source: JST

Figure4.2.10 Traffic Volume by Time and Direction

Figure4.2.10shows traffic volume by time and direction. In the morning peak, the traffic flow from east is its peak. As the result of V/C analysis, East-West and East-East (U-turn) direction exceeds its capacity as shown in Table 4.2.6. V/C. If Volume/ Capacity (V/C) was lower than 1.0 the result was indicated as "OK", otherwise result was indicated as "NG". If V/C exceeds 1.0, chronic traffic congestion is occurred. In terms of the level of service[1], it was diagnosed as F rank. F rank is the lowest rank in the six categories in the Highway Capacity Manual.



Source: JST

Note: Upper figure indicates total traffic volume per hour. Lower figure indicates traffic volume of heavy vehicle per hour

Figure4.2.11 Traffic Volume at Morning Peak Hour (7a.m. – 10a.m.)

Table 4.2.6 V/C Analysis Result

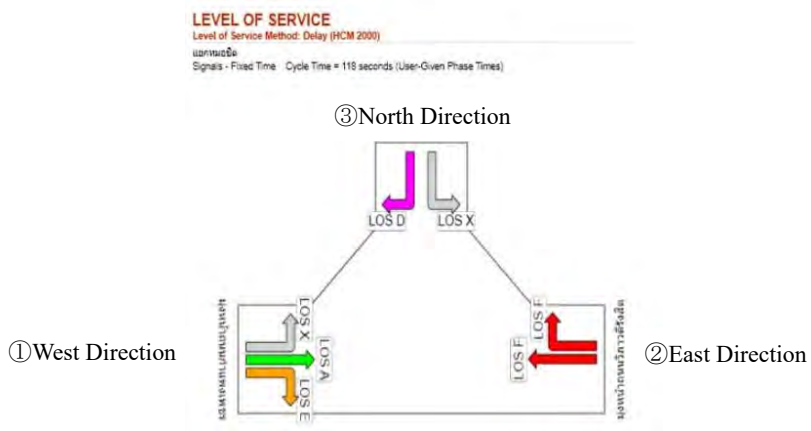
Points	①		②		③	
Direction	Straight	U-Turn	Straight	U-Turn	Left	Right
Number of Lanes	3	1	2	1	1	2
Volume / Capacity q／C i	0.304	0.000	1.542	1.522	0.021	0.062

[1] Level of service(LOS) indicates the condition of traffic management which is described as six categories from A to F. LOS for signalized intersections is defined in terms of average delay time that is subtraction of travel time with signalized intersection and without signalized intersection.

Result	OK	OK	NG	NG	OK	OK

Note: OK= Volume/ Capacity (V/C) is less than1.0. NG=V/C is over 1.0.

Source: JST



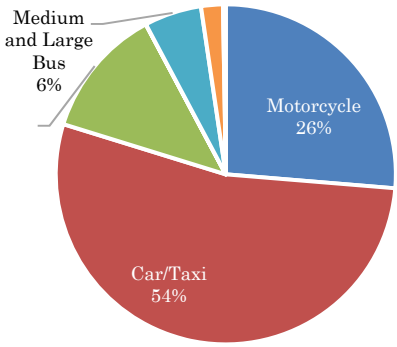
Source: JST

Figure4.2.12 Level of Service

Figure4.2.13 shows the proportion of traffic mode on intersection. The middle and longdistance buses occupies six (6) percent of all traffic mode. They are converted to 1.5 – 2.0 PCU, thus it affects the traffic flow compared to the standard-sized automobile.

Relocation of Mochit 2 Bus Terminal will decrease bus trips and other related trips such as taxi trips from Mo Chit 2 Bus Terminal to center of Bangkok. Therefore,the relocation is expected tocontribute to the alleviate the traffic flow at Kam Phaeng Phet 2 Road. On the other hand, at the heaviest traffic volume on intersection (East- East direction and East - West direction), the ratio of bus in the total traffic is not high. Therefore, bus does not affect on the traffic congestion at the intersection.

However, traffic congestion prevents bus operators from their smooth operation. JICA survey team recommends to alleviate the traffic flow at Kam Phaeng Phet 2 Road by improvement the detour road or Kam Phaeng Phet 2 Road itself, or, Mo Chit 2 Bus Terminal should be relocated to other places where the traffic volume is smaller and the congestion is much less.



Source: JST

Figure4.2.13 Proportion of Traffic on Intersection Classified by Type of Car

5) Result of Interview Survey

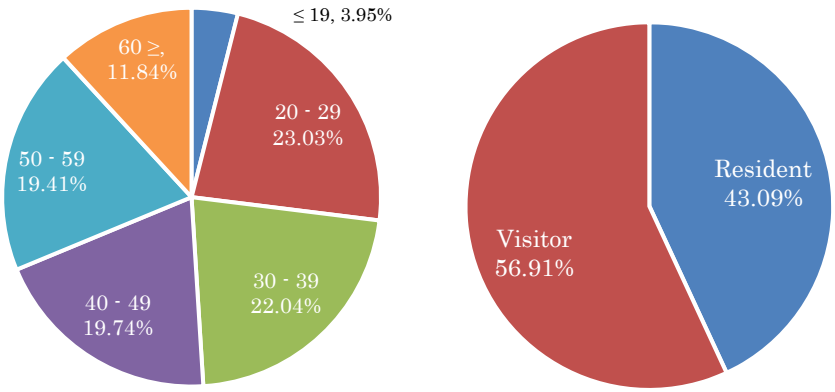
As for interview survey, 300 samples were collected to gather the opinions about Mochit 2 Bus

Terminal. The results were used to determine the adequate bus terminal location and necessary infrastructure around the new bus terminal. Questions are as as shown again in Table 4.2.7. The results are summarized in below.Basic characteristics are summarized in Figure4.2.14.

Table 4.2.7 Questions in the Interview Survey

Category	Items
Attribute	・Gender ・Age ・Vehicle ownership ・Residence
Trip Information	・Trip Purpose ・Origin and destination
Bus Usage Situation	・Frequency of use ・Transhipment to railway
Stated Preference	・Maximum walk distance ・Stated preference for each traffic mode

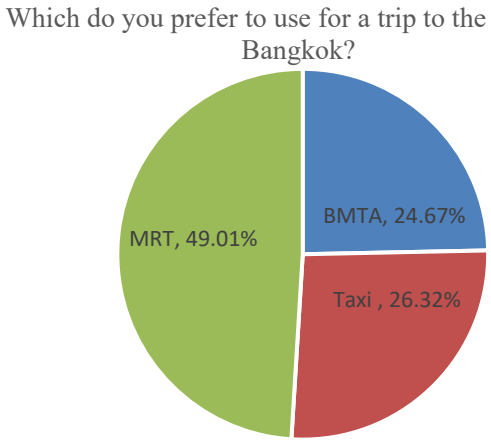
Source: JST



Source: JST

Figure4.2.14 General Attributes of Ineterviewee (Left: Age, Right: Residence)

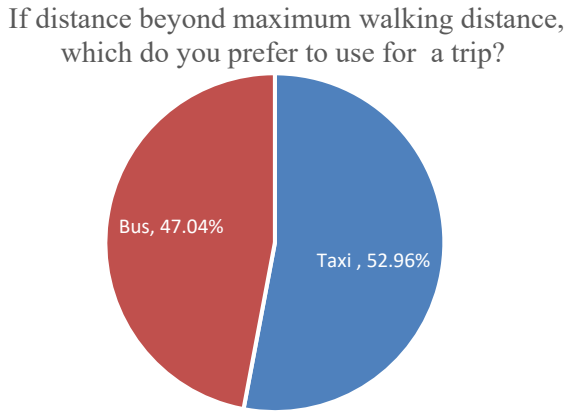
Interviewee were asked about stated preference on the traffic mode from Mochit 2 Bus Terminal to center of Bangkok. The results revealed that over a half of interviewee choosed MRT. It is assumed that MRT is preferred because is more punctual and time saving than other traffic modes. It means most of interviewee chooses the time regardless of their fare, since BMTA is generally cheaper than MRT' fare. From this result, JICA survey team suggests to make bus terminal close to a MRT station.



Source: JST

Figure4.2.15 Stated Preference for Traffic Mode Heading to Center of Bangkok

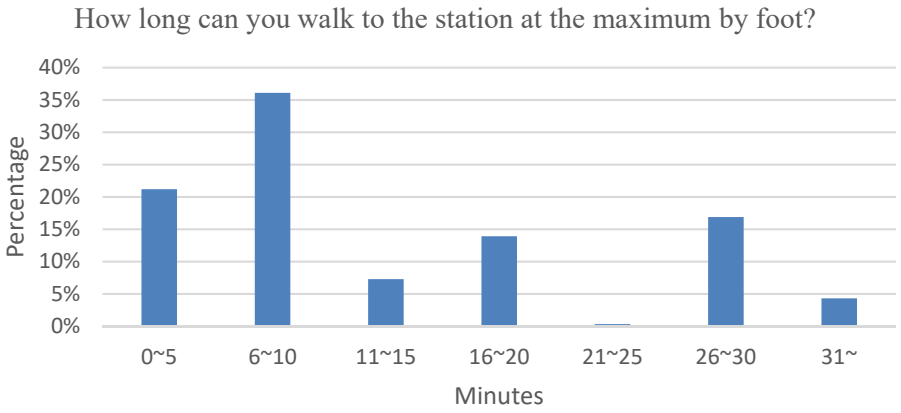
Interviewee were also asked about their stated preference on traffic mode from certain place to other places beyond the walking distance. The results revealed that 47% of interviewee choosed bus. Therefore, JICA survey team suggests to introduce bus service as inter-area transport in Bang Sue Area.



Source: JST

Figure4.2.16 Stated Preference for Traffic Mode Heading to Closest Station

Interviewee are asked about maximum acceptable walking time to the bus terminal or train station,in case of using the skywalk that covered by roof. Result is as shown in Figure4.2.17. Peak appeared in six (6) to ten (10) minutes. Avagrage walking minutes is 16 minutes. The bus terminal over than walking distance from the other public transport modes, since many people tend to use train to trips to center of Bangkok. Average walking distance should be considered in the development plan.



Source: JST

Figure4.2.17 Maximum Walking Minutes

From the result of the traffic survey on Mochit 2 Bus Terminal, findings are concluded as follows.

- An arterial road around Mo Chit 2 Bus Terminal has much more traffic flow than its capacity. Traffic congestion affect to effective bus operation.
- Impact of bus terminal is limited in terms of traffic situationthe share of in current traffic volumesmaller.
- Considering transshipment from bus to other mode, walking distance to other traffic mode should be less than 10 minutes.
- Bus terminal should be located near a train station.
- Bus terminal should be connected to route bus service operated inside Bang Sue Area.

(4) Issues of Mo Chit 2 Bus Terminal

Current issues of Mo Chit 2 Bus Terminal are summarized as follows:

1) Lack of accessibility from train, especially UMRT stations

The distance from Mo Chit 2 Bus Termninal to the nearest UMRT stations, BTS Mo Chit Station and MRT Kamphaeng Phet,is about 1.05km and 1.45km, respectively. Hence, it can be inferred that passengers transfering from Mo Chit 2 Bus Terminal to those stations are rare. Therefore, it would be necessary to relocate bus terminal to near train station to increase the number of passengers transferring between these twotraffic (2) modes.

2) Lengh of standing time

As buses are spending long time staying at platforms, by shortening the time interval, it is possible to operate with larger number of buses and smaller number of platforms effectively.

3) Congestion in surrounding area

In surrounding area of Mo Chit 2 Bus Termninal, congestion has become a chronic issue. Kamphaeng Phet Road is the arterial road in front of Mo Chit 2Bus Terminal, but congestion occurring in peak hours may affect the punctuality of the bus operation.

Source: JST

Figure4.2.18 Congestion on Kamphaeng Phet 2 Road

4) Bus depot

Short distance bus operators in Mo Chit 2Bus Termninal usemultiple places outside the bus terminal, e.g. under the space of Don Muang toll road, to park their vihecles. For long distance bus operators use a bus depot next to Mo Chit 2Bus Termninal. Area of the depot is about 3.2 ha. It could be possible to discuss the relocation of this depot ro outside of Bang Sue Area.

4.3 Status of Storm Drainage System

Storm drainage system is managed by Department of Drainage and Sewerage, Bangkok Metropolitan Administration (BMA).

Bang Sue Area is in the basin of Chao Praya River. However, as Bangkok's geography is generally flat and average altitude is arroximately 0 m, the drainage network using natural water body and channel to discharge storm water toChao Praya River can work only in low tide period. Therefore, normally, pumping stations and water gates are used to discharge stormwater to river. Moreover, trunk drain pipes that directly connect to river are planned to be installed under the ground of Bang Sue Area.

The drainage system is as shown inFigure4.3.1, Figure4.3.2, Figure4.3.3, Figure4.3.4 and Figure4.3.5.

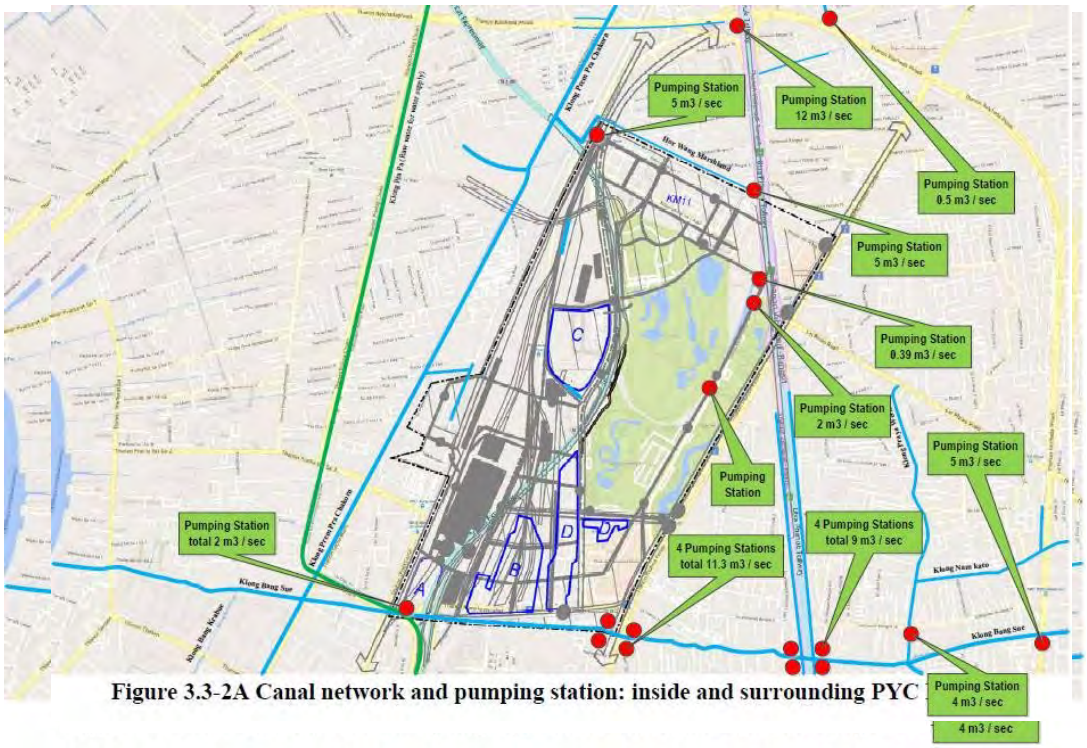
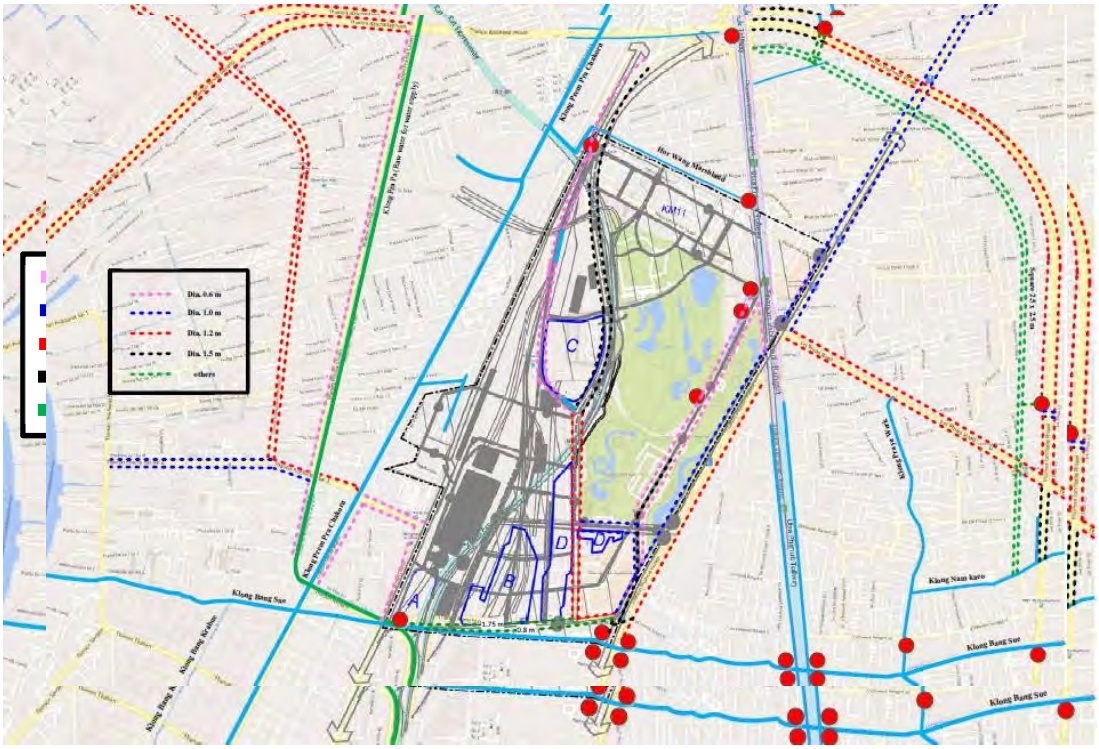


Figure 3.3-2A Canal network and pumping station: inside and surrounding PYC

Source: JST

Figure4.3.1 Canal Network and Pumping Station

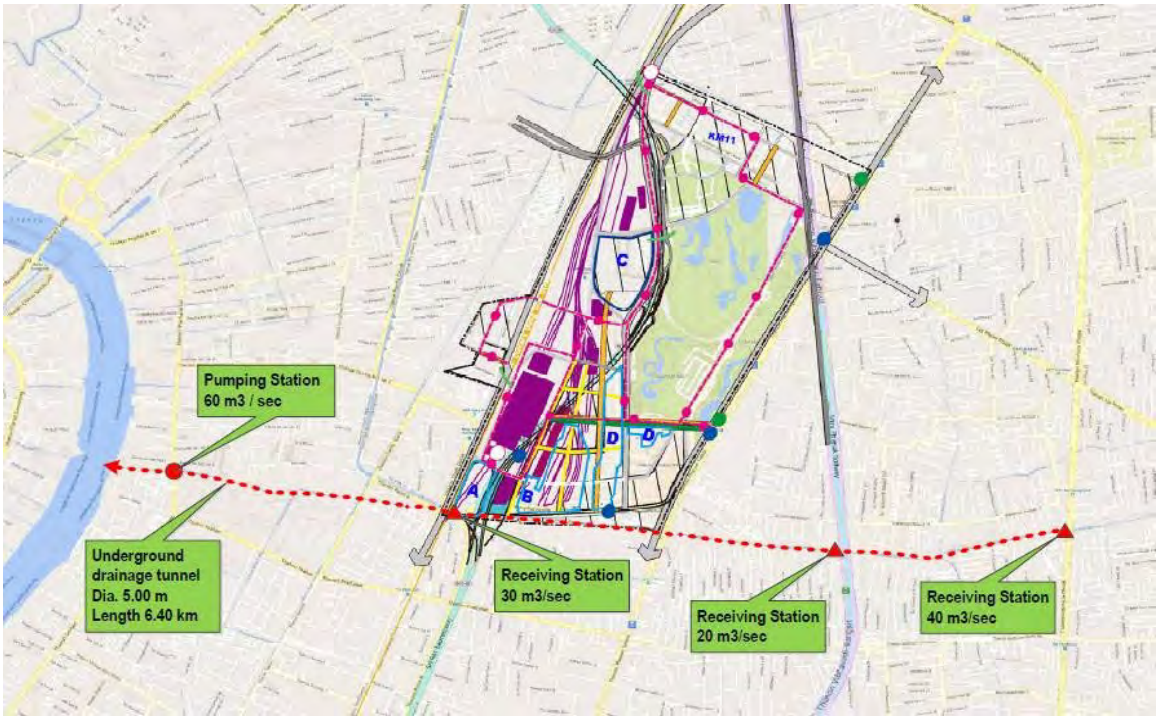


Source: JST

Figure4.3.2 Drain Pipe Network (Existing)

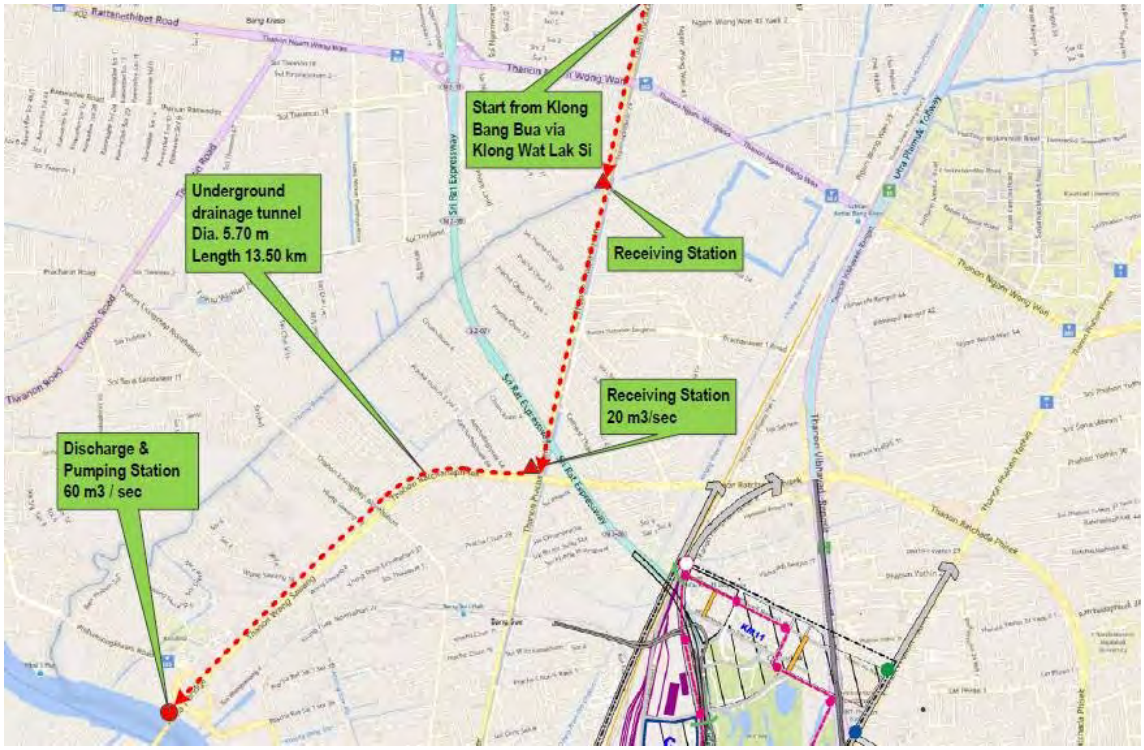
Source: JST

Figure4.3.3 Klong Prem Pra Chakon Trunk Drain Pipe (Opened in 2001)



Source: JST

Figure4.3.4 Beneath Klong Bang Sue Trunk Drain Pipe (under Construction)



Source: JST

Figure4.3.5 Klong Prem Pra Chakon / Klong Bang Bua Trunk Drain Pipe (under Detailed Design)

4.4 Status of Water Supply System

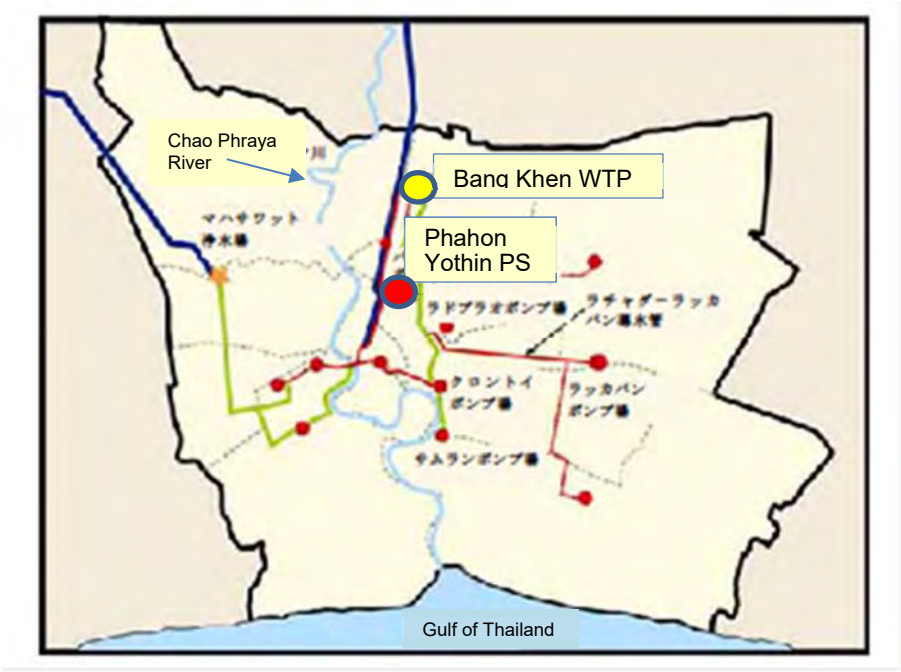
Water supply system in Bangok is managed by Metropolitan Waterworks Authority(MWA). The status of Region 2, which covers Bang Sue Area and is managed by Phaya Thai office, is as as shown inTable4.4.1.

Table4.4.1 Water Supply in MWA Region 2

No.	Items	Description
1	Supply area	60.91 km2
2	No. of contracts	88,281
3	Annual supply volume	127.117 million m3
4	Water leakage ratio	23.36%
5	Total length of pipeline	approx. 1,389km

Source：MWA yearly report（2015）

Water supply network of Bangkok is as as shown in Figure4.4.1. The coverage of water supply system in Bangkok is 98%. Water supply for Bang Sue Area is treated at Bang Khen WTP (3.9 million m3/day) and delivered from Phahon Yothin Pump Station.



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Source: JST

Figure4.4.1 Water Supply Network in Bangkosk

Bang Khen WWT is as shown inFigure4.4.2.

Source: JST

Figure4.4.2 Bang Khen WTP

For water quality in Bangkok, the water treated at WTP sastisfies a certain standard for drinking water, but the quality is delining as it flows through pipeline or stored at water tank, thus, the water from household taps is not drinkable anymore. Instead, people in Bangkok buy drinking water from bottled water or tanked water sold at vending machine, or, purified water by purification machine. Water rates per squremeter is about from 8.50 to 14.45 Bahts. As shown in Table4.4.2, the water rates are defined depend on consumption volume.

Table4.4.2 Water Price (MWA)

Household		Commercial, Government, Industry	
Consumption Volume (m^3)	THB/m^3	Consumption Volume (m^3)	THB/m^3
1-30	8.50	0-10	9.50
31-40	10.03	11-20	10.70
41-50	10.35	21-30	10.95
51-60	10.68	31-40	13.21
61-70	11.00	41-50	13.54
71-80	11.33	51-60	13.86
81-90	12.50	61-80	14.19
91-100	12.82	81-100	14.51
101-120	13.15	101-120	14.84
121-160	13.47	121-160	15.16
161-200	13.80	161-200	15.49
over 200	14.45	over 200	15.81

Source: MWA

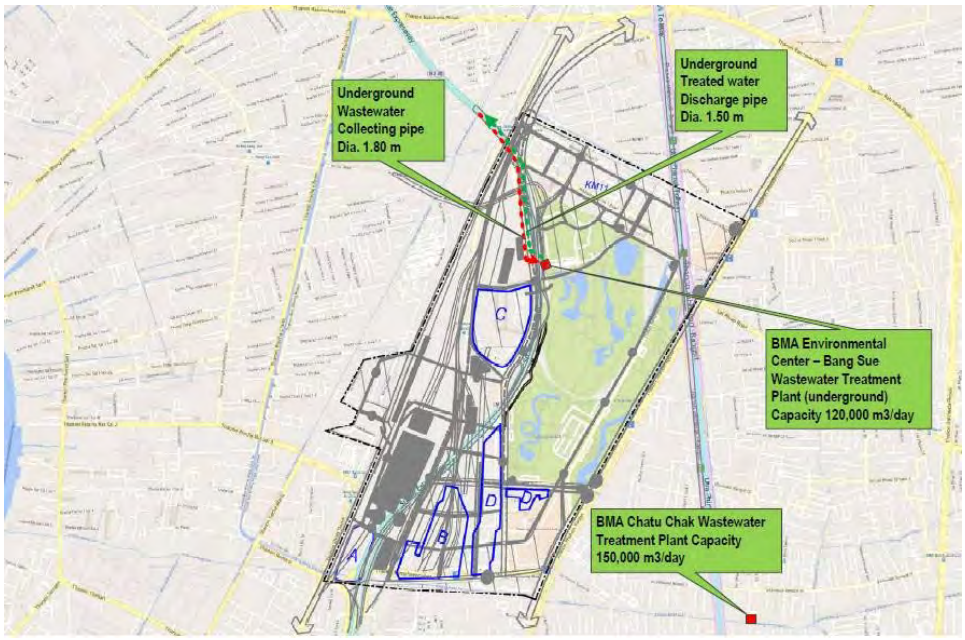
4.5 Status of Sewerage System

The sewerage system in Bangkok is managed by Department of Drainage and Sewerage, Bangkok Metropolitan Administration (BMA). In the neighborhood of Bang Sue Area, there are two wastewater treatment plants (WWTPs) which are described as follows:

Table 4.5.1 Overview of WWTP in the Neighborhood of Target Area

No.	Facility	Capacity	Remark
1	Bang Sue WWTP	120,000 m^3/day	In December 2016, the WWTP is already operating at its full capacity. However, according to BMA, its capacity can be increased to 200,000 m^3/day if the facility is improved.
2	Chatuchak WWTP	150,000 m^3/day	As this WWTP is located upstream of the target area, it is not economical to consider this plant for development in the target area.

Source: JST



Source: JST

Figure 4.5.1 Location of WWTPs in Neighborhood of Bang Sue Area

Bang Sue WWTP(Figure 4.5.2) started its operation in 2012 as the latest facility in Bangkok. The characteristics of the Bang Sue WWTP are: that most of the main facilities for water treatment are settled underground; and Bang Sue Environmental Education and Conservation Center (Bang Sue EECC) has been constructed on the ground. Treated water is used for water-friendly pond in the area of Bang Sue EECC.

Source: JST

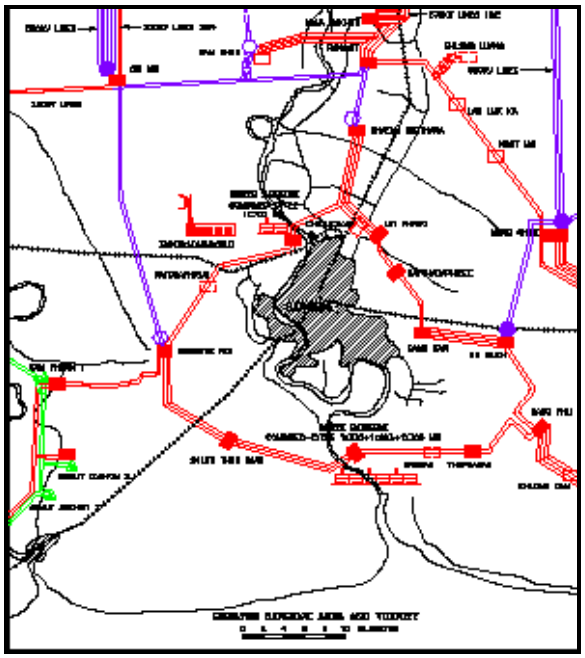
Figure 4.5.2 Bang Sue WWTP

4.6 Status of Power Supply and Distribution Infrastructure

In Thailand, there are three major power suppliers: Electricity Generating Authority of Thailand (EGAT), Metropolitan Electricity Authority (MEA), and Provincial Electricity Authority (PEA). EGAT is a state enterprise managed by Ministry of Energy (MOE), which is responsible for power generation and supply throughout the country. MEA is responsible for power distribution in Bangkok Metropolitan Area. PEA is responsible for power distribution in all 72 provinces except for those in the service area of MEA. PEA also promotes electrification in rural villages. Both MEA and PEA are state enterprises under the Ministry of Interior (MOI). The provision of infrastructure for power generation and distribution in Bangkok is managed by MEA. The power supply network in Bangkok (220 kV) is as shown in Figure 4.6.1.

In Thailand, Small Power Producers (SPP) Program was introduced in 1992. Through this program, the Government of Thailand aimed to: 1. Improve the efficiency of energy use by utilizing by-product of common power source and renewable energy, and 2. Reduce usage and import of oil.

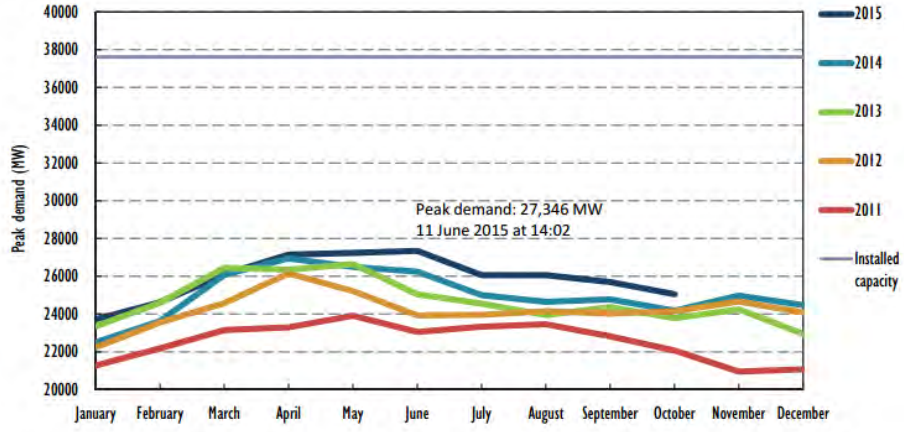
SPP will apply to projects of EGAT, and if the project sastifies a certain standard, it will be approved as an SPP project. The prices of generated power and other selling conditions are given by EGAT at the time of application. For SPP, who joins the program, EGAT will ensure to purchase the generated power up to 90,000 kW. SPP can sell the rest of electric power and heat (steam, cooling water) to manufacturers in industrial zones or other customers, independently.



Source: JST

Figure4.6.1 Power Distribution Network of Bangkok

Figure4.6.2shows the trend of power generation capacity and consumption in 2015. At peak season, i.e. April, it still hasremaining capacity which is about 25% of installed capacity.



Source: EGAT (2016), "Grid governance and management", presentation to IEA Review Team.

Source: EGAT

Figure4.6.2 Power Demand and Supply

As shown in Table4.6.1, electricity prices are defined depend on voltage and used volume. The rate per kwh is about 3.2 – 4.4 Bahts.

Table4.6.1 Electricity Prices

Voltage	Used volume	(Bahts/kwh)
12-24kV	No limit	3.9
Less than 12kV	Less than 150kWh	3.2
	151kWh - 400 kWh	4.2
	More than 400 kWh	4.4

Source: MEA

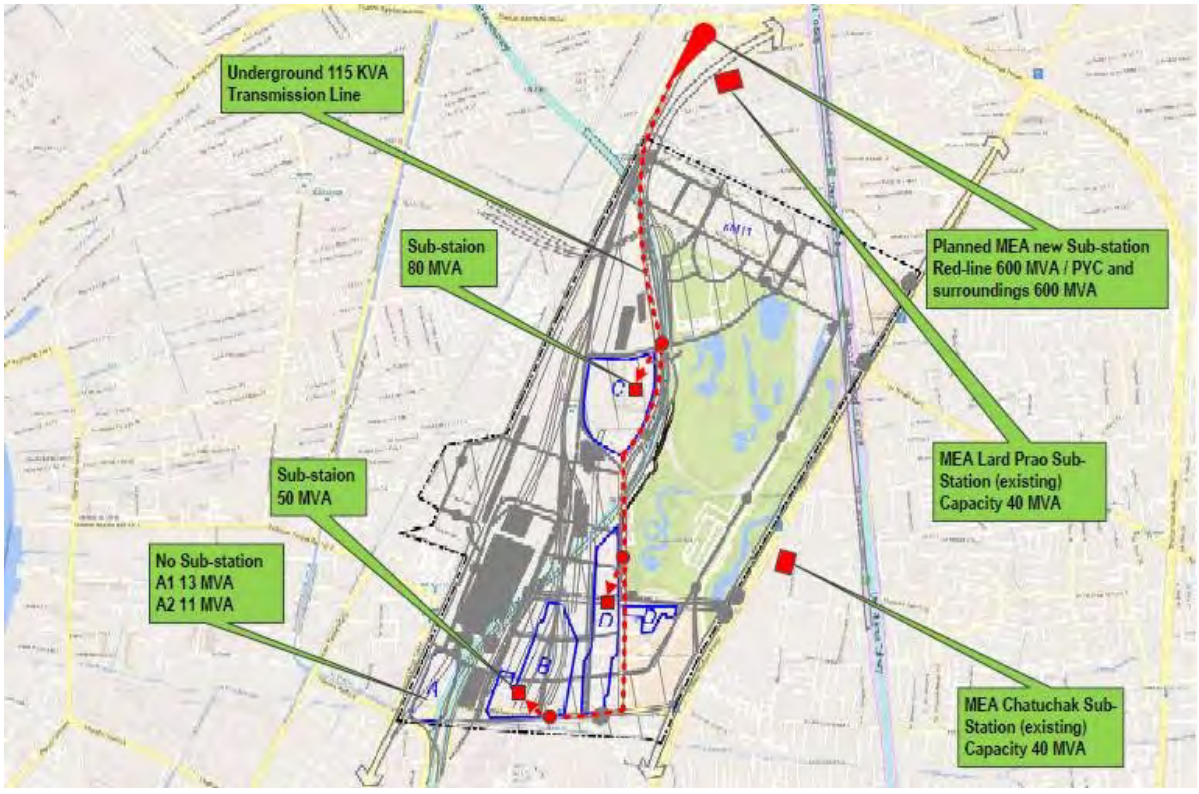
In the Bang Sue Area and its surrounding area, electricity is supplied through two sub-stations which are managed by MEA. In addition, a new substation, having an area of about 6,400 m^2 in the Bang Sue Area, is planned under the agreement between SRT and MEA.

The overview of substations is as shown in Table 4.6.2 and their locations are as shown in Figure 4.6.3.

Table 4.6.2 Overview of Substations in Surrounding Target Area

No.	Facility Name	Status	Capacity	Operation Rate	Remarks
1	Lard Prao Substation	In service	40 MVA	50%	Remaining capacity of two substations is 40 MVA
2	Chatuchak Substation	In service	40 MVA	50%	
3	EGAT Chatuchak High-voltage Substation	Planning		—	—
4	MEA Substation (for Red Line, ARL)	Composing detailed plan	600 MVA	—	Construction starts in 2017 and is expected to be carried out for three years.
5	MEA Substation (for urban development in surrounding area of Bang Sue Station)	Planning	600 MVA （＋ 300 MVA）	—	・Reserve capacity of ＋300 MVA. ・Power transmission lines in Zone-B, C, D are expected to be installed underground. ・Transmission line: 115 KVA ・Duct's diameter：1.8 m

Source: JST



Source: JST

Figure 4.6.3 Transmission Lines and Substations Planned to be Constructed in Target Area

In Thailand, solar PV rooftop feed-in tariff (FIT) policy was announced in 2013. It is stated that power generated from solar PV installed on commercial/residential rooftop and governmental rooftop shall be purchased up to 100,000 kW and 800,000 kW, respectively. As the quota for commercial/residential rooftop has already reached to full capacity, the remaining applications are for government buildings rooftop only. According to MOE, it is planned to stop FiT for solar PV; instead, FiT for liquefied natural gas (LNG) generation is being considered as LNG is more economical choice at the present time. Therefore, in the future, residential self-consumption will be the main demand for solar PV power.

Thailand has rich amount of solar radiation, about 1.5 times of that of Japan (1,000 kW/m^2). As solar panels work more efficient under lower temperature, however, the temperature is high throughout the year in Thailand. Thus, scale of a solar panel must be 1.3 times in Thailand in order to reach the same storage level as in Japan.

In Thailand, solar power is not very popular in general and the panels are installed in some condominium/apartment/factory/hospital/large-scale commercial buildings only. In addition, it takes a long time to apply and obtain approval on installation from the government, which resulted to the slow growth of solar power utilization in Thailand.

4.7 Status of Oil and Gas Pipelines

In the target area, there is one oil pipeline and one gas pipeline. The overview of these facilities is as shown in Table 4.7.1 and Figure 4.7.1. However, gas pipeline is for business use only. In Bangkok, piped gas is not supplied to each household, instead, people use propane gas.

Table 4.7.1 Overview of Oil and Gas Pipeline in Surrounding Target Area

No.	Type of Pipeline	Owner	Remark
1	Oil pipeline	Fuel Pipeline Transportation Limited (FPT)	Supply for Don Muang Airport
2	Pressurized natural gas pipeline	PTT Public Company Limited	・Installed underground ・Diameter: 300 mm ・At present, 300 MMscfd *1(1.17 MPa)

*1：MMscfd: Million standard cubic feet per day, is a unit of measurement for gases.
Source: JST

Source: JST

Figure4.7.1 Location of Oil and Gas Pipeline in Surrounding Target Area

4.8 Waste Treatment

Waste treatment in Bangkok is managed by Department of Environment, Bangkok Metropolitan Administration (BMA). In Thailand, waste is categorized into three (3) major groups: conventional waste, industrial waste and infectious waste. They have three (3) treatment methods: incineration, landfill and recycling.

Bangkok is divided into 50 sub--districts. From 8p.m.a.m. to 3p.m.a.m. everyday, garbage trucks patrol around the city to collect waste from collocting points. The collected waste is hauled to one of the three (3) transfer stations (Sai Mai, Nongkham, On Nuch) where waste is classified into conventional waste, dangerous waste from hospitals and factories, and recycling waste. Then, it is treated either by recycling or pressurization/incineration. After that, treated waste will be transported to final treatment sites in Nakhon Pathom Province or Chachoengsao Province Phanom Sarakham District for landfill.

4.9 Smart City

4.9.1 Existing Plan by PTT

Bang Sue Area is one of the ten (10) candidate districts selected by Government of Thailand to promote a model of Smart City. The model must improve the energy efficiency of its area in water supply, gas, power, heat supply and cogeneration. PTT cooperated with Chulalongkorn University to compose a conceptual plan of Smart City for Bang Sue Area. major points of this plan are described in the following parts.

(1) Mass Rapid Transit (MRT)

Bang Sue Area will be planned to construct MRT and monorail so that public transport accessibility is expected to become much better and convenient for visitors. As te result, the number of vehicles inside

the area may decrease and traffic congestions may be eased.

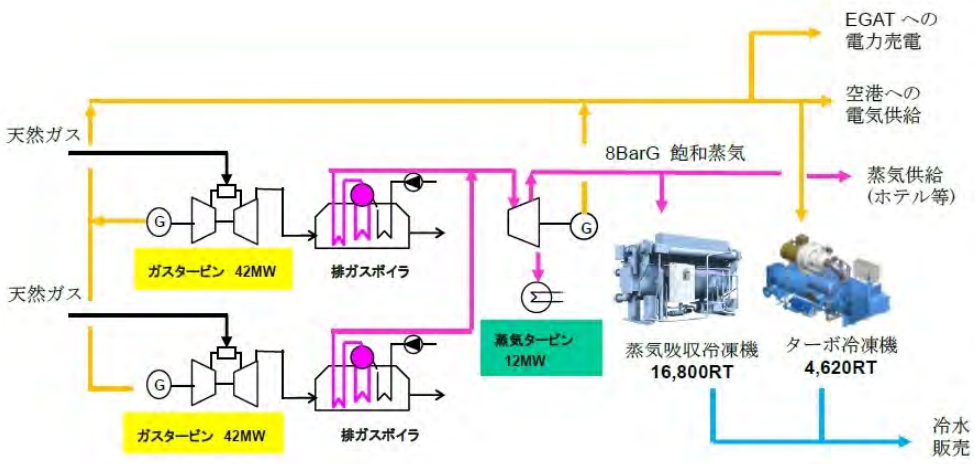
(2) Provision of Wi-Fi

Free public Wi-Fi will be provided in Bang Sue Area. Wi-Fi is not only for accessing to internet but also for supporting society in distributing application and service. also, it would be possible to maintain and operate the Wi-Fi efficiently. Wi-Fi will become a social infrastructure which will help utilize big data and open data as “Data resources”. This new resource will generate innovations in service, industry and social activities.

(3) District Cooling System

District cooling system will be introduced in Bang Sue Area and solar panels will be installed at various places. Public common ducts are planned to accommodate smart grid, gas pipes and underground cooling pipes.

In Thailand, there is a FIT policy for electricity generated by cogeneration to be purchased at fix tariff. It is becomingpopular for industrial facilities. For example, in Suvarnabhumi Airport, gas turbine cogeneration is used, exhaust heat is used for vapor absorption refrigerator to provide cool water. This system is very efficient as it is not only supplingies electricity for the airport, sells electricity to EGAT, but also supply vapor for hotels, and sells cool water.



Source: Survey on Technology Introductionin Reduction of Carbon Dioxidefor Realizing a Low-carbon Society in Asia in 2018

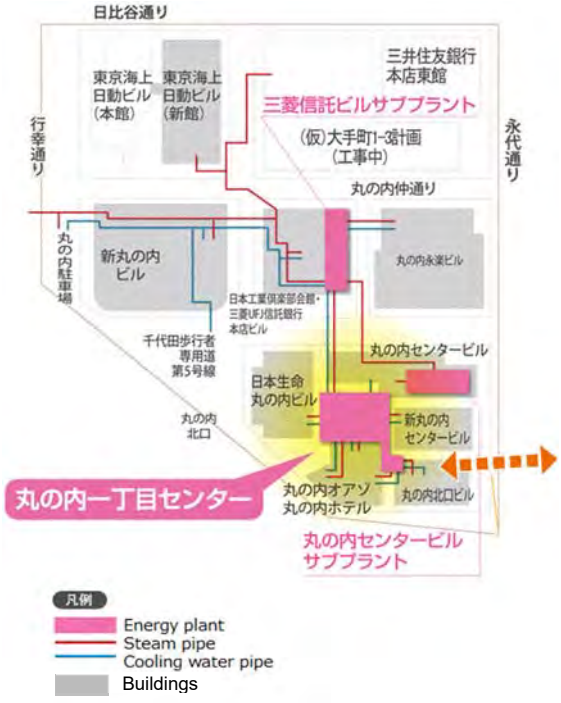
Figure4.9.1 Cogeneration and District Cooling System in Suvarnabhumi Airport

4.9.2 District Cooling System / Cogeneration

(1) Overview of District Cooling System / Cogeneration

Interms of an area where cooling water is supplied, the area with larger Floor Area Ratio (FAR) will be prioritized and energy center will be located at near a building with largest heat demand. Pipelines will be arranged near the center of heat demand in each building so that distance to each target building is uniform and from supply trunk pipes from energy center can supply for multiple buildings. In case there are multiple targets in the supply area, distributed system with sub plant will be considered. In the area with large number of small buildings which haves relatively small FAR and total floor area less

than 3,000 m2, in order to save the cost of construction common utility, heat source for each building can be considered. However, in case of underground floors of large buildings are connected to buildings around, district cooling will be considered even for small buildings. In pipeline arrangement, trunk pipes will be installed in common ditch or common underground floor as it would be easy for mantenance, and branches to each building will be buried to save construction cost of big common ditch. In Bang Sue Area, on vacant lot, open-cut method will be used while on buildings or deeper location where it is difficult for open-cut, jacking method or shield method will be used for open common ditch (or service tunnel).



Source:Marunouchi Heat Supply Co., Ltd.

Figure4.9.2 An Example of Pipeline Arrangement for District Cooling System

For district cooling heat source to use waste heat from cogeneration more efficiently, Absorption Chiller Heater with Auxiliary Waste Heat Recovery (GENELINK) is considered. To respond to the fluctuation of demand or heat supply from cogeneration, it is considered to install turbo cooling machines which have large capacity and high efficiency. Either absorption cooling machine or turbo cooling machine is in part-load operation, and for entire operation, high efficiency is maintained by using machines with high Integrated Part Load Value (IPLV) and capacity demarcation. In addition, if there is demand for vapor, e.g., hotels near the location of heat source, supply of vapor from wasted heat of cogeneration shall also be considered. To deal with the peak-load in midday, heat storage tank shall be considered, and it shall also be used as water tank for firefighting or emergency.

(2) Overview of Basic Framework of Developing Cogeneration and District Cooling System

The overview of basic framework of developing cogeneration and district cooling system in Bang Sue Area is considered as follows:.

1) Energy Infrastructure for Target Facilities

The type of energy needed for each facility is listed in Table4.9.1. For vapor supply, except for hotels, it may be used for vapor absorption cooling machine installed in some buildings; however, demand is expected to be small. In case of newly constructed buildings, main demand must be cooling water supply to each building. Considering the cost of constructing distribution pipeline to each zone, cooling by independent heat source will be applied in case that the target buildings are located too far from the energy center or buildings are too small.

Table4.9.1 Energy Needed for Each Type of Facilities

Type	Assumed Energy
Office, Government Building	Cold Water, Electrical, Water supply and sewage system, Telecommunications
Commercial Building	Cold Water, Electrical, Town Gas, Water supply and sewage system, Telecommunications
Hotel	Cold Water, Vapor, Electrical, Town Gas, Water supply and sewage system, Telecommunications
Condominium	Cold Water, Electrical, Town Gas, Water supply and sewage system, Telecommunications
Convention Center	Cold Water, Electrical, Water supply and sewage system, Telecommunications

Source:JST

2) Types of Supply and Installation Plan

There are three types of systems for district heating and cooling supplying in Japan, i.e., 1) heat supply project type, 2) concentration plant type, and 3) inter-building type. These types are selected based on the building's function, scale, heat demand, distance to energy center, and route of district pipeline. The location of energy center would be selected to be near the building with highest heat demand or at the center of a group of relatively big buildings.

Table4.9.2 Types of Supply

Classification	Scale	Agreement	Supply Entity	Supply Form	Others
1. Heat Supply Business Type	Large	Supply Regulation based on the Law of Heat Supply Business	Hear Supply Business Person based on the Law	Supply Duty based on the Law of Heat Business	Permission of Road Occupancy is handled conformed to Road Occupancy
2. Central Plant Type	Middle to Small	Agreement on Supplier and Consumer	Energy Supply Business Person based on Agreement	Supply Duty based on Agreement	Permission of Road Occupancy is possible on the system
3. Buildings Accommodation Type	Small	Mutual Agreements in each Building owners	Plural Building Owners	Decision by mutual Agreements	Permission of Road Occupancy is possible on the system

Source:JST

3) Considered Main Instruments and Facility System

Main instruments and facility system for energy infrastructure of Bang Sue Area are considered in Table4.9.3. Cogeneration, which higher energy efficiency and absorption cooling machine using GENELINK with higher COP, shall be applied.

Table4.9.3 Main Instruments and Facility System

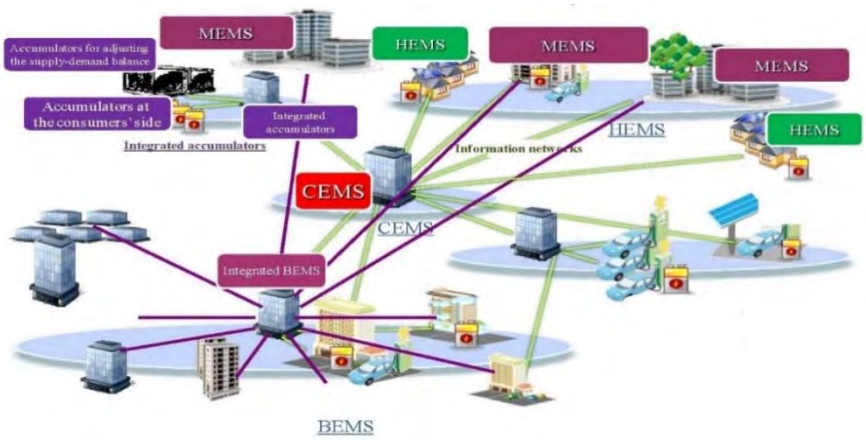
Main instruments	Facility system
Natural gas cogeneration	Highly efficient machine that is fueled by natural gas distributed by gas pipe of PTT nearby Bang Sue Area will be used. Gas engine and gas turbine are two of the main types of cogenerations. As in Bang Sue Area, heat demand is mainly for business and commercial

Main instruments	Facility system
	use while demand for industrial use are relatively low (thermal electric ratio is low), from the perspective of total efficiency, gas engine is being considered. Brief specs：Generation capacity 5,200～7,800kW (for reference)  Highly efficient gas engine cogeneration by K company (for reference)
Vapor firing GENELINK absorption cooling machine	Equipped with GENELINK using vapor from cogeneration and natural gas, used as base machine for operation Brief specs：Cooling capacity 281～3,517kW（1,000USRT, JIS Standard COP1.43 (for reference)  Highly efficient GENELINK absorption cooling machine by K company (for reference)
Inverter-Turbo-cooling machine	Equipped with part load high efficient inverter, it will follow the fluctuation of heat load. Combined with absorption cooling machine as an entire heat source, it will control the operation to minimize total energy Brief specs：Cooling capacity 500～5,400USRT,COP6.5 (for reference)  Highly efficient Inverter-Turbo-cooling machine by M company(for reference)
Cooling water heat storage tank	Introduced for peak-cut of maximum load in day time. Also can be used as water tank for daily use or firefighting in emergency situation to save construction cost. Brief specs：Constructed on-site
Renewable energy facility	Install solar power generation facilities in vacant areas or on rooftop. Can also be used as a dispersed power source for households.
Regional delivering pipe	Trunk pipe of cooling water and vapor are SGP of utility corridor, buried pipes are prefab pipes.

Source: JST

4.9.3 Energy Management System by Communication Infrastructure and Smart Grid

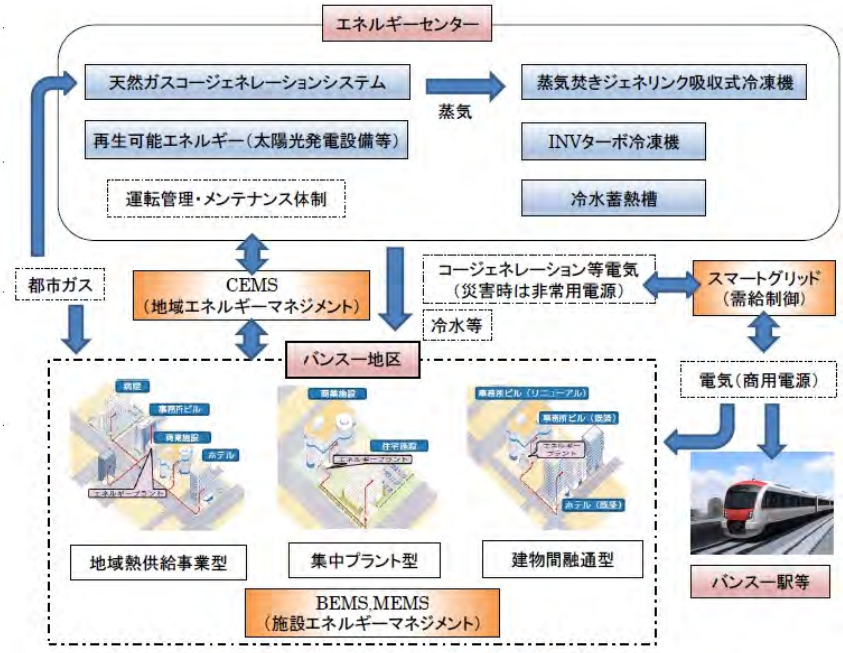
Energy management (CEMS, BEMS, and MEMS) and smart-grid are introduced as part of Smart City technology. By introducing BEMS in buildings, e.g., office, commercial buildings, and condominiums, it would be possible to optimize energy use for each building. Also, CEMS shall help control energy data in facilities, cogeneration of energy center, and supply-demand of district cooling system. Thus, it is possible for energy use optimization at a district level.



Source：METI

Figure4.9.3　Image of Energy Management System

Image of energy infrastructure system is as shown in Figure4.9.4.



Source: METI

Figure4.9.4　Image of Energy Infrastructure System

To select whether thermal or electric energy shall be the main power source, it must be necessary to consider the ratio between thermal and electric energy to be use of facilities which are expected to be constructed in Bang Sue Area. Electricity will be generated by cogeneration as a base and supplement and commercial power supply shall be controlled by grid. In addition, operation of cogeneration and heat sources shall be optimized by CEMS and BEMS by utilizing the data on energy demand in each facility and the whole area.

Development policies to implement the concept are described below:

① Commercial power supply in redeveloped area shall be distributed depending on power demand

after smart grid adjusts the supply-demand balance.

② Making electricity and cooling water interchangeable based on building scale and electric-heat demand (heat supply project type, concentration plant type, and inter-building type)

③ Optimizing energy system by installing CEMS, BEMS, and MEMS to control energy use in the area, in office buildings, commercial buildings, or residential buildings

④ In case of power cut due to disaster, electricity shall be generated by cogeneration using town gas

⑤ The arrangement of utility common duct accommodating pipes for heat supply, gas, water supply and power supply, must be planned with consideration on density of supply area, road arrangement, and flexibility in case of degradation or urban re-organization

⑥ Currently, according to Bangkok Comprehensive Plan 2013, it is regulated to install cogeneration in Bang Sue Area as it is a commercial area. It needs the help of authorities to make necessary procedure to install the cogeneration plant in Bang Sue Area.

4.9.4 Energy Infrastructure (Electricity, Town Gas, Water, Communications etc.)

(1) Electricity

Capacity and arrangement plan of cogeneration shall be decided with consideration on heat supply and balance. Cogeneration power source is connected to commercial power supply system, so that it can be used as an emergency generator during electricity outage. Also, capacity of cogeneration will be decided based on power demand, commercial electricity rate, and gas prices. The remaining electricity can be sold via SPP program.

(2) Town Gas

There is a town gas pipelines near Bang Sue Area. In the future, it should be branched to each building.

(3) Water Supply and Sewerage

This will be developed based on standards of management authorities.

(4) Communications (for Infrastructure Related to Energy)

Introduction of CEMS and smart-grid is considered as a part of Smart City. In Japan, there are some examples in which the systems are installed by manufacturers' initiative. In addition, by introducing BEMS and MEMS in buildings, e.g., office, commercial buildings, condominiums, it would be possible to optimize energy use for each building, and for district level if CEMS is introduced.

(5) Common Duct

Common duct is constructed mainly for installing cooling water and vapor pipeline. Depending on the construction conditions, e.g., location and diameters, cooling water pipes can also be buried. Town gas, water supply, and sewerage pipeline will be installed following the standards of management authorities; however, in order to save cost of tunnel opening and make it easier for maintenance, in some cases, they shall be installed collectively with another infrastructure. Infrastructure of communication will shall utilize common duct as much as possible.

On 30 June 2016, MEA, in cooperation with TOT Public Company Limited, announced that they

shall implement a project to bring power transmission lines and communication lines underground. According to this announcement, THB 51.7 billion (approx. JPY 150 billion) shall be invested and at the end of 2020, along the major roads in Bangkok Metropolitan Region (Rama-Ⅲ Road, Rama-Ⅳ Road, Ratchada Road, etc.), there would be 127 km of utility corridor to be constructed.

(6) Others

Renewable energy and energy saving is also considered. If there is an available space, installation of solar panels shall be considered on rooftop, solar hot water system or solar panels shall also be considered. Also, to obtain FAR bonus as described by urban planning law, energy saving green building shall be built.

4.9.5 Smart Transportation

In developing the concept of Smart City, smooth traffic management is important. Therefore, it would be important to use ITS to control traffic flows smoothly. ITS items, which is applicable to Bang Sue Area, are listed below. In Thailand, there is an ITS Masterplan 2012-2017, and below items are proposed upon consideration of ITS described in the master plan:.

(1) Provision of Road Traffic Information

For road traffic information, traffic volume could be collected by using probe data or devices installed on gantry. As for probe data, it is collected by the global positioning system (GPS) installed on probe vehicles and processed at data centers. Besides measuring traffic volume, it would also be possible to introduce a system for predicting congestion length by calculating road occupancy.

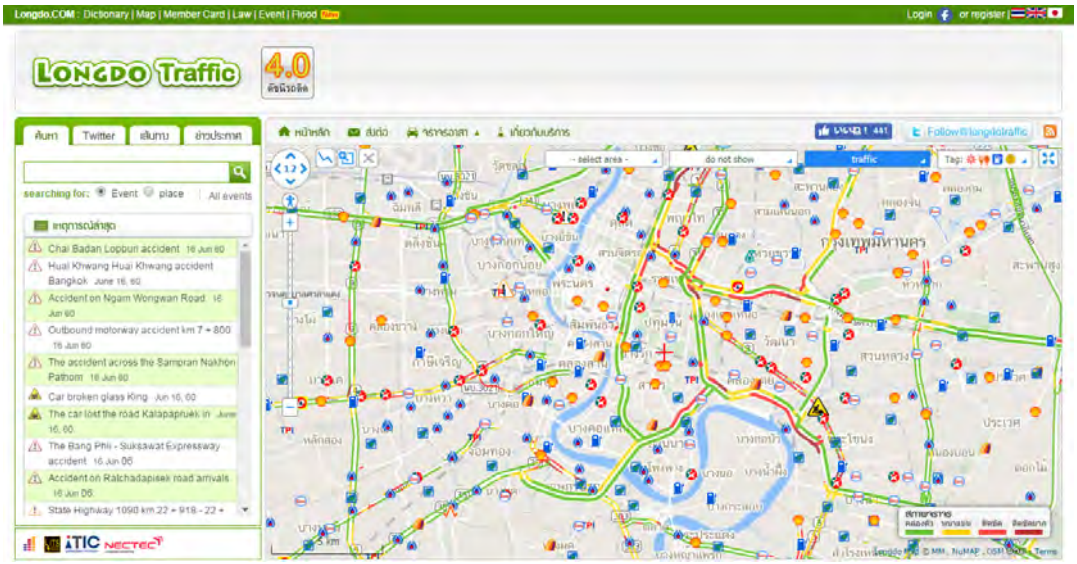
For traffic volume measurement, up to now, Thailand has introduced the following methods:

Firstly, the MOT and Ministry of Communication (MOC) implemented a project that installs GPS on 700 taxis to collect and analyze probe data. As a result, 10,000 taxis in Bangkok were installed with GPS, collected data on congestion are provided via an application named T-Square.

In terms of collecting data using devices on gantry, it may be possible to be installed, as Expressway Authority of Thailand (EXAT) is using closed circuit television (CCTV) to measure traffic volume. Traffic information collected by EXAT is publicized on multiple pages like BKKTraffic.com, BMA Live Traffic, and Longdo Traffic/Traf.

For either of the systems above, it is not expected that the system shall uniquely cover only the traffic information in Bang Sue Area, but it should be an extension of the existing system already covering for Bangkok. The reasons are that for road users, traffic information outside Bang Sue Area is also useful, and it would save cost for installing new system or new traffic control center.

Also, at present, collected traffic data in Bangkok are available on the internet but it would be necessary to provide traffic data to road users in Bang Sue Area on Variable Message Sign (VMS) and information devices in the district. Examples of VMS installation are that EXAT and BMA installed information board in front of the expressway toll gates to provide traffic information to users, such as congestion level (Green: normal, Yellow: low speed, Red: congested), and estimated travel time. In Bang Sue Area, if information board is installed in front of major intersection, road users may change their behaviors and thus, it would contribute to ease traffic jams.



Source: iTIC

Figure4.9.5 Traffic Information Provision through Internet

(2) Public Transportation Priority System (PTPS)

By introducing Public Transportation Priority System, which will prioritize public transportation vehicles like buses, it would reduce the burden on public transportation operation and increase the convenience by warranting the punctuality of the service. The same system has been stated in OTP report and has been proposed to ensure the smooth operation of the BRT. The overview of PPTS is as shown in Figure4.9.6

Source：OTP

Figure4.9.6 Overview of PPTS

(3) Signal Coordination System

This system will set signal timing based on traffic situation and coordinate among signals to control the traffic flow in the city. Particularly, it will modify the length of cycle in peak-hours and off-peak hours, also, it will modify the length of green time of successive signals. At present, in Bangkok, although the length of cycles is pre-set, policemen still should switch the signals manually to respond to the traffic situations. In addition, by installing Emergency Vehicle Preemption System (FAST), it is expected that emergency vehicles would be prioritized to pass quickly to increase the survival rate, crime

clearance rate and prevent traffic accidents at the intersections, in cases of emergency service response.

Normally, traffic signals are managed by police; hence, it is necessary to collaborate with them to implement this concept. In Bangkok, installation, maintenance, and management of CCTV as part of the existing ITS facility, are the responsibilities of BMA and operated by the police.

(4) Parking Information System

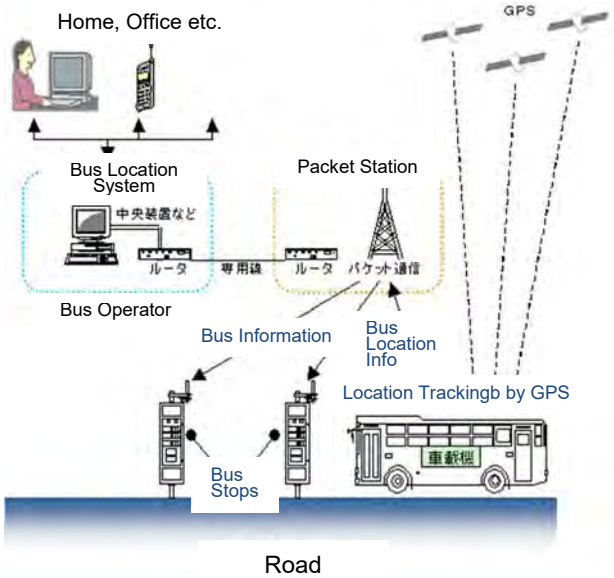
Parking information system will utilize data from ITS to provide availability and price of parking lots for drivers. This system is expected to guide drivers to appropriate parking area, eliminate illegal parking, and reduce the traffic of cars searching for parking. Information will be provided via cellphones, road signals, community antenna television (CATV), and car navigation. Image of parking information provided on the vehicle information and communication system (VICS) in Japan is as shown in Figure4.9.7.

Source：Urban Development Bureau of Tokyo

Figure4.9.7 Image of Parking Information Provided on VICS

(5) Bus Location System

The system will provide information of the bus location on the information boards at bus stops and internet, so that the passengers can know the arrival time and current location of a bus. This system may be suitable for Bang Sue Area for circulating buses and inter-city buses by BMTA. The information can be provided through information boards installed at bus stops or to passengers via internet.



Source: MLIT

Figure4.9.8 Image of Bus Location Systems

(6) System for Information Provision

This system will inform the traffic situation and departure/arrival of taxi. This system will use the same devices with road traffic information provision system shown in Figure4.9.8. However, besides road traffic information, information on taxi booking, weather, flooding information in case of heavy rain, and local shops in Bang Sue Area would also be provided. Firstly, providing taxi booking system via cellphones or devices installed in the neighborhood will increase the convenience for this mode. Along with information provision system, it is expected to provide useful information for road users.

(7) Common Smart-card

Common Smart-card is proposed to be used for renting bicycles and for circulating buses. At present, for both BTS and MRT, IC cards are used but they are not interchangeable. If IC cards for trains are unified and integrated with payment function for shopping or for use in buses in Bang Sue Area, it would be more convenient for usersce.

(8) Autonomous Driving

In recent years, autonomous driving has been steadily developed, mainly in European countries. In France, according to the roadmap of Autonomous Driving Program, it is expected that autonomous small buses, large buses, and trucks would be on public road from 2020. From this fact, it is also expected that self-driving buses shall be operated in Bang Sue Area in future.

4.9.6 Disaster Prevention

The main disaster in Thailand is flooding occurring during heavy storm. The most recent large-scale flood occurred in 2011, in which, flooding and landslides spreading over the north, northeast, and central regions of Thailand. It is reported that flood is caused by heavy storm during typhoon which increases discharged water volume from dam in the north and causes storm surge.

Flooding measures in Thailand are as follows.

(1) Current Flooding Measures in Bangkok

Flooding measures in Bangkok consist of soft-measures and hard-measures. Descriptions are as shown inTable4.9.4.

Table4.9.4 Flooding Measures in Bangkok Metropolitan Region

Hard measures	Soft measures
・ Construct outer dike and water gates at channels to prevent flooding flow from Northeast. ・ Preserve the area between outer dike and downtown area as spring water area. ・ Construct channel and pump to discharge storm water to Chao Praya River ・ Construct embankment and water gates at channels to prevent flooding of Chao Praya River.	・ Preserve rice field area outside the outer dike as green belt and ensure its function in flood controlling. ・ Appoint area in the urban with relatively low elevation to serve as retention area (where it is not allowed to be developed without government's approval) ・ Develop flooding information system and flooding response center to instruct and control urbanization process and water bodies.

Source: Sustainable Watershed Policy Senario in Population Surge Region, Correspondent Stratagy to Global Scale Cyclical Fluctuation in Monsoon Asia Region,Kengo SUNADA and Other, 2009）

(2) Situation of Bang Sue Area after heavy rain

In Bang Sue Area, rain water is drained quicly althourh sometimes roads are temporally flooded after heavy rain for short period. There are drainage pipes and pumping stations around Bang Sue Area. In addition, two (2) trunk drainage pipes named “Klong Prem Pra Chakon” and “Klong Bang Sue” are developed. These drainage facilities work well and it prevent serious flood in Bang Sue Area in these years.

(3) Business Continuity Planning (BCP) for Flooding

Although Japan and Thailand have different geographical conditions, “Guideline for making BCP for flooding measures in office” written by MLIT – Kanto Regional Development Bureau can be a source of reference.

1) Characteristics of Flooding BCP

① Flooding is different from earthquake as there is a lead time until disaster strikes.

Different from earthquake disaster which is unexpected, flooding disaster occurs after a certain time from raining. Therefore, if actions are planned appropriately based on flooding BCP, it would be possible to reduce damage drastically.

② Flooding is different from earthquake as there are some regions left undamaged.

Flooding will come from burst points on dike and sweep throughout a wide area in the downstream. However, there are some regions may be left totally undamaged. Therefore, it is necessary to understand the flood risk from hazard map or other resources.

③ Flooding is different from earthquake as direct damage will last longer.

Earthquake only lasts for few seconds to few minutes, but flooding can last for few days to few weeks. Therefore, it is necessary to consider measures to deal with flooding in a long period.

2) Items for consideration in making flooding BCP

Prevent measure in advance, initial and emergency response are taken into consideration.

a) Prevent measures in advance

Data collection in advance: Flooding hazard maps.

Flooding measures for buildings: facility rooms, e.g. electric and mechanical room, should be in high position, water resistant materials should be applied for outer wall.

Apply for insurance.

b) Initial response

Collect data on real-time water level.

Collect rare information and evacuation information.

c) Emergency response

Instruction structure: establish a department for disaster measures.

Base: settle back-up facilities in undamaged area.

Information transmission: inform partners and stakeholders about the damage and

rehabilitation.

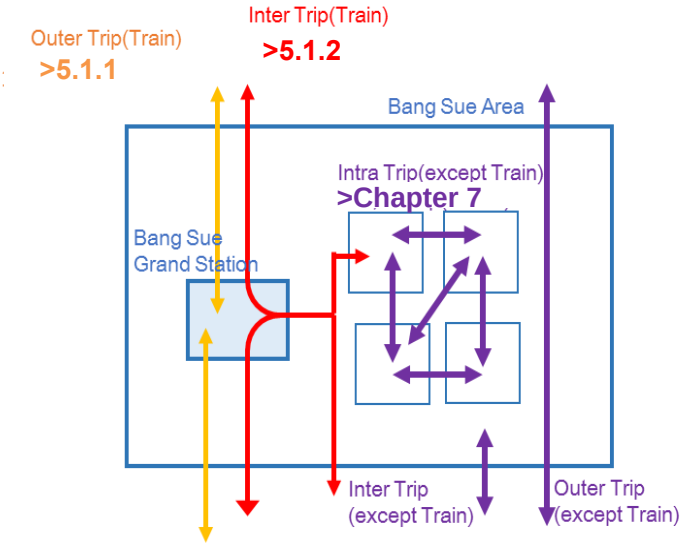
Securement of staff: secure important business continuality and rehabilitation resources.

Supply chain: prepare multiple supplier, supply route and modes.

Chapter 5 Future Demand Forecast

5.1 Demand of Railway Passengers at State Railway of Thailand (SRT) Bang Sue Grand Station

The purpose of demand forecast of railway passengers is to estimate the volume of outer trip and inter trip by trains which go through Bang Sue Grand Station and Bang Sue Area. A framework of demand estimation is as shown in Figure 5.1.1.



Source: JST

Figure 5.1.1 Framework of Demand Estimation

5.1.1 Review of Existing Forecast

(1) Demand Forecast of Existing Railway

The future network of the Bangkok railway and the forecast of transport volume are described in Mass Rapid Transit Master Plan in Bangkok Metropolitan(M-MAP) by Office of Transport and Traffic Policy and Planning (OTP) as shown in Table 5.1.1. Some projects such as construction of new lines related to Bang Sue Grand Station and some extension projects of the existing lines are listed in M-MAP. However, not all projects make headway as initially planned.

This study will forecast railway passengers at Bang Sue Grand Station based on the basic data used in M-MAP.

Table 5.1.1 Master Plan in Bangkok Metropolitan Region

Master Plan	Total Distance (km)	Station	Coverage Area (km^2)	Coverage People (million people)	
Urgent Plan	236	145	370	3.3	Light Red Line: Bang Sue-Taling Chan (15 km) -under construction Light Red Line: Bang Sue-Phaya Thai-Makkasan (9 km) and Makkasan-Hua Mak (10 km) Dark Red Line: Bang Sue-Rang Sit-Thammasat (36.3 km) Dark Red Line: Bang Sue-Hua Lampong (6.5 km) Dark Green Line: Mochit-Saphan Mai (11.4 km) and Baring-Samut Prakarn (12.8 km)
					Purple Line: Bang Yai-Bang Sue (23 km) - under construction Blue Line: Bang Sue-Tha Pra (13 km) and Hua Lampong-Bang Kae (14 km)
First 10-year Plan (within 2019)	391	237	525	3.8	Light Red Line: Salaya-Taling Chan (14 km) Dark Red Line: Hua Lampong-Bang Bon (18 km) Airport Rail Link: Don Muang-Bang Sue-Phayathai (21.8 km) Dark Green Line: Saphan Mai-Khu Khot (7 km.) Light Green Line: National Stadium-Yos Sae (1 km) Purple Line: Bang Sue-Rat Burana (19.8 km) Orange Line: Taling Chan-Thailand Cultural Center-Bang Kapi-Min Buri (37.5 km)
Second 10-year Plan (within 2029)	509	312	680	5.13	Dark Red Line: Bang Bon-Mahachai (20 km) Light Red Line: Bang Bamru-Makkasan (10.5 km) Dark Green Line: Khu Khot-Lam Luk Ka (6.5 km.) and Samut Prakarn-Bang Pu (7 km) Blue Line: Bang Kae- Buddha Monthol Sai 4 (8 km) Yellow Line: Lad Phrao- Pattanakarn (12.6 km) and Pattanakarn-Sam Rong (17.8 km) Grey Line: Watcharapol-Rama IV-Rama IX Bridge (26 km) Light Blue Line: Din Dang-Sathorn (9.5 km) Airport Rail Link Extension

Source: M-MAP (Mass Rapid Transit Plan in Bangkok Metropolitan Region, June 2010)

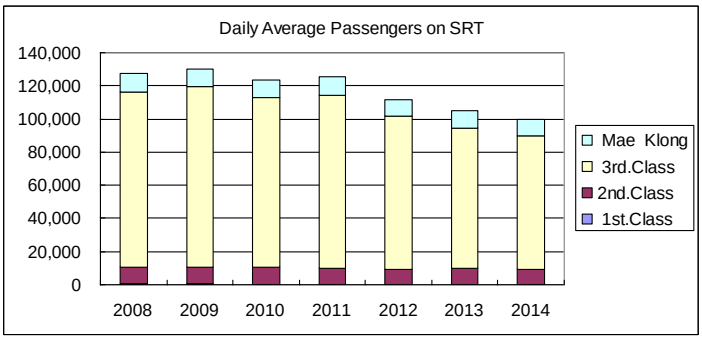
The number of passengers at Bang Sue Grand Station was forecasted in 2016 by OTP. It includes generated/attracted trips from redevelopment area around Bang Sue Grand Station. The forecasted number is as shown in Table 5.1.2.

The number estimated by OTP should be reviewed and verified because the total number is as big as that of JR-Shinjuku Station (Japan), which is the biggest station in the world with 760,000 boarding passengers per day. Recently, the number of SRT railway passengers is decreasing and the number is about 100,000 per day as shown in Figure 5.1.2. Even though under the assumption that Bangkok has a half of the national population, it might be difficult to expect more than 50,000 passengers to use the existing railway except an urban mass rapid transit (UMRT) transportation network such as mass rapid transit (MRT) or Bangkok Mass Transit System (BTS) at the center of Bangkok.

Table 5.1.2 Railway Passengers Forecast by OTP

(Per day)	Year 2022		Year 2032		Year 2037	
	Boarding	Alighting	Boarding	Alighting	Boarding	Alighting
Dark Red Line	105,600	106,100	185,200	185,100	217,100	218,000
Light Red Line	65,400	65,900	89,000	88,500	96,900	96,900
Long Distance Train	29,300	29,600	86,100	86,100	106,500	106,100
High-speed Rail	38,600	38,600	69,200	69,100	85,700	86,100
Airport Rail Link	30,700	30,800	48,400	48,600	60,300	60,100
Blue Line	56,700	56,500	121,500	121,300	145,400	144,600
Total	326,300	327,500	599,400	598,700	711,900	711,800

Note: Including traffic from the new redevelopment in Bang Sue Area.
Source: OTP



Note: Mae Klong is an independent, short distance route which is not connected with other routes.
Source: JST based on SRT

Figure 5.1.2 Daily Average Passengers on SRT in Thailand

(2) UMRT Passengers

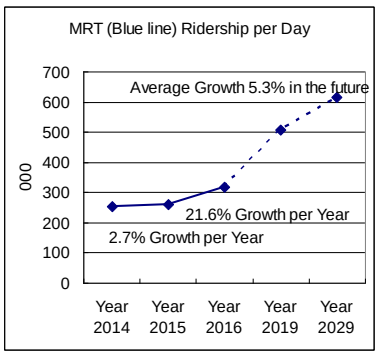
The Dark Red Line, Light Red Line, Airport Rail Link (ARL), MRT Blue Line, and BTS, they are described as UMRT. The annual growth rate of each line is as shown in Figure 5.1.3. According to Mass Rapid Transit Authority of Thailand (MRTA), the annual growth rate of MRT Blue Line is forecasted to be 5.3% in the future. According to Bangkok Mass Transit System Public Company Limited (BTSC), the actual growth rate of BTS is already 6.9% per year at present. According to SRT Electrified Train Co., Ltd. (SRTET), the average annual growth rate of ARL is 10.5%. These passengers' growth rates are higher than the population growth rate in Bangkok. It means that the usage of railway becomes more popular for those people living in and around Bangkok.

Figure 5.1.4 shows the comparison of MRT/BTS/subways extension and users in the world. The total extension and number of passengers of UMRT in Bangkok are still less compared with the other countries, since the UMRT network in Bangkok is still not dense. As shown in Figure 5.1.5, Sukhumvit Station of MRT and Siam Station of BTS have the largest passengers in each line. In the most recent year, the number of passengers in Siam Station, which is an interchange between two BTS lines, is approximately 112,600 and the number of passengers in Asok is 85,100. As the passengers of UMRT in Bangkok is increasing year by year, these numbers will higher in 2017.

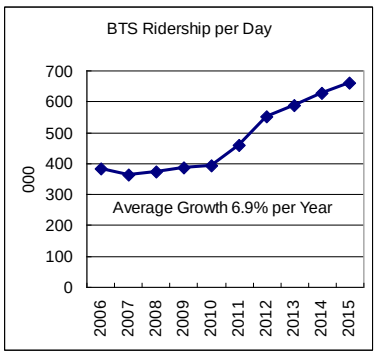
Although the number of railway passengers increases year by year, MRT and BTS have limit of their

carrying capacity. The capacity of one section is estimated to be about 300,000 for one line[1].

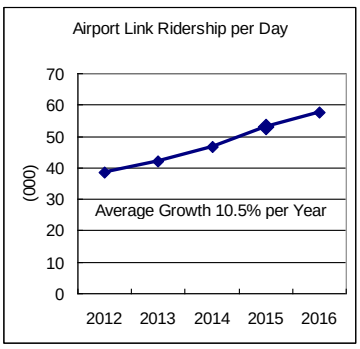
The distribution of the trip length of MRT is as shown in Figure 5.1.6. As the average trip length gets shorter, the number of passenger transhipment increases, and it increases the capacity of the entire line. Since Bangkok's average commuting distance exceed 6.0 km, the current use of railway is established in combination with other transport modes.



Source: MRT t

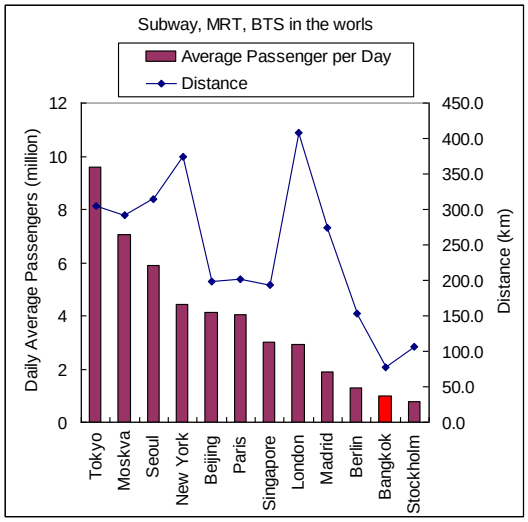


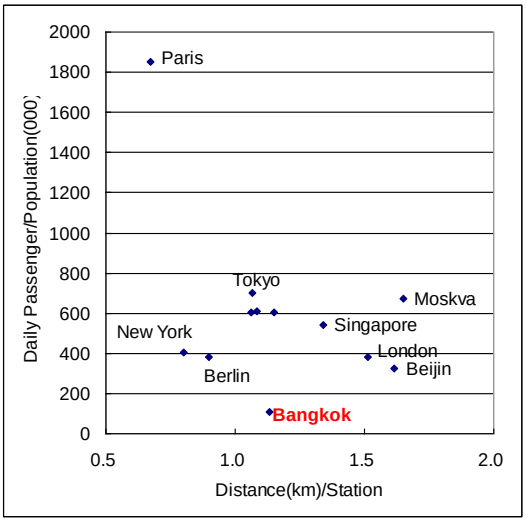
Source: SRT



Note: The number is the total of all stations
Source: JST based on SRT

Figure 5.1.3 Growth of Intra City Transportation Network

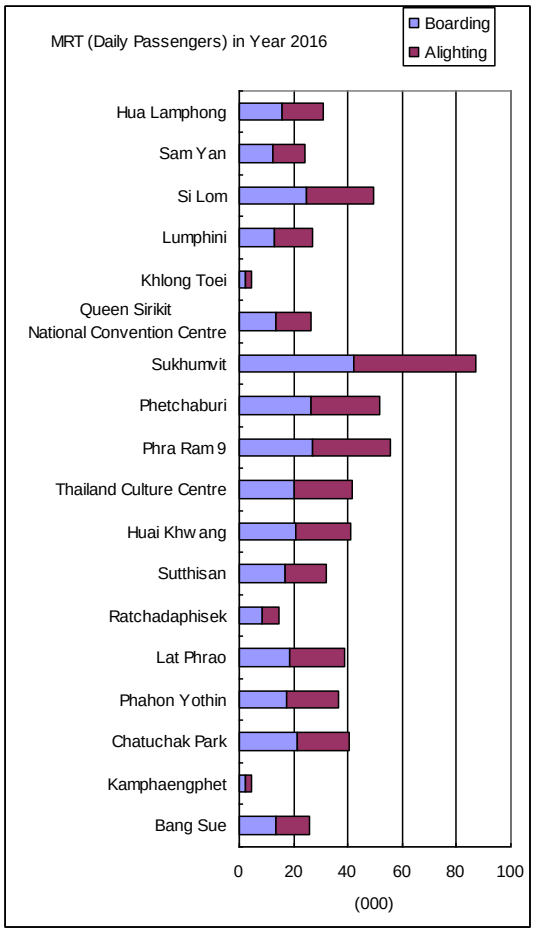


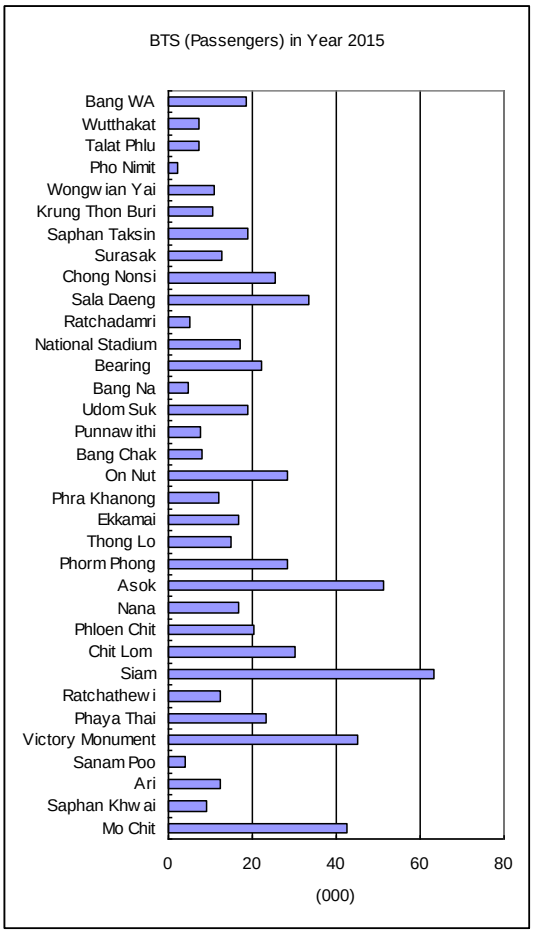


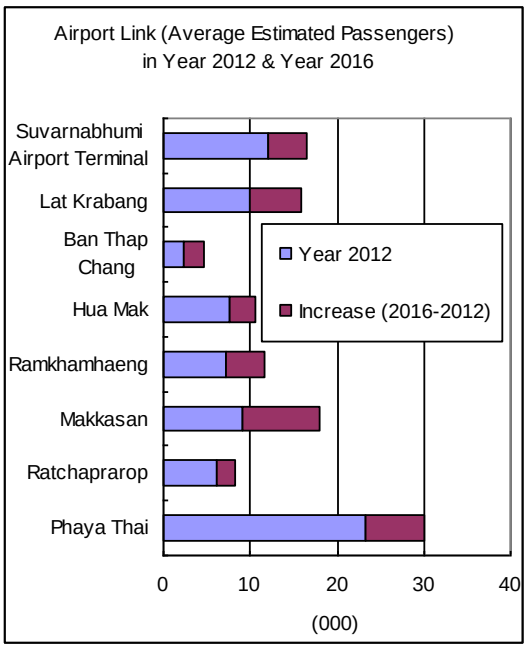
Source: Japan Subway Association

Figure 5.1.4 Comparison of MRT/BTS/Subways Extension and Users in the World

[1] (900 persons per train) x (every 5 minutes) x (14 hours) x (2 ways)

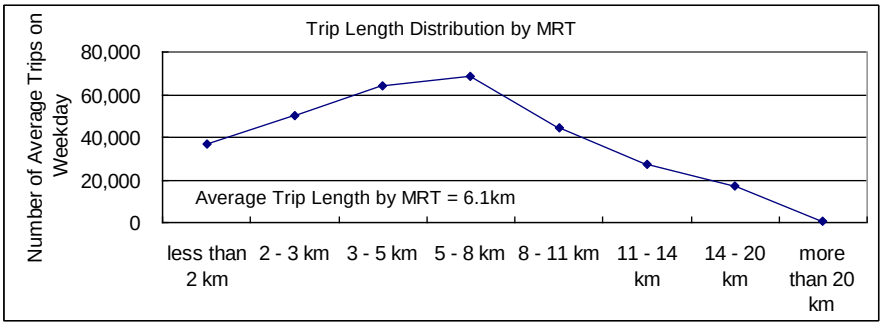






Source: JST based on MRT, BTS, SRT

Figure 5.1.5 Average Daily Passengers of MRT, BTS, and Airport Rail Link by Station



Source: JST based on MRT report

Figure 5.1.6 Trip Length Distribution by MRT Passengers

(3) Dark Red Line

Dark Red Line is expected to be used mainly for commuting. Approximately 80% of ridership is expected for commuting purpose. Passengers of Dark Red Line are forecasted by OTP and SRT as shown in Table 5.1.3. The numbers of passengers estimated by the two authorities are quite different from each other, because the number of passengers estimated by OTP includes generated passengers from Bang Sue Area redevelopment, while estimated number of passengers by SRT and JST do not.

The passenger estimation for Dark Red Line is as shown in Table 5.1.3. The conditions of the assumption are as follows:

- The baseline of the number of passengers: 23,717 (same as in year 2015 at Hua Lamphong Station)
- The growth rate: 6.9% (same as BTS)

In this survey, the modal share of railway is expected to increase up to 20% in the future, as instructed by the Government of Thailand.

Table 5.1.3 Dark Red Line Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	105,600	139,847	185,200
	Arrival	106,100	140,140	185,100
SRT	Departure	14,033	17,740	21,353
	Arrival	37,161	46,978	56,545
JST	Departure/Arrival	37,878	52,919	73,934

Note:In this table, OTP's estimation includes the generated passengers from Bang Sue Area redevelopment while SRT and JST estimation do not.
Source: JST based on OTP , SRT

(4) Light Red Line

Light Red Line will start from Bang Sue Grand Station and heads to two destinations. One goes to Talin Chan and Salaya to the west, while the other goes to Hua Mak to the south. As of August 2017, the section between Bang Sue and Talin Chan is under construction, and the section is planned to commence its operation in 2020, the same period with Dark Red Line opening. The passenger capacity on one way per day is estimated to be 25,200.

The target passengers of Light Red Line in Bang Sue Grand Station in the future are firstly those who come from the west of Bang Sue Area, and secondly, are the additional induced passengers. There is a

possibility that they will get on SRT new lines. The present survey assumed that the new SRT passengers at Bang Sue Grand Station swill grow at the same growth rate of MRT passengers. The potential of Light Red Line is as shown in Table 5.1.4., and the result of estimation is as shown in Table 5.1.5.

The conditions of the assumption are as follows:

- The baseline of the number of passengers: 25,200 (passenger capacity of one way per day)
- The growth rate: Same as the population growth rate and MRT passengers' growth rate

Table 5.1.4 Potential of Light Red Line

	Basic Line* (people/day)	Year 2022 (people/day)	Year 2027 (people/day)	Year 2032 (people/day)	Growth
Obvious demand	25,200	27,398	29,294	30,826	Growth by Population
Induced demand	25,200	32,564	42,081	54,379	Growth by MRT
*) By Bus & Morning Rail Operation					

Source: JST

Table 5.1.5 Light Red Line Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
Forecast by OTP	Departure	65,400	77,200	89,000
	Arrival	65,900	77,200	88,500
Forecast by SRT	*) No report	–	–	–
Study Team	Departure/Arrival	59,963	71,375	85,205

Source: JST

(5) Long-distance Train

Although some trains survived after the opening of high-speed railway in Japan, some of them were abolished or transferred to the private sector because many passengers shifted from the old long-distance trains to the high-speed railway trains. Therefore, the forecast by SRT, which estimated that passengers of long-distance train will not increase, is comparatively reasonable. The present survey forecasted the number of passengers of long-distance train by using the growth rate of population in Bangkok under the condition that a half of the estimated passengers will shift to high-speed railway trains. The result is as shown in Table 5.1.6. The conditions of the assumption are as follows:

- The baseline of the number of passengers: Number of passengers in 2012, 2013, and 2014
- The growth rate: Population growth
- A half of the passengers of long-distance train will shift to other modes such as high-speed railway.

Table 5.1.6 Long-distance Train Passenger Estimation

Estimated by		Estimated Passengers (people/day)					
		Year 2012	Year 2013	Year 2014	Year 2022	Year 2027	Year 2032
OTP	**Departure**				29,300	40,486	86,100
	Arrival				29,600	40,776	86,100
SRT (including actual number number of passengers)	**Hua Lamphong**	25,311	23,419	22,422			
	Bang Sue	910	960	916	24,646	24,646	24,646
JST	**Departure/Arrival**				13,398	14,325	15,074

Source: OTP, SRT, JST

(6) High-speed Train

There are five main routes of high-speed train decided by the Government of Thailand as shown in Table 5.1.7. Bang Sue Grand Station is planned as the terminal station. For the demand forecast of Bangkok-Chiang Mai route, the result of the "Preparatory Survey for the Bangkok-Chiang Mai High-speed Rail Development Project" supported by Japan International Cooperation Agency (JICA) is used as reference. On the other hand, feasibility studies on the other routes are not available. Therefore, the forecast for the other routes is estimated in proportion to the population.

Table 5.1.7 Demand Forecast of Planned High-speed Railways

Destination		Estimated Passengers (people/day)		
		2022	2027	2032
1	Chiang Mai		25,408	29,357
2	Ubon Ratchathani		18,242	21,077
3	Nong Khei		15,096	17,441
4	Padang Besar		2,353	2,718
5	Rayon		9,351	10,804

Source: JST based on the "Preparatory Survey for the Bangkok-Chiang Mai High-speed Rail Development Project" and population growth rate

OTP also has its own estimation. The comparison of the forecast for the five routes of high-speed trains by OTP and JST is as shown in Table 5.1.8. It should be noted that the number of passenger estimation by JST includes the departure and arrival of passengers.

Table 5.1.8 Comparison of Demand Forecast of Planned High-speed Railway by OTP and JST

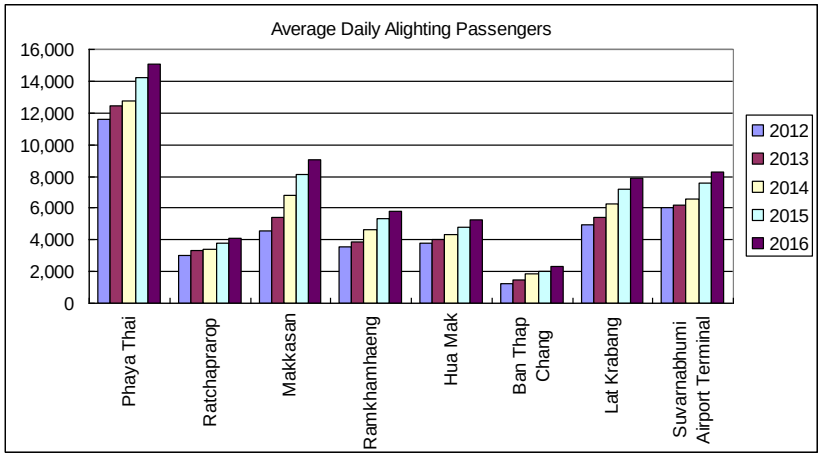
Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	38,600	53,900	69,200
	Arrival	38,600	53,850	69,100
SRT	Departure	-	-	-
	Arrival	-	-	-
JST	Departure+Arrival		70,449	81,397

Source: OTP, JST

(7) Airport Rail Link (ARL)

ARL is currently connected to the Suvarnabhumi International Airport and Phaya Thai Station. It connects to MRT Blue Line at Makkasan Station (Phetchaburi Station for MRT Blue Line) and BTS Sukhumvit Line at Phaya Thai Station. In the future, it will be extended to Bang Sue Grand Station.

The average daily alighting passengers on ARL by station are as shown in Figure 5.1.7. The numbers of passengers at Makkasan and Phaya Thai Stations are larger than at the ARL station at Suvarnabhumi International Airport. It shows that ARL is used not only as an airport line but also as UMRT for daily transfer.



Source: JST based on SRT

Figure 5.1.7 Average Daily Alighting Passengers at Airport Rail Link by Station

At the ARL station at Suvarnabhumi International Airport, more than 5% of flight passengers use ARL, as shown in Table 5.1.9.

Table 5.1.9 Share of ARL Users in Flight Passengers

(per year)	Airport Passenger (thousand people)		Alighting Passenger (thousand people)			
	Suvarna-bhumi	Don Muang	Suvarna-bhumi Airport Terminal	(Ratio) *) note	Phaya Thai	(Ratio) *) note
2015	52,902	30,304	2,759	5.2%	5,179	9.8%
2016	55,892	35,204	3,027	5.4%	5,491	9.8%

Note: (Alighting Passenger)/ (Airport Passenger at Suvarnabhumi International Airport)
Source: Department of Civil Aviation Thailand and SRT

The growth of flight passengers is generally in proportion to the growth of the gross domestic product (GDP). By considering the distance from the airports to Bang Sue Grand Station, about 10% of the flight passengers in Don Muang Airport and about 5% of flight passengers in Suvarnabhumi International Airport will be expected to use Bang Sue Grand Station.

Based on the share of the ARL users in flight passengers, the future demand of ARL is estimated as shown in Table 5.1.10. The assumption is; In the future of Year 2032 it is assumed the utilization share of Airport rail link in total number of airport passengers will be twice as 10% and 20% in Suvarnabhumi International Airport Terminal Station and Phaya Thai respectively, as the result of tourist promotions and integrated development surrounding Bang Sue Area.

Table 5.1.10 Airport Rail Link Passenger Estimation

Estimated by		Estimated Passengers (people/day)		
		Year 2022	Year 2027	Year 2032
OTP	Departure	30,700	35,193	48,400
	Arrival	30,800	35,316	48,600
SRT	Departure		18,596	17,812
	Arrival		21,153	20,900
JST	Departure/Arrival		48,725	70,405

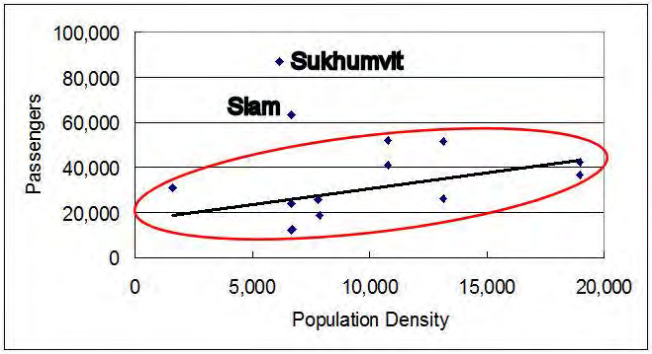
Source: OTP, SRT, JST

(8) MRT Blue Line

The demand of Blue Line is forecasted by OTP and SRT. By reviewing the data, it seems that most of Blue Line passengers considered transfering from MRT Bang Sue Station to Bang Sue Grand Station. However, some passengers from/to Blue Line consider using buses, taxis and walking by foot from MRT Bang Sue Station. Therefore, it is not appropriate to count all of Blue Line Bang Sue Station passengers as Bang Sue Grand Station users.

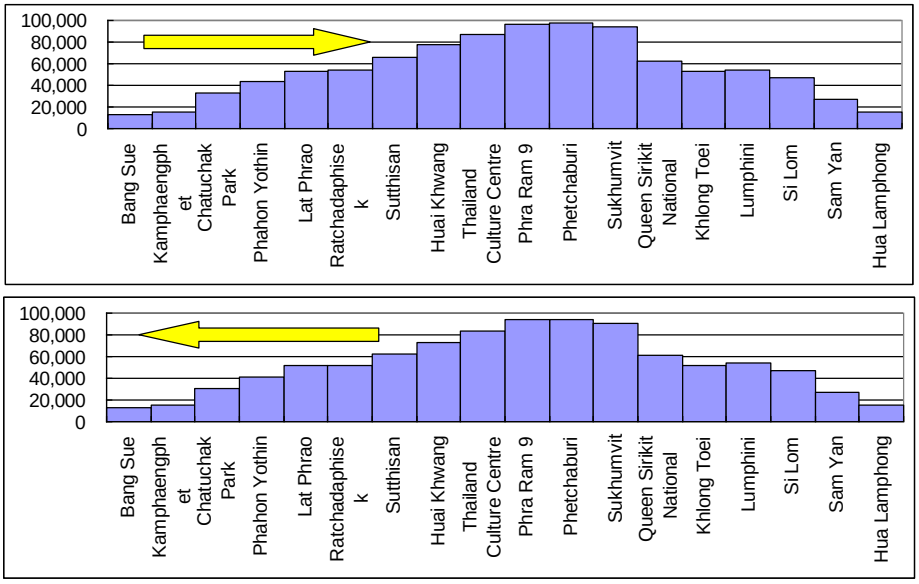
Generally, the number of passengers in each station is proportional to the density of population in the surrounding area as shown in Figure 5.1.8. Stations with special conditions, e.g., interchange stations such as Sukhumvit or Siam, and a station located at the center of the central business district (CBD) will attract more passengers. With this, MRT Bang Sue Station is not connected with other commuter lines at present.

However, in the future, Blue Line will become a loop line and will be connected to the Dark Red Line at MRT Bang Sue Station. MRT Bang Sue Station has the possibility to become one of the largest interchange points of the loop line in Bangkok. Figure 5.1.9 shows the number of passengers in Blue Line. Based on the trend of the number of passengers in each station, it could be claimed that MRT Bang Sue Station will have more passengers in the future.



Source: MRT, BTS, JST

Figure 5.1.8 Number of Passengers of Each Station and Population Density



Source: MRT

Figure 5.1.9 Average Daily Passengers on the Blue Line on Weekdays by Section and Direction in 2016

The result of the demand forecast for Blue Line is as shown in Table 5.1.11. In this table, the number estimated by JST means the total number of passengers in MRT Bang Sue Station while the estimated number of passengers by OTP and SRT means the number of transfer passengers from MRT Bang Sue Station to Bang Sue Grand Station.

Table 5.1.11 Demand Forecast of Passengers in MRT Bang Sue Station

Estimated by		Estimated Passengers (people/day)			
		Year 2016	Year 2022	Year 2027	Year 2032
OTP	Departure	-	56,700	89,100	121,500
	Arrival	-	56,500	88,900	121,300
SRT	To Red Line	-	7,017	8,870	10,676
	To Airport Rail Link	-	1,340	1,303	1,285
Study Team (Temporary)	Departure/Arrival	25,931	28,193	30,144	31,720

Source: OTP, SRT, JST

In the above number of passengers estimated by JST, passengers generated from/attracted to Bang Sue Area are not included. It only includes passengers from/to outside of MRT Bang Sue Station, as well as passengers who transfer to the other lines.

5.1.2 Railway Passengers in Bang Sue Area

(1) Forecast Framework

Table 5.1.12 shows the framework of the forecast. In order to forecast the railway passengers at Bang Sue Grand Station, the matrix should be filled in.

Generated/attracted trips in Bang Sue Area depend on the number of employees and residents. The employees and residents are determined by floor plan which will be planned based on property demand forecast. Examples of person trip data in Tokyo and Association of Southeast Asian Nations (ASEAN) cities are as shown in Figure 5.1.10, which shows that the generated/attracted trips are almost in proportion to the population of residents and employees.

The prediction method is a four-step estimation. Based on the real estate demand, the generated trips are estimated. The attracted trips are estimated based on the distribution of available transportation facilities. Then, the mode sharing rate is estimated, and finally, the traffic distribution and quantity are obtained.

(2) Number of Trips per Person per Day

Generally, the number of person trip per person per day is more than 2.0 trips for commuting in urban area. In Figure 5.1.10, Jakarta and Manila were surveyed in 2002 and 1996, respectively, and the target areas of survey contained rural areas. Therefore, the numbers of trips per day in these two cities are lower than 2.0. On the other hand, the data of Hanoi and Yangon are relatively new (in addition, the area of Hanoi in 2005 was narrower than now due to municipal integration in 2008), and the number of trips per day is over 2.0. From this viewpoint, the person trips in Bangkok, which is highly urbanized today, is considerd to be more than 2.0 trips per person per day.

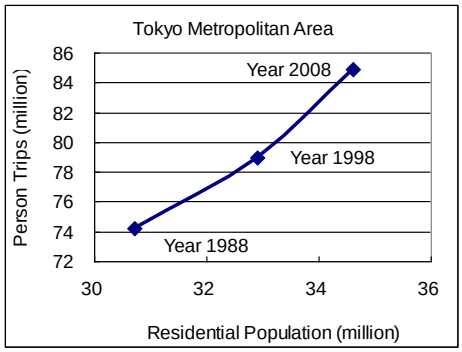
Commuting trips could be estimated based on the number of office workers; employees and customers

in the commercial area; and residents. The number of commuting trips in Bangkok is assumed at about 2.0 trips, and other trips beyond 2.0 should be assumed as a trip for other purposes. Except for people who have more than one working place, the purpose of the trips beyond 2.0 should be treated as business, social visit, shopping, etc. Share of purpose of trips in Bangkok and other cities in Asia is as shown in Figure 5.1.11, for reference.

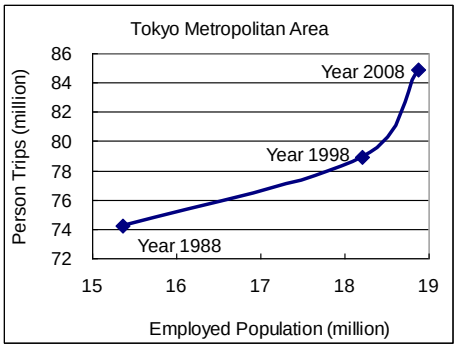
Table 5.1.12 Forecast Framework

				DESTINATION			
				SRT (1-5)	**Redevelopment Zone (6-13)**	**City (14-15)**	**Total**
ORIGIN	**SRT**	**1**	**Dark Red Line**	Transhipment passenger at Bang Sue Station	Passengers getting off from Bang Sue to redevelopment area	Passengers getting off to the other area	Total number of passengers getting off at Bang Sue
		2	**Light Red Line**				
		3	**Long Distance Train**				
		4	**High-speed Rail**				
		5	**Airport Rail Link**				
	Redevelopment Zone	**6**	**Bus Terminal**	Passengers getting on to Bang Sue from redevelopment area	Intra traffic in redevelopment area except for Bang Sue Station	Generated trips from redevelopment area by non-SRT way	Outflow trips from redevelopment area
		7	**SRT Land**				
		8	**A1+A2**				
		9	**B**				
		10	**C**				
		11	**D (West)**				
		12	**D (East)**				
		13	**KM11**				
	City	**14**	**Blue Line**	Passengers getting on from the outside area	Attracted trips to redevelopment area by non-SRT way	*) Outside	*) Outside
		15	**BTS/Bus/Car/Taxi/ sFoot**				
	Total			Total number of passengers getting on at Bang Sue	Inflow trips to redevelopment area	*) Outside	

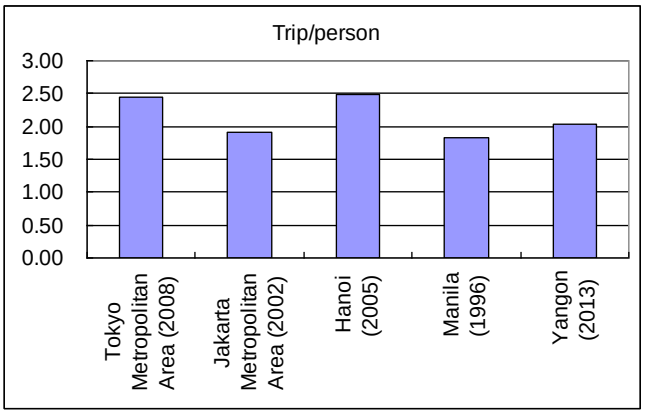
Source: JST



Source: Tokyo Metropolitan Area Person Trip Survey and Basic Resident Register

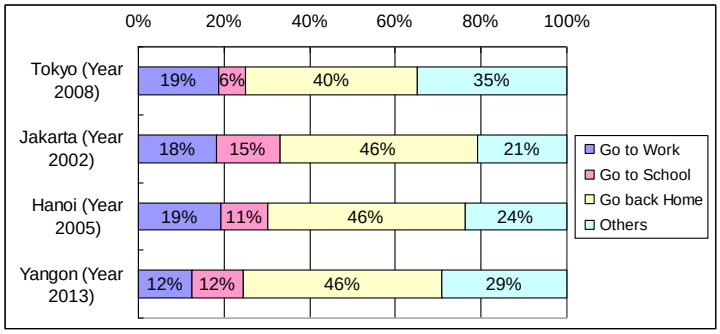


Source: Tokyo Metropolitan Area Person Trip Survey and Basic Census

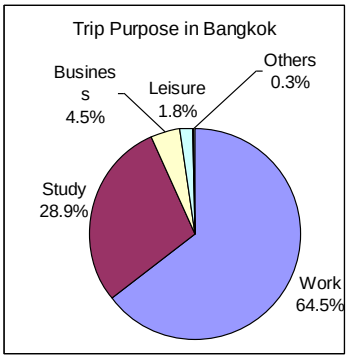


Source: Tokyo Metropolitan Area Person Trip Survey (2008), Jakarta STRADA JICA (2002), Hanoi HAIDEP JICA (2005), Manila MMUTIS JICA (1996), Yangon YUTRA JICA (2013)

Figure 5.1.10 Examples of Person Trips per Person per Day



Source: Tokyo Metropolitan Area Person Trip Survey (2008), Jakarta STRADA JICA (2002), Hanoi HAIDEP JICA (2005), Manila MMUTIS JICA (1996), Yangon YUTRA JICA (2013)



Source: Red Line Study

Figure 5.1.11 Share of Purpose of Trips in Bangkok and Other Cities in Asia

The character of Bang Sue Area is a business and commercial area and visitors come mainly for work, shopping or events. Therefore, extra trips other than basic 2.0 trips for commuting is assumed as shown in Table 5.1.13.

Table 5.1.13 Assumption of Extra (Non Commuter) Trips in Bang Sue Area

One Way (Generated/Attracted)	Inter Trips	Intra Tripa
Office	1.3	0.1
Commercial	1.0	0.2
Resident	1.1	0.2
Hotel	1.2	0.1
Convention	1.0	0.2

Source: JST

(3) Estimated Modal Share

The modal share of train in Bang Sue Area is estimated to reach 40% in the future. It is assumed that the transfer rate between different lines will be 50%-65%. The transfer rate between different directions of long-distance train and high-speed railway is also assumed at 50%-65%.

After subtracting the number of passengers on long-distance train and high-speed railway from generated/attracted passengers in Bang Sue Area, passengers from the area are divided into other transport modes.

The inter city bus utilization rate is supposed to be 20% of those who come out from the station or who are in Bang Sue Area, and do not use the commuter trains. The rest are supposed to use other modes such as buses, cars, taxis, and so on. It should be considerd that several transportation modes are required to access from zones in Bang Sue Area to Bang Sue Grand Station since some zones are locate not within walking distance from Bang Sue Grand Station.

In Japan, the access area to a train station is usually planned within 150 m from a station. The passenger attraction rate of a station gradually decreases until the distance of 500 m, and for over 500 m, other access modes will be required. Condsidering the temperature and the climate in Bangkok, it would be appropriate to estimate that the maximum comfortable walking distance outside is maximum 500 m or rather less.

(4) Railway Passenger to Bang Sue Grand Station from Bang Sue Area (One Way)

Based on estimations above mentioned, generated trips in Bang Sue Area is estimated as shown in Table 5.1.14. For estimation, the Senario 2, i.e. the case of intergrated development which is explained in Chapter 6, and its planned floor area in Chapter 7 was applied as a condition of estimation.

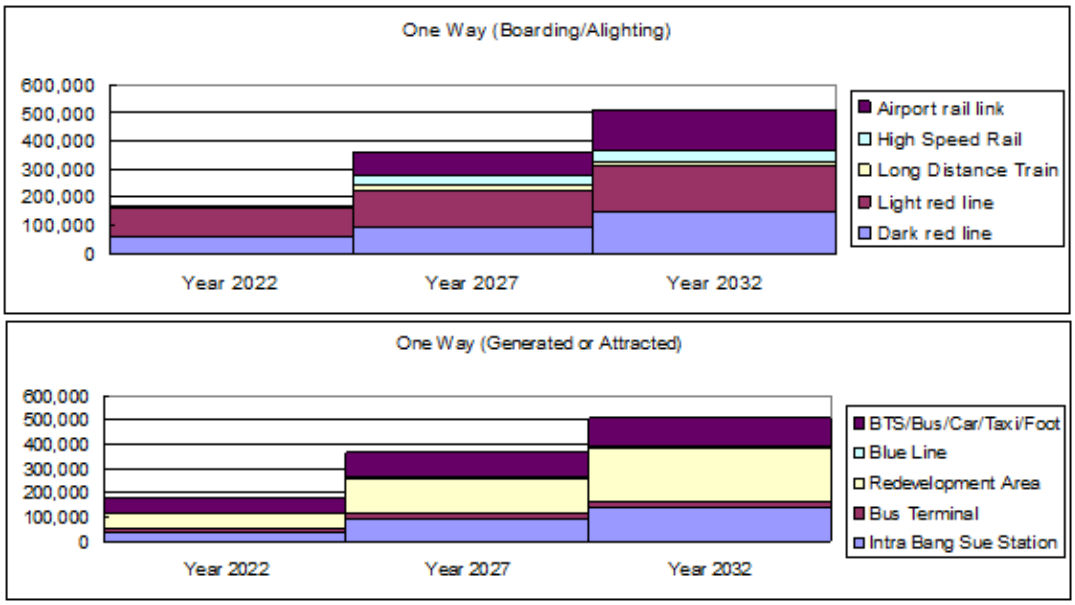
Table 5.1.14 Generated Trips in Bang Sue Area

	Estimated Passengers (people/day)		
Zone	**Year 2022**	**Year 2027**	**Year 2032**
SRT Land & F	113,600	233,800	233,800
A	17,500	17,500	17,500
B	0	0	97,600
C & I	0	49,800	67,400
D	4,500	4,500	117,400
H	0	0	36,300
KM11	0	54,000	54,000
Total	135,600	359,600	624,000
(Inter Trips)	116,100	305,300	529,900

Source: JST

(5) Forecasted Number of Passengers in Bang Sue Grand Station

Based on abovementioned analysis and assumptions, as the final result of forecasting, the number of railway passengers in Bang Sue Grand Station is estimated as shown in Figure 5.1.12. The number of passengers is almost at the same scale of Ueno Station including JR, Keisei, and subway (Ginza Line, Oedo Line, and Hibiya Line).



Source: JST

Figure 5.1.12 Passenger Estimation of Bang Sue Grand Station

Table 5.1.15 Passenger Estimation of Bang Sue Grand Station

One Way (Boarding or Alighting)	Year 2022	Year 2027	Year 2032
Dark Red Line	58,352	94,702	144,755
Light Red Line	101,989	132,421	169,598
Long-distance Train	13,389	14,303	14,954
High-speed Rail	0	35,170	40,374
Airport Rail Link (Red Line)	0	86,586	137,188
Total	173,730	363,182	506,870

From or To	Year 2022	Year 2027	Year 2032
Intra Bang Sue Station	37,395	92,839	136,836
Bus Terminal	13,365	24,141	27,540
Redevelopment Area	60,122	139,005	220,150
Blue Line	9,389	10,631	12,184
BTS/Bus/Car/Taxi/Foot	53,458	96,565	110,160
Total	173,730	363,182	506,870
(From Entrance of Bang Sue Grand Station)	136,334	270,343	370,034

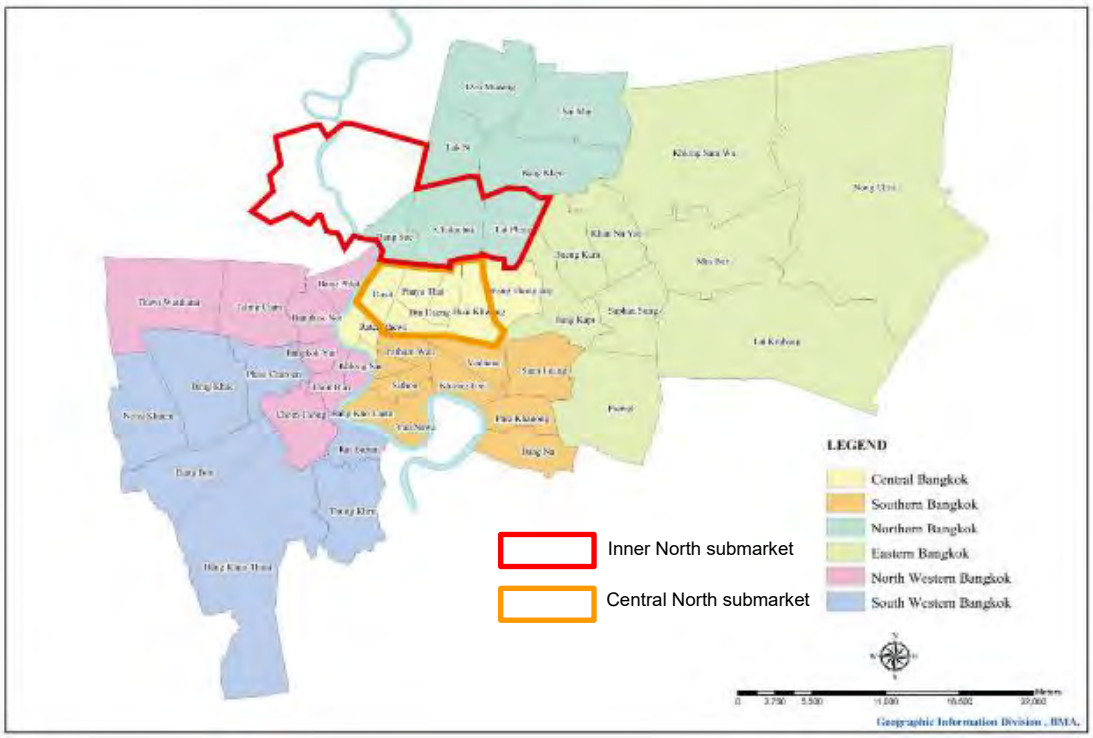
Note: Passengers to Blue Line is not included in the table.
Source: JST

5.2 Property Demand in Bangkok and its Environs

The future property demand in Bang Sue Area is estimated based on the recent property market data which contains the property stock from 2006 to 2016, and the planned floor area from 2017 to 2021. It is assumed that the market demand is naturally covered by market suppy; therefore, the estimated future supply will be considered as future demand.

5.2.1 Property Submarkets in Bangkok and its Environs

The area of Bangkok and its environs is divided into 12 submarkets as shown in Figure 5.2.1. Bang Sue Area is located at Chatuchak District in the Inner North submarket. Therefore, the estimation of the future supply will focus on the share of Inner North submarket and Chatuchak District in Bangkok and its environs. The share of Central North submarket, which is located just next to Bang Sue Area, will be given attention too.



Source: JST

Figure 5.2.1 Property Submarket in Bangkok and its Environs

Table 5.2.1 Districts and Counties in Each Submarket

Submarket	Districts
Central Bangkok	Bang Rak, Pathum Wan, Sathorn
Central East	Khlong Toey, Wattana
Central South	Bang Kho Laem, Yannawa
Rattanakosin	Phra Nakhon, Prom Pap Sattru Phai, Samphanthawong
Central North	Din Daeng, Dusit, Huay Kwang, Phaya Thai, Ratchathewei
Inner North	Bang Sue, Chatuchak, Lat Phrao, Muang Nonthaburi
Outer North	Bang Khen, Don Muang, Lak Si, Sai Mai, Pak Kret, Muang Pathum Thani, Khlong Luang, Thanyaburi, Nong Suea, Lat Lum Kaeo, Lam Luk Ka, Sam Khok
Inner West	Bang Phlat, Bangkok Noi, Bangkok Yai, Chom Thong, Khlong San, Pasi Charoen, Rat Burana, Taling Chan, Thonburi
Outer West	Bang Bon, Bang Khae, Bang Khun Thien, Nong Khaem, Thawi Wattana, Thung Khru, Phra Samut Chedi, Bang Kruai, Bang Yai, Bang Bua Thong, Sai Noi
South	Bang Na, Phra Kanong, Muang Samut Prakan, Phra Pradaeng
Inner East	Bang Kapi, Bung Kum, Khan Na Yao, Prawet, Saphan Sung, Suan Luang, Wang Thonglang
Outer East	Khlong Sam Wa, Lat Krabang, Min Buri, Nong Chok, Bang Bo, Bang Sao Thong, Bang Phli

Note: Bang Sue Area locates at Chatuchak district in INNER NORTH Sub-market
Source: Jones Lang LaSalle

5.2.2 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs

The past stocks from 2006 to 2016 and the planned supplies until 2021 in Bangkok and its environs are as shown in Figure 5.2.2, Figure 5.2.3, Figure 5.2.4, and Figure 5.2.5. The data of hotel is only available from 2008.

(1) Office

The office floor stock of Bangkok and its environ is 7,375,975m^2 in 2006, and 8,626,664m^2 in 2016. Its planned floor area in 2021 will be 9,977,252 m^2. The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 135 %.

(2) Retail

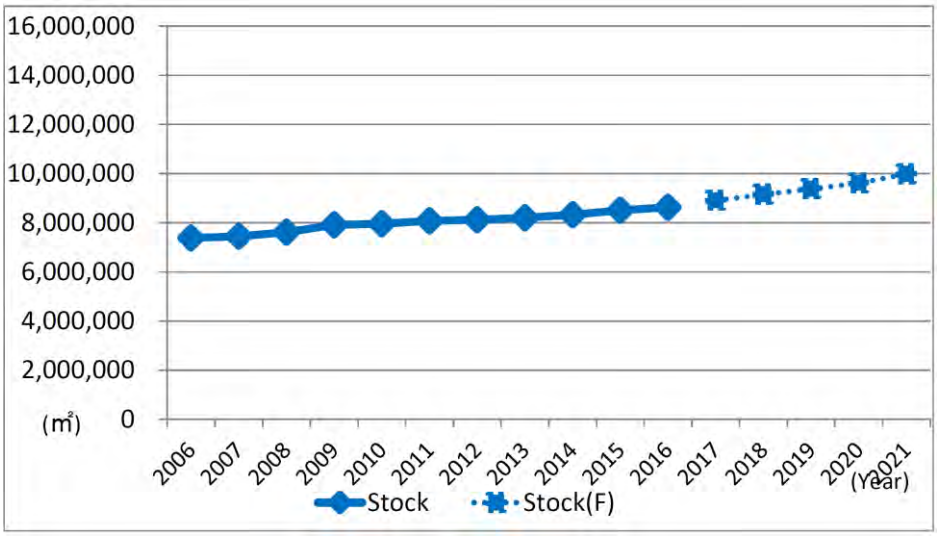
The retail floor stock of Bangkok and its environ are 7,293,476 m^2 in 2006 and 12,203,808 m^2 in 2016. The planned floor area in 2021 will be 14,992,162 m^2. The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 200%.

(3) Condominium

The condominium unit stocks of Bangkok and its environs are 54,836 units in 2006 and 444,882 units in 2016. The planned floor area in 2021 will be 584,061 units. The growth rate of the stock in 15 years, from 2006 to 2021, will be approximately 1,000%.

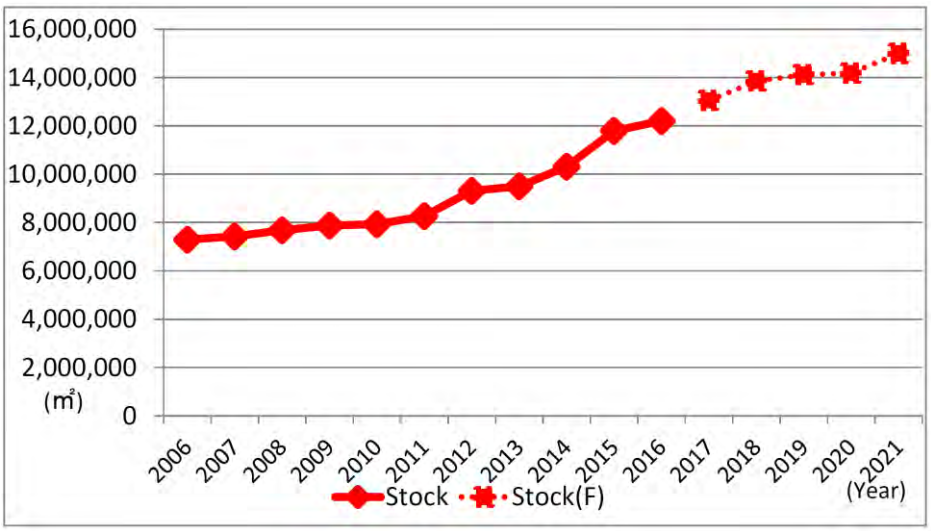
(4) Hotel

The hotel room stocks of Bangkok and its environs are 2,297 rooms in 2008 and 20,620 rooms in 2016. The planned stock in 2021 will be 27,753 rooms. The growth rate of the stock in 11 years, from 2008 to 2019, will be approximately 1,200%.



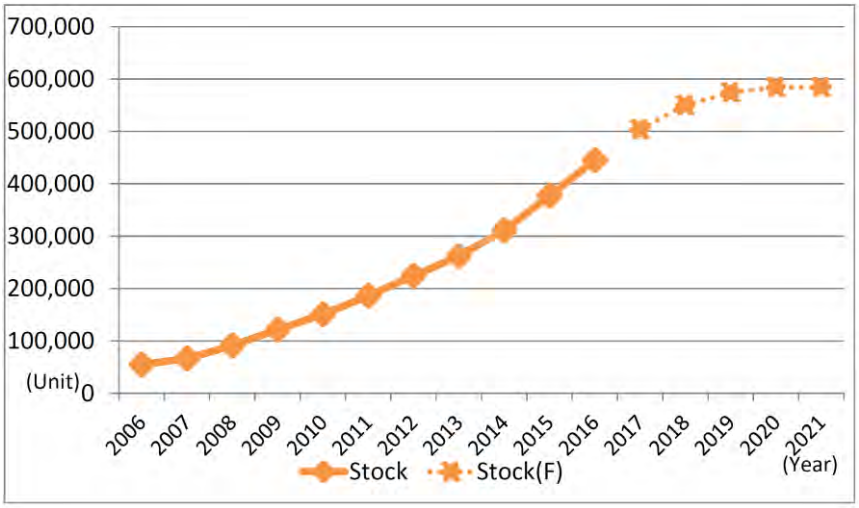
Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.2 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs (Office)



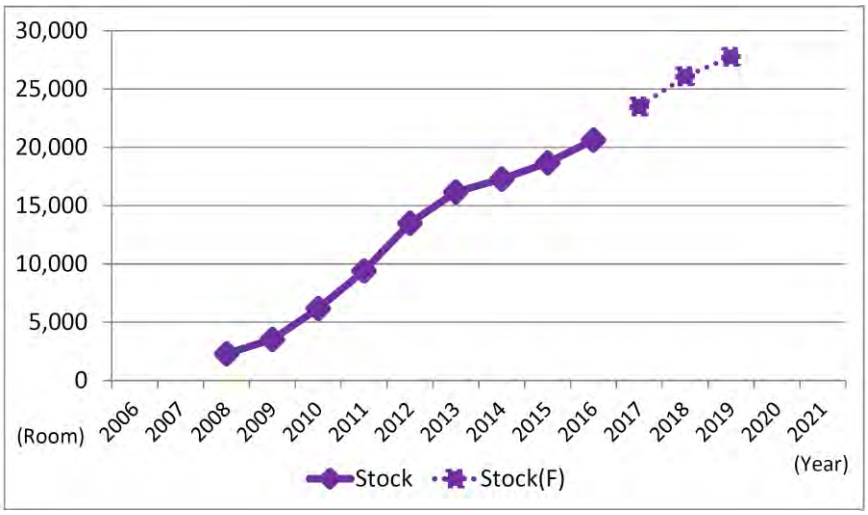
Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.3 Past Stocks and Planned Floor Area until 2021 in Bangkok and its Environs (Retail)



Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.4 Past Stocks and Planned Units until 2021 in Bangkok and its Environs (Condominium)



Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

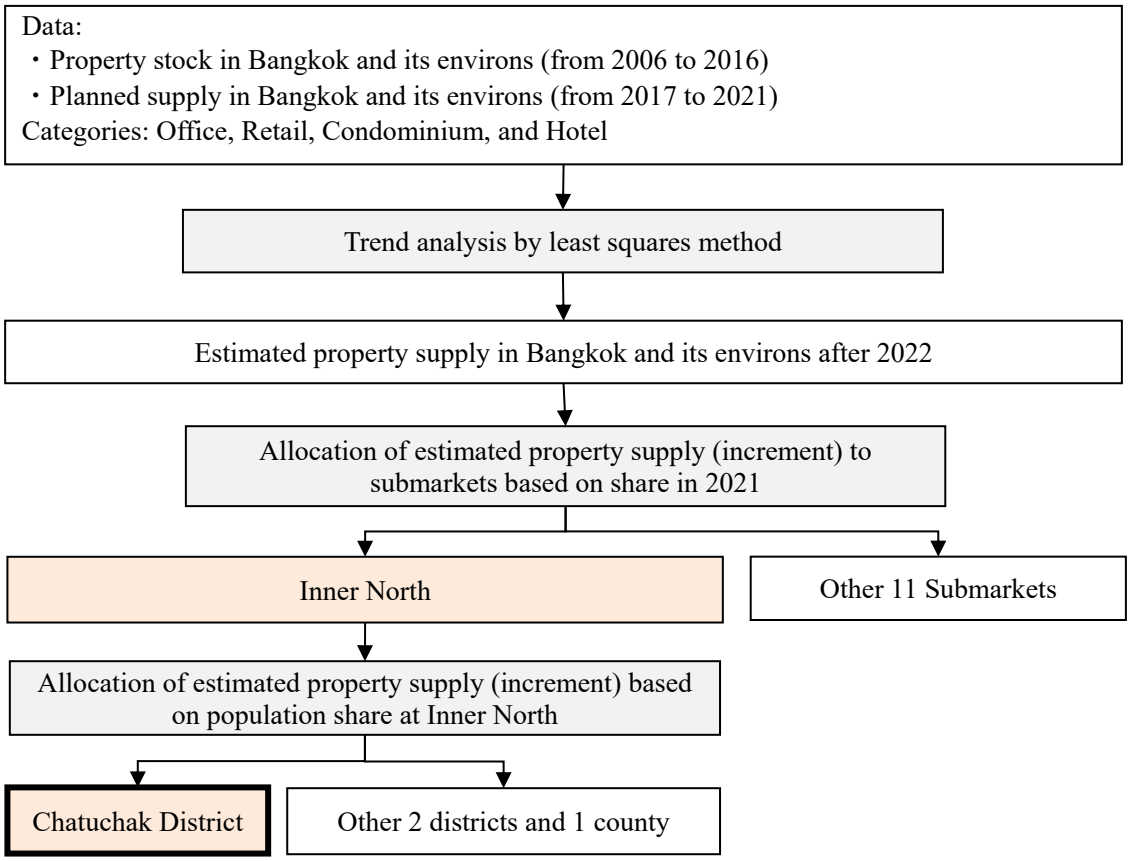
Figure 5.2.5 Past Stocks and Planned Rooms until 2021 in Bangkok and its Environs (Hotel)

5.2.3 Approach to Estimate Property Supply in Bang Sue Area after 2022

(1) Methodology and Process

The estimation of property supply in Bang Sue Area after 2022 follows the process as shown in Figure 5.2.6.

Firstly, the future property supply in Bangkok and its environs is estimated by least squares method based on the past trend and the planned floor supply. Secondly, the estimated supply in Bangkok and its environs is allocated to Inner North, based on the share of each submarket in 2021. Finally, the allocated supply of Inner North is allocated again to Chatuchak District based on the population share of three districts and one county at Inner North. The allocated future supply of Chatuchak District is considered as the future supply in Bang Sue Area.



(Property supply in Chatuchak District is considered as property supply in Bang Sue Area.)

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 5.2.6 Process of Future Property Supply in Bang Sue Area

(2) Estimation of Future Property Supply in Bangkok and its Environs

The future property supply is estimated by least squares method based on the past trend and the planned floor supply. The least squares method formulas for office, retail, condominium, and hotel are shown below.

1) Office

- Data: The office floor stock from 2006 to 2016 and the planned office floor area from 2017 to 2021 in Bangkok and its environs[2].
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	= a×x＋b
	= (a)159,210×ln(x)＋(b)7,093,958
x：Years	r-squared：0.9601

[2] Jones Lang LaSalle

2) Retail

- Data: The retail floor stock from 2011 to 2016 and the planned retail floor area from 2017 to 2021 in Bangkok and its environs[3]. Since there are different trends of supply from 2006 to 2010 and from 2011 to 2016, the data from 2011 to 2016 was selected as base data.
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	= a×x＋b
	= (a) 7,101,361×ln(x)＋(b) 4,748,188
x：Years	r-squared：0.9806

3) Condominium

- Data: The condominium unit stock from 2006 to 2016 and the planned condominium units from 2017 to 2021 in Bangkok and its environs[4].
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	= a×x＋b
	= (a) 41,336×ln(x)＋(b) 33,460
x：Years	r-squared：0.9763

4) Hotel

- Data: The hotel room stock from 2008 to 2016 and the planned hotel rooms from 2017 to 2019 in Bangkok and its environs[5].
- Hypothesis: Future stock will grow interannually.

Formula	
Future Stock	= a×x＋b
	= (a) 2,367×ln(x)＋(b) 4,707
x：Years	r-squared：0.9871

5) Estimated Result

The general trend of estimated property supply in Bangkok and its environs after 2022 is as shown in Figure 5.2.7 and Table 5.2.2.

[3] Jones Lang LaSalle
[4] Jones Lang LaSalle
[5] Jones Lang LaSalle

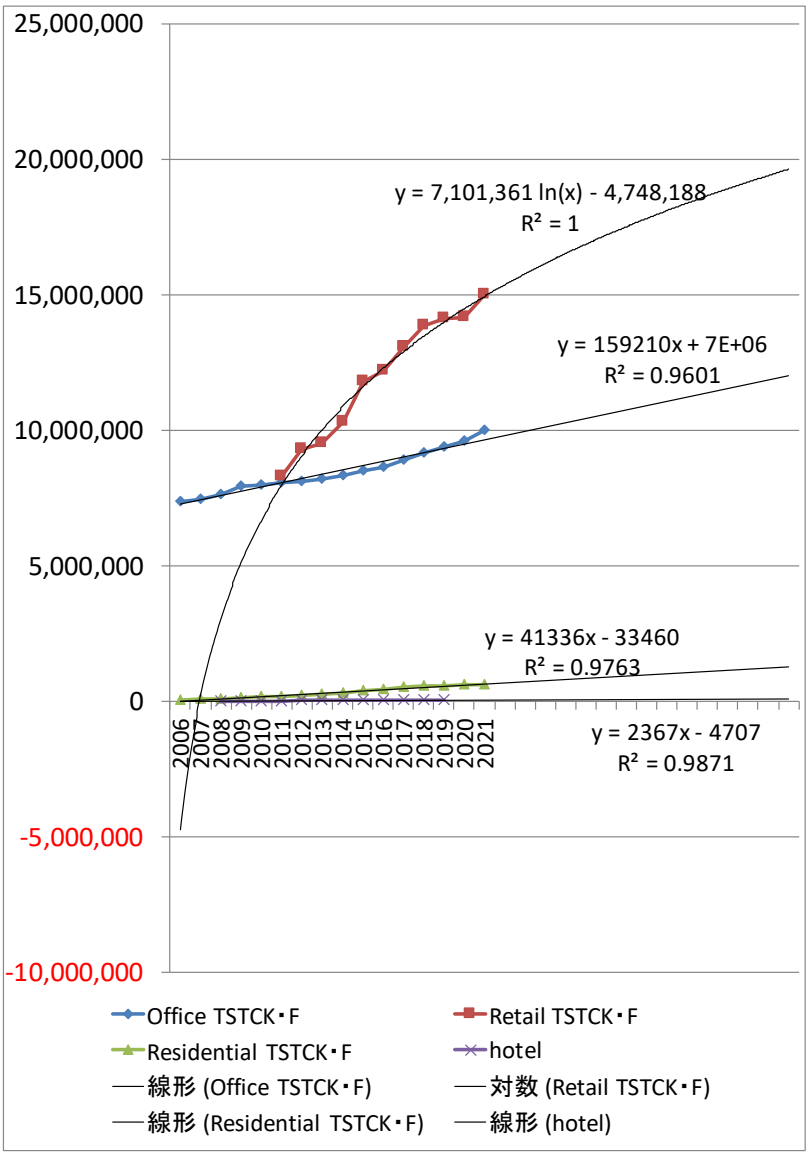


Figure 5.2.7 Past Record and Estimated Trend of Property Supply in Bangkok Property Market

Table 5.2.2 Estimated Property Stock in Bangkok and its Environs after 2022

	Office (m^2)	Retail (m^2)	Condominium (unit)	Hotel (room)
2021 (Planned figure)	9,977,252	14,992,162	584,061	45,000
2027 (Estimated figure)	11,392,628	18,656,739	1,082,612	59,202
2032 (Estimated figure)	12,188,678	19,863,254	1,289,292	71,037
2037 (Estimated figure)	12,984,728	19,863,254	1,495,972	82,872

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

5.2.4 Shares of Central North and Inner North Submarkets in Property Supply in Bangkok and its Environs

The shares of Central North and Inner North submarkets in the property supply in Bangkok and its environs are as shown in Table 5.2.3, Table 5.2.4, and Table 5.2.5 . Data of the hotel room stock and plan in each submarket is not available.

The share of office grows from 2016 to 2021, both in Central North and Inner North. The growth in Central North, which is closer to CBD than Inner North, is outstanding.

Regarding retail, the share of Central North grows firmly, but the trend of Inner North is unclear.

Regarding condominium, comparing the shares in 2006 and 2021, the share of Central North declines. On the other hand, the share of Inner North grows significantly. In fact, along Phahon Yothin Road around Bang Sue Area at the Inner North, many condominiums under construction can be found, as of October 2017.

Table 5.2.3 Share of Property Supply in Bangkok and its Environs (Office)

	2006	2016	2021
Central North	20.6%	22.5%	24.6%
Inner North (including Bang Sue Area)	10.3%	10.9%	11.1%

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Table 5.2.4 Share of Property Supply in Bangkok and its Environs (Retail)

	2006	2016	2021
Central North	6.9%	7.8%	9.4%
Inner North (including Bang Sue Area)	7.8%	10.1%	8.3%

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Table 5.2.5 Share of Property Supply in Bangkok and its Environs (Condominium)

	2006	2016	2021
Central North	16.8%	15.2%	14.5%
Inner North (including Bang Sue Area)	5.5%	15.8%	17.1%

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Upon these data, the shares in 2021 shown below are applied to allocate the estimated property supply to Inner North.

1) Office：11.1%
2) Retail：8.3%
3) Condominium：17.1%
4) Hotel：11.1% (Share of hotel is assumed the same as that of office)

5.2.5 Share of Chatuchak District in Property Supply at the Inner North

The population share among three districts and one county in Inner North is as shown in Table 5.2.6. It is hypothesized that the share of Chatuchak District in property supply in Inner North will be in parallel with the share of population. Therefore, the population share of Chatuchak District, which is 22.7%, is applied to allocate the estimated property supply to Chatuchak District.

Table 5.2.6 Share of Population at the Inner North

	Bang Sue	Chatuchak	Lat Pharao	Mueang Nonthaburi	Total
Population	126,136	158,130	121,000	332,388	405,266
Population Share	18.1%	22.7%	17.4%	41.8%	100.0%

Source: JST based on data of BMA for Bang Sue, Chatuchak, Lat Pharao, data of World Atlas for Mueang Nonthaburi

5.2.6 Property Supply in Chatuchak District after 2022 (Scenario 0 as a Basic Trend)

The property supply in Chatuchak District (original estimation) in 2027, 2032, and 2037 is as shown in Table 5.2.7.

In 2032, the estimated property supply figures are as follows:

1) Office: 55,704 m^2 (Net Floor Area)

2) Retail: 91,748 m^2(Gross Floor Area)

3) Condominium: 27,367 units

4) Hotel: 656 rooms

Table 5.2.7 Property Stock and Increment in Chatuchak District after 2022

Office (NLA/㎡)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase(㎡)	Chatuchak Increase(㎡)
2021	9,977,252	—		1,107,475		0
2027	11,392,628	1,415,376	1,415,376		157,107	35,652
2032	12,188,678	796,050	2,211,426		245,468	55,704
2037	12,984,728	796,050	3,007,476		333,830	75,756

Retail (GFA/㎡)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase(㎡)	Chatuchak Increase(㎡)
2021	14,992,162	—		1,244,349		0
2027	18,656,739	3,664,577	3,664,577		304,160	69,023
2032	19,863,254	1,206,514	4,871,092		404,301	91,748
2037	20,894,244	1,030,990	5,902,082		489,873	111,167

Codominium (unit)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase(unit)	Chatuchak Increase(unit)
2021	584,061	—		99,874		0
2027	1,082,612	498,551	498,551		85,252	19,346
2032	1,289,292	206,680	705,231		120,595	27,367
2037	1,495,972	206,680	911,911		155,937	35,387

Hotel (room)

	Total Stock	Increase from previous term	Increase from 2011	Inner North Share in 2011	Senario 0 (Original)	
					Inner North Increase(room)	Chatuchak Increase(room)
2021	45,000	—		4,995		0
2027	59,202	14,202	14,202		1,576	358
2032	71,037	11,835	26,037		2,890	656
2037	82,872	11,835	37,872		4,204	954

Note: In this report, the estimated supply will be considered based on market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Chapter 6 Redevelopment Concept Paper and Scenario

6.1 Examination Fields and Progress

Essential urban development-related study fields were examined to elaborate a concept paper.

The examination fields and result are as shown in Table 6.1.1.

Table 6.1.1 Study Fields and Result

No.	Examination Field	Contents
1	Vision	・ Manifestation of future urban development based on socioeconomic trend related to Bang Sue Area.
2	Basic policies	・ Technical, financial, and organizational methods to realize the spatial development in the vision.
3	Spatial structure and formation of the area	・ Whole concept of the methods for spatial development as shown in 1-3 of "Basic policies".
4	Urban functions	・ Urban functions needed in Bang Sue Area deriving from superior plans, market demand, and lessons learned from Japan.
5	Infrastructure to realize the urban functions	・ Kinds and scale of infrastructure necessary for realizing the urban functions and floor supply.
6	Energy infrastructure	・ Water, gas, electric power, cogeneration as well as common duct utility control system.
7	Road networking Route assignment plan	・ Planning of an efficient and safe road network.
		・ Analysis on traffic volume and inflow of people in terms of traffic capacity allowed in the area.
8	Area traffic management	・ Area traffic management including BRT.
9	Preparedness against natural disasters/ BCP	・ Basic policy for disaster preparedness including measures against flooding.
		・ Content of BCP.
10	Accessibility to/ from Bang Sue Station	・ Upgrading users' comfort and area networking by providing skywalks, sky decks, an underground shopping area, elevators, escalators, etc.
11	Land use and related policies	・ Land use planning analyzed in terms of urban functions, floor supply, infrastructure, road networking, and area traffic management.
		・ Guidelines for management of land use and area designing.

Source: JST

6.2 Vision

Bangkok stood the first in the top 20 global destination cities by international overnight visitors in 2016, drawing away from other worldwide major cities like London, Paris, Dubai, New York, Singapore, Kuala Lumpur, Istanbul, Tokyo, etc. Nowadays, Bangkok is considered as one of the major hubs in terms of international movement of people. At the same time, the worldwide interurban competition is getting more and more severe in terms of attracting blue-chip companies, excellent human resources, international conventions, and inbound tourists from foreign countries. In this context, it is important to share a clear development vision widely among all stakeholders with a view of enhancing sustainable development and interurban competitiveness of Bangkok and Bang Sue Area with efficient public and private investments.

Both Thai and Japanese sides basically agreed to embrace the following as Bang Sue Area urban

redevelopment vision. The "Gateway to City of Angels" implies high specifications for redevelopment to realize a dynamic and attractive urban core, where people from all over the world get together for joy and creation.

Concept paper is as shown in Appendix 6-1.

Bang Sue – Gateway to "City of Angels"

A dynamic and attractive super urban core
where people from all over the world get together for joy and creation.
Based on "Government Center", "MICE Center" and "New Industry Incubation Center", Bang Sue Area will be expected to continuously offer different types of original culture, information, and ideas created by all types of people living and getting together in the area.

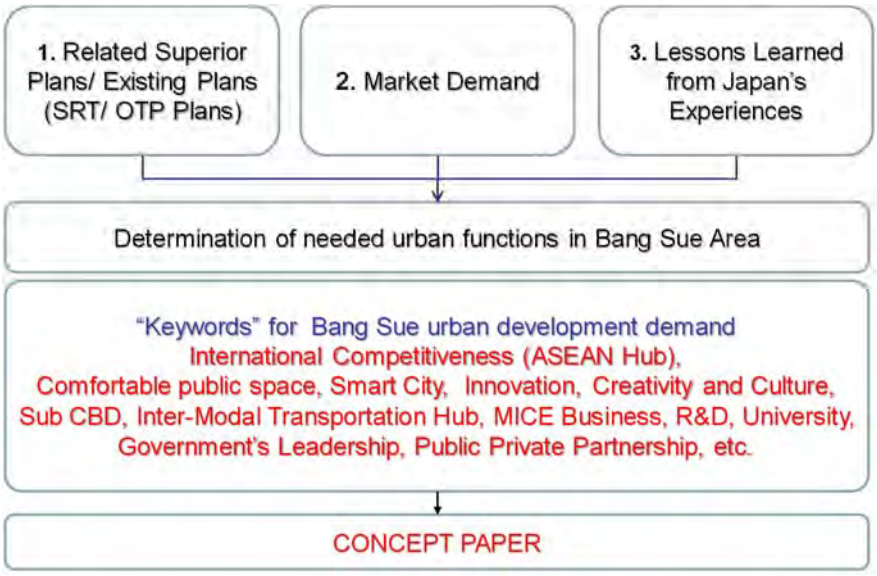
6.3 Development Concept Paper

6.3.1 Urban Functions Needed for Bang Sue Area

Urban functions needed for Bang Sue Area are derived as shown below.

(1) Points of View to Consider Urban Functions Needed for Bang Sue Area

Figure 6.3.1 represents three points of view to consider urban functions needed for Bang Sue Area.



Source: JST

Figure 6.3.1 Three Points of View to Consider Urban Functions Needed for Bang Sue Area

(2) Three Points of View

1) Related Superior Plans/ Existing Plans (SRT/ OTP Plans)

Urban functions required for Bang Sue Area in the superior plans are as shown in Table 6.3.1.

"Thailand 4.0" focuses on medical and wellness, digital IoT, and technological innovation, while socioeconomic plans focus on human resource development, economic competitiveness, and green

development. Thailand has a national policy for enhancing meetings, incentives, conferencing, exhibitions (MICE) in Bangkok by public-private partnership (PPP). The Mass Rapid Transit Master Plan in Bangkok Metropolitan Region (M-MAP) considers Bang Sue Area as one of the intermodal nodes in Bangkok. The Bangkok Comprehensive Plan defines the maximum Floor Area Ratio (FAR) in Bang Sue Area as 800%.

Thus, Bang Sue Area is designated as one of the largest urban development cores in Bangkok and the whole Thailand.

Table 6.3.1 Urban Functions Required for Bang Sue Area in the Superior Plans

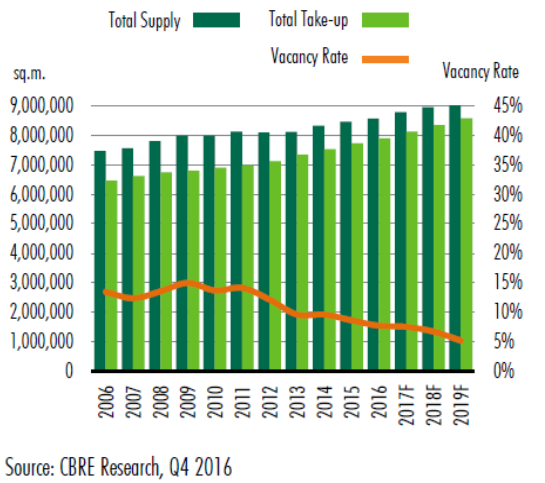
Category	Name of Plan	Keywords related or applicable to Bang Sue Area
Industrial	Thailand4.0	• 1.Medical, Wellness, 2.Digital IoT, 3.Innovation, Culture and high-valued service in five new categories • Keyword for innovation: Smart City, Low-carbon society, Medical Hub, etc.
Economic/Social	The 20-year national strategic plan	• "Green Development" in six areas • 1.Enhancing Human Resource, 2.Strenghthen economy and competitiveness, 3.Green Development in six primary strategies
Economic/Social	The 12th Plan (2017～2021)	• Enhancing Human Resource, Green Development • "Science Technology, Research and Innovation"
Other specific strategy	MICE Strategy	• Thai Government actively promotes MICE under collaboration of government and private sector. • Public Organization: Thailand Convention & Exhibition Bureau (TCEB) • Private sector (association): Thai Exhibition Association (TEA)
Transport	UR-MAP, M-MAP	• Inter-Modal Nodes
Urban Planning	The Bangkok Comprehensive Plan (2013)	• Bang Sue area : Commercial Zone, FAR 8:1 (sub CBD)

Source: JST

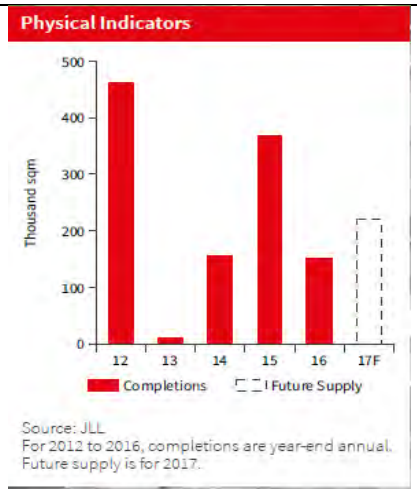
2) Market Demand

The recent market demand for office, condominium, and high-end hotel is generally up trending.

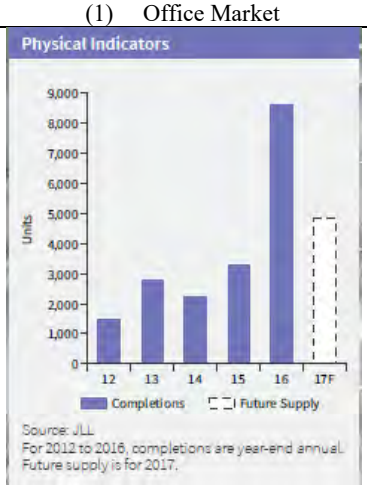
Recent property market demand in Bangkok is as shown in Figure 6.3.2. The floor area of foreign retail also has been increasing with some fluctuations for several years. Presently, Bangkok seems to have a steady property demand to some extent.



(1) Office Market



(2) Foreign Retail Market in Thailand



(3) Condominium Market

(4) High-end Hotel Market

Resource: CBRE/ JLL HP

Figure 6.3.2 Recent Property Market Demand in Bangkok

3) Lessons Learned from Japanese Experiences

The Thai side has visited main cities in Japan, e.g., Yokohama, Saitama, Osaka, Nagoya, Fukuoka, etc., to learn lessons from existing developments. The tips for success in Bang Sue Area development are as shown in Table 6.3.2: Land Mark Tower (Yokohama), civic center with direct connection to the station (Saitama), sky decks/ incubation office/ knowledge center (Osaka), academic organizations (Nagoya), feeder bus terminal connected to the central railway station (Fukuoka).

Table 6.3.2 Tips for Success in Bang Sue Area Development

City and Area In Japan	Important Point of View	What we can propose for Bang Sue Area development?
1. YOKOHAMA Minato-mirai-21	➢"Landmark Tower" ➢Stepwise development	✓A landmark high-rise with symbolic design (SRT Land)
2. SAITAMA Saitama City New Urban Core Area	➢Government office buildings around the station	✓MOT Governmental office building (Zone H)
3. OSAKA Ume-kita	➢Practical flow line planning from/to Station ➢Classy commercial space ➢Comfortable walking space ➢Permanent exhibition space ➢Entrepreneur incubation office space ➢Knowledge capital	✓Commercial strategy/ Flow line from/to Station (Sky decks in Zone A and around Station) ✓Permanent exhibition space for new high-tech products and incubation office space (Zone F/ SRT Land) ✓R&D related facilities (Zone I)
4. NAGOYA Nagoya Station Area including Sasashima-Live-24	➢AICHI University Nagoya Campus	✓Academic institutes including universities (Zone I)
5. FUKUOKA Hakata Station Area	➢Integrated and useful bus terminal with good access to commercial space ➢Station plaza	✓Integrated development of a feeder bus service terminal and commercial space (Zone A)

Source: JST

(3) Major Findings from the Points of View to Determine Needed Urban Functions in Bang Sue Area

The major findings from the Points of View to determine needed urban functions in Bang Sue Area are as shown in Table 6.3.3.

Table 6.3.3 Major Findings from the Points of View to Determine Needed Urban Functions in Bang Sue Area

Point of View	Major Findings in terms of Urban Development in Bang Sue Area	Urban Functions Needed for Bang Sue Area
1. Related Superior Plans/ Existing Plans (SRT/ OTP Plans)	☐ New urban core is needed maximizing the advantages of the best location as one of the main traffic nodes in Bangkok. ☐ Development policy for intellectual value-based industries. ☐ improvement in transport system	☐ Symbolic landmark tower building ☐ Entrepreneur incubation office ☐ R&D related facilities ☐ Medical, health & care related facilities ☐ New modal system development ☐ *Environmentally friendly & attractive development (including Smart City idea)* ☐ *Leadership in ASEAN Community*
2. Market Demand (in Bangkok)	☐ Property market is generally uptrending. ☐ Office/ Commercial/ Residential/ Hotel developments shall be the base of promising regular income for the landowner (SRT).	☐ Office/ Shopping center/ Condominium/ Hotel ☐ MICE related facilities (Arena/ Convention center/ Accommodations) ☐ *Appropriate development size*
3. Lessons Learned from Japan's Experiences	☐ Different urban functions which attract more and more people ☐ Access to/ from nearby stations ☐ Coordination between public and private/ PPP/ Stepwise development ☐ Environmentally and financially sustainable development	☐ Government office building ☐ Comfortable walking/ open space networking ☐ University/ Academic facilities ☐ Station plaza/ Sky plaza ☐ Integrated and useful bus terminal ☐ *PPP/ Public initiative/ Stepwise dev.*

**Italic font: Intangible functions*

Source: JST

(4) Urban Functions Needed in Bang Sue Area

The urban functions needed in Bang Sue Area derived from Table 6.3.3 are as shown in Table 6.3.4. The key functions are “Government Center”, “MICE Center” and “New Industry Incubation Center”. The collateral functions, which will be the main income source for the landowner, are office, commercial, residential, and hotel.

Table 6.3.4 Urban Functions Needed in Bang Sue Area

	Function 1	Function 2	Function 3
Challenging points	Government hospitality for visitors/ comfortable and creative public space	Further diversification of visitors’ purposes	Enhancement of R&D, Intellectual Industry
Key function	Government Center • Gov. building • Museum	MICE Center • Arena/ Convention hall	New Industry Incubation Center • University • Incubation office spaces
Expected effects	• Ensure the ridership of new railways • Allow rapid infrastructure development	• Ensure the ridership of new railways • Make the best use of potential business chances	• Ensure the ridership of new railways • Initiate the country’s industrial policy
Collateral functions	• Office • Commercial • Residential • Hotel		

Note: MICE=Meeting/Incentive Travel/Convention/Event
Source: JST

6.3.2 Development Concept Paper (Draft)

The essence of the draft “Development Concept Paper” is as shown in Table 6.3.5. The draft “Development Concept Paper” is as shown as Appendix 6-1.

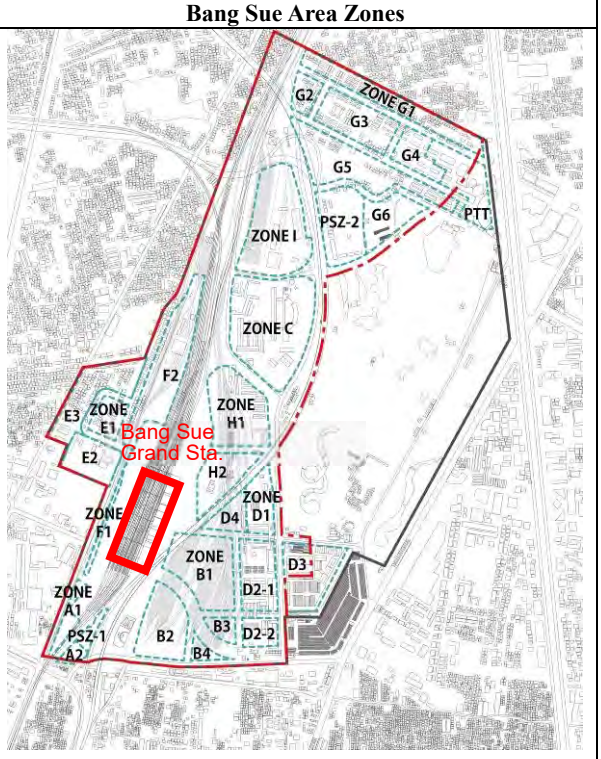
Table 6.3.5 Essence of the Draft "Development Concept Paper"

No.	Essence	Contents
1	Objectives	・ Year 2032, ten years later since Red Line's inauguration, will be the target year of the present concept paper. ・ To clarify development concepts and actions among different stakeholders as common purposes. ・ To widely share, in the international community as well as inside the country, the development needs of CBD and the main roles of Bang Sue Area, which will be one of the main traffic terminals in Bangkok, emerging as a worldwide urban agglomeration.
2	Target Area	Bang Sue Grand Station and neighboring land
3	Vision	As shown in Section 6.2.
4	Basic Concept	Concept 1: To grow up to a centripetal urban core in Bangkok Metropolitan Area, which plays important roles in the international community. (1) To form an international and regional business and interaction center. (2) To ensure sustainability including safety and environmental friendliness. Concept 2: To create an eternally beloved new central district full of various attractiveness. (1) To create various attractions of urban life, from old to new, from a bustle of market places to ultramodern skyscrapers. (2) To create a comfortable walking space so that everyone would enjoy strolling along decks and paths in the area. Concept 3: To create a visitor-friendly traffic terminal area comfortable for everyone. (1) To create a world-class traffic terminal area comfortable for both Thai and foreign visitors. (2) To upgrade the user-friendliness in terms of transfer by creating public spaces. Concept 4: To stepwisely realize the conceptual plan by both public and private sectors. (1) To enhance all kinds of partnership between public-private and private-private, beside a strong initiative by the public, in order to properly realize the conceptual plan.

Source: JST

Urban functions to be assigned by zone are as shown in Table 6.3.6.

Table 6.3.6 Urban Functions to be Assigned by Zone

Zone		Urban Functions to be Assigned	Bang Sue Area Zones
Zone A	1	Office/ commercial/ hotel	
	2	Commercial	
Zone B	1,2	Residential, commercial, office	
	3,4	Commercial	
Zone C		Super arena or MICE facilities of the same kind	
Zone D	1	Hotel/ residential/ office/hospital (high-end constructions in expectation of the increase of foreign guests)	
	2	Residential/ commercial/ hotel/ office	
	3	Residential/ commercial/ hotel/	
	4	Residential/ office	
Zone E (SRT Land)	1,2	Office/ commercial (including a high-rise which will be one of the main landmarks of Bang Sue Area, Knowledge center and incubation office space) Civic center (future headquarters of MOT)/ redidential	
	3	Residential	
Zone F	1	Commercial (retail shops to be constructed under skydecks around Bang Sue Grand Station)	
	2	Office /commercial (including amusement facility) /residential/ hotel	
Zone G	(KM 11)	High-end residential (garden city with abundant greenery space)/ commercial/ office/ hospital/ school	
Zone H	1	Office/commercial/residential	
	2	Office/commercial/residential/hotel	
Zone I		Residential (high-rise condominiums)/ commercial	

Source: JST

6.4 Development Scenario

6.4.1 Development Scenario

There are two types of development, i.e.: Scenario 1 “Individual Development” and Scenario 2 “Integrated Development” as shown in Table 6.4.1 and Table 6.4.2.

Scenario 1 consists of individual development thoroughly by the private sector on an ad hoc basis, while Scenario 2 is a national project based on the country’s distinct policy for upgrading the whole value of Bang Sue Area with an integrated development to provide potential investors with maximum advantages.

Scenario 2 is based on the premise that Thai central government takes a strong initiative in the redevelopment in Bang Sue Area which is indispensable for ensuring an appropriate and effective positioning of urban functions described inTable 6.4.1Table 6.3.1.

In the present report, it is Scenario 2 that is recommended in terms of effectiveness and sustainability

of the redevelopment.

Table 6.4.1 Comparison between "Integrated Development" and "Individual Development"

Development Framework/ Investment Condition		Scenario 1: Individual Development	Scenario 2: Integrated Development
Development Framework	M/P Positioning	M/P approved by SRT Board	M/P approved by Cabinet, designated as special development district
	M/P Contents	Primarily private development of office/retail/ residential area, wherever feasible	Model case of TOD/Smart City with both public infrastructure and private development, orchestrated to maximize land value
	Implementation Structure	Implementation between SRT and Private	Implementation between Gov't, SRT and Private
	Coordination Process	Coordinate separately with each related agency	Establish "One Stop" window for accelerated coordination within special district
	Development Steps	Develop primarily based on availability of land	Step-wise development to maximize land value
Investment Condition	PPP Tender Process	Tender conditions and documents are developed top-down	Tender conditions and documents are developed interactively with inputs from private, so as to ensure bankability
	Leasehold Period	30 years	50 years（based on BMA special zone regulation）
	Government Support	Nothing specific	Tax incentives and longer grace period as part of special development district support
	Expected Results	Usual private development. Profitability and economic effects are changed depending on developer's tendency.	Many bidders, A grade development, high profitability, significant economic benefit

Source: JST

Table 6.4.2 Key Consideration Points for Development Planning and Demand Forecast

Private/ Public	Floor use/ facilities	Scenario1: Individual Development	Scenario2: Integrated Development
Private Development Portion	Office	-Difficult to develop A grade skyscraper under 30 year leasehold condition. Suitable for back office demand, B grade, mid-low rise building.	-Possible to cultivate corporate HQ demand and develop A grade skyscraper. -However, balancing of office space supply is required. For example, ceiling supply set at 20% of total incremental supply forecast in North Bangkok area.
	Retail	-Limited to "flow-based" demand from terminal station pass-thru users. Primarily develop small-mid scale retail outlets to fulfill daily shopping needs.	-Both flow and stock (from office and residential dev) demand as catchment. Large scale retail development assuming destination shopping behavior.
	Hotel	-Business hotel to capture business trips from local cities, three star hotel.	-Capture international visitors, high grade , four to five star hotel.
	Condominium/House	-Difficult to justify landed house under 30year leasehold. Limited to apartments for short-term lease. Development area will need to be limited.	-Condominium and landed houses can be developed under 50year leasehold. Together with green network, prime residential district brand can be developed.
	MICE Facility	-MICE facilities are not feasible since it is difficult to develop as "destination" district.	-MICE facilities can be justified. However, size and function will need to take into account other competing MICE facilities in Bangkok.
Public Infrastructure Portion	Transport facilities（Inner zone roads, skywalk, park&ride, taxi bay, etc.)	-Limited gov't budget for inner zone transport. Private develops portions of transport facility, which may not be sufficient. As a result, transport convenience is sacrificed.	-Proactive development of transport facilities based on gov't budget and PPP availability payment scheme. Inner transport is extremely convenient and recognized as model case of TOD.
	Green and environment friendly network(park, green space, wind corridor, etc.)	-Coordination with city planning is delayed since this is SRT land solely developed by SRT. As a result, green network development is limited.	-Budgeting coordination with city planning is smooth, as this is cabinet approved special district. Ideal green network is developed, which will generate premium value for residential development and add to visitor demand generation.
	Basic utility (water treatment, electricity, gas) ,energy saving and other environment facilities	-Basic utility development requires coordination with multiple agencies, which could cause delay. Private is required to invest in own environment facilities, which sacrifices overall efficiency.	-"One stop" window allows coordinated planning and development of basic utilities. Budget/incentives for smart city related facilities are in place.

Source: JST

6.4.2 Adjustment of Demand Forecast for Scenario 2 (Integrated Development)

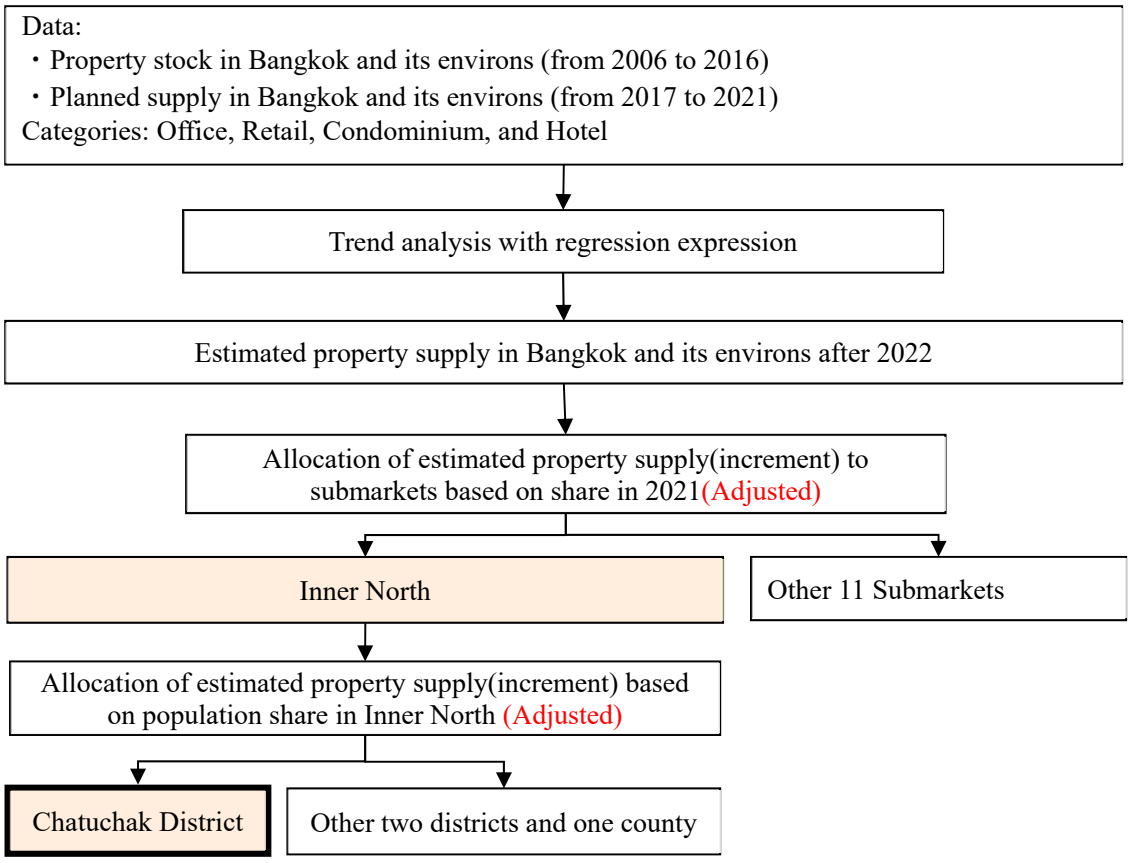
The property demand estimates after 2021 as shown in Section 5.2.4 are estimated by least squares method based on the past trend and the planned floor supply. Be that as it may, more demand will be expected with Scenario 2 (See Section 6.4.1), which is subject to maximizing the gross value added of the redevelopment through government initiative. Key points for development planning and demand forecast are considered in the present section.

(1) Methodology

With Scenario 2, it is considered that the additional value in Bang Sue Area would be maximized with the strong initiative of the Government of Thailand. Bang Sue Area would be more attractive and classy as newly developed urban core. In addition, there would be more demand of urban development around Bang Sue Area as transportation hub.

Therefore, in the present section, "shares of Inner North submarket in Bangkok and its environs" and "share of Chatuchak District in Inner North submarket" are adjusted for Scenario 2.

The process of estimation abovementioned and adjusted items is as shown in Figure 6.4.1.



(Property supply in Chatuchak District is considered as property supply in Bang Sue Area.)

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Figure 6.4.1 Process of Future Property Supply in Bang Sue Area

(2) Estimation of Future Property Supply in Bangkok and its Environs

Estimated property supply in Bangkok and its environs after 2022 is as shown in Table 6.4.3.

Table 6.4.3 Estimated Property Stock and Increment in Bangkok and its Environs after 2022

	Office (m^2)	Retail (m^2)	Condominium(unit)	Hotel (room)
	(Total Stock)			
	(Total Supply after 2022)			
2021 (Planned figure)	9,977,252	14,992,162	584,061	45,000
2027 (Estimated figure)	11,392,628	18,656,739	1,082,612	59,202
	1,415,376	*3,664,577*	*498,551*	*14,202*
2032 (Estimated figure)	12,188,678	19,863,254	1,289,292	71,037
	2,211,426	*4,871,092*	*705,231*	*26,037*
2037 (Estimated figure)	12,984,728	20,894,244	1,495,972	82,872
	3,007,476	*5,902,082*	*911,911*	*37,872*

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

(3) Adjustment of Shares of Central North and Inner North Submarkets in Property Supply in Bangkok and its Environs

The future share of Inner North is adjusted based on its share in 2021 and share of Central North in 2021. Adjusted shares of property supply of Inner North submarket in Bangkok and its environs are as shown in Table 6.4.4. The foundation of adjusted shares is as shown below.

1) Office: Referring to 38%, the average share of Central North in increased floor area from 2007 to 2016. It was adjusted slightly lower than 38%, to consider it should be a long-term trend.
2) Retail: Referring to the average share of Central Bangkok (29%) and Inner North (21%) in increased net floor area from 2007 to 2016. The redevelopment of Bang Sue Area may bring more concentration of shopping malls to the Inner North; therefore 25% as in between of 29% and 21% was adopted.
3) Condominium: Simply referring to 18%, the average share of Central North in increased floor area from 2007 to 2016.
4) Hotel: As the submarket data is not available, it simply referes to the adjusted share of office (30%), as the trend of distribution of hotels generally has high correlation as with the offices.

Table 6.4.4 Adjustment of Shares of Property Supply of Inner North in Bangkok and its Environs

	Office（m^2）	Retail（m^2）	Condominium（unit）	Hotel（room）
Share of Inner North in 2021	11.1%	8.3%	17.1%	11.1%
Inner North Adjusted Share	30.0%	25.0%	18.0%	30.0%

Note: Share of hotel is assumed as the same as the office
Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

(4) Share of Chatuchak District in Property Supply in Inner North

By considering having Bang Sue Area as a transportation hub within the district, shares of Chatuchak District are adjusted as shown in Table 6.4.5.

1) Office: 80%
2) Retail: 60%
3) Condominium: 25%
4) Hotel: 80%

Table 6.4.5 Adjusted Shares of Chatuchak District in Property Supply in Inner North

	Office（㎡）	Retail（㎡）	Condominium（unit）	Hotel（Room）
Share based on population share	22.7%	22.7%	22.7%	22.7%
Adjusted share	80.0%	60.0%	25.0%	80.0%

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

(5) Property Supply in Chatuchak District After 2022 (high-end estimation for Senario 2)

Property supply in Chatuchak District (high-end estimation for Senario 2) in 2027, 2032, and 2037 is as shown in Table 6.4.6. At the point of 2032, figures of estimated property supply are as follows:

1) Office: 530,742 m^2 (NFA)
2) Retail: 730,664 m^2 (GFA)
3) Condominium: 31,735 units
4) Hotel: 6,249 rooms

Table 6.4.6 Property Supply in Chatuchak District after 2022 (High-end Estimation)

Office(NLA/㎡)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(㎡)	Chatuchak Increment(㎡)
2021	9,977,252	—		1,107,475		
2027	11,392,628	1,415,376	1,415,376		424,613	339,690
2032	12,188,678	796,050	2,211,426		663,428	530,742
2037	12,984,728	796,050	3,007,476		902,243	721,794

Commercial(GFA/㎡)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(㎡)	Chatuchak Increment(㎡)
2021	14,992,162	—		1,244,349		
2027	18,656,739	3,664,577	3,664,577		916,144	549,687
2032	19,863,254	1,206,514	4,871,092		1,217,773	730,664
2037	20,894,244	1,030,990	5,902,082		1,475,520	885,312

Condominium(戸)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(unit)	Chatuchak Increment(unit)
2021	584,061	—		99,874		
2027	1,082,612	498,551	498,551		89,739	22,435
2032	1,289,292	206,680	705,231		126,942	31,735
2037	1,495,972	206,680	911,911		164,144	41,036

Hotel(部屋)

	Total Stock	Increment from previous term	Increment from 2021	Share of Inner North in 2021	High-end estimation	
					Inner North Increment(room)	Chatuchak Increment(room)
2021	45,000	—		4,995		
2027	59,202	14,202	14,202		4,261	3,408
2032	71,037	11,835	26,037		7,811	6,249
2037	82,872	11,835	37,872		11,362	9,089

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

(6) Conversion from Property Supply (high-end estimation) to Gross Floor Area

Estimated property supply in Chatuchak District will be the basic information to study the floor volume and the layout in the stage of studying the “development plan”. Thus, estimated net floor area for office, units for condominium, and rooms for hotel will be converted to gross floor area.

The basic units for conversion to gross floor area are as shown in Table 6.4.7.

Table 6.4.7 Basic Units for Conversion to Gross Floor Area

Category	Average Floor Area / One Unit or Room	Rentable Area Rate
Office	—	60%
Condominium	80 m^2/ unit	70%
Hotel	35 m^2/room	60%

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided by Jones Lang LaSalle

Based on the basic units for conversion to gross floor area, future gross floor area in Chatuchak District in 2032 is estimated as shown in Table 6.4.8. To be balanced with the market demand, the total floor area will be developeded step-by-step under the principle of stepwised development as shown in Section 6.4.3

Table 6.4.8 Future Gross Floor Area in Chatuchak District in 2032 (Scenario 2)

Category	Gross Floor Area	Share
1) Office	884,570 m^2	15.8%
2) Retail	730,664 m^2	13.0%
3) Condominium	3,626,902 m^2	64.7%
4) Hotel	364,518 m^2	6.5%
Total	5,606,654 m^2	100.0%

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST, based on data provided byJones Lang LaSalle

6.4.3 Estimated Demand for Scenario 1 (Individual Development)

Investment conditions for Scenario 1 consist of individual development having more disadvantages for private investors than Scenario 2 consisting of integrated development plan as shown in Table 6.4.1. Therefore, it will be expected that less development could be achieved in case of Scenario 1 compared with Scenario 2. As figures for reference, demand for Scenario 1 is estimated under the condition as shown in Table 6.4.9. The estimated gross floor areas are as shown in Table 6.4.10.

Table 6.4.9 Conditions for Adjustment of Shares in Each Scenario

Category	Adjustment of Inner North's Shares of Property Supply in Bangkok and its Environs			Adjustment of Chatuchak District's Shares of Property Supply in Inner North		
	Scenario 0	Scenario 1	Scenario 2	Scenario 0	Scenario 1	Scenario 2
1) Office	11.1%	25.0%	30.0%	22.7%	30.0%	80.0%
2) Retail	8.3%	Only within 400 m from the station	25.0%	22.7%	Only within 400 m from the station	60.0%
3) Condominium	17.1%		18.0%	22.7%	10%	25.0%
4) Hotel	11.1%		30.0%	22.7%	Only within 400 m from the station	80.0%

Note: In this report, estimated supply will be considered as market needs and demand.
Source: JST

Table 6.4.10 Future Gross Floor Area in Chatuchak District in 2032 (Scenario 1and 2)

Category	Gross Floor Area (Scenario 1)	Gross Floor Area (Scenario 2)
1) Office	276,438 m^2	884,570 m^2
2) Retail	453,536 m^2	730,664 m^2
3) Condominium	420,482 m^2	3,626,902 m^2
4) Hotel	142,951 m^2	364,518 m^2
Total	1,293,407 m^2	5,606,654 m^2

Source: JST

6.4.4 Stepwise Development

(1) Development Preconditions

The development preconditions are described below.

- The present bus terminal in Zone C will be relocated in Old Mo Chit by 2023.
- Japanese side will propose development phasing and land use for the zones which are not mentioned in Thai side's existing plan.

1) Middle and long distance bus terminal

Middle and long-distance bus terminal is planned to be relocated. An adequate place was considered in terms of accessibility to Bang Sue Grand Station, center of Bangkok, commercial buildings nearby and construction easiness.

As shown in Table 6.4.11 Comparison Table for Medium and Long Distance Bus Terminal, parking space in front of Mo Chit Station (Old Mo Chit) can be considered as adequate relocation place. Main reason is that this place is close to Bang Sue Grand Station, Blue Line, and Green Line, thus, it has high accessibility to the center of Bangkok City. Secondly, Old Mo Chit is close to Chatuchak Weekend Market and Zone D that is possibly developed. Thirdly, Old Mo Chit is currently used as parking place; therefore, construction is easier than other candidates.

Furthermore, parking place in front of Mo Chit Station will be developed in high density. Bus platform and depot should be separated and depot should be moved to the dead space under the existing expressway. Some of the middle and long-distance buses already use the dead space as depot.

Table 6.4.11 Comparison Table for Medium and Long Distance Bus Terminal

	Items	Zone B	Zone C (Mo Chit 2)	Near Mo Chit Station、 BTS Depot (Old Mo Chit)	Outside of Bang Sue Area Distant Place
1	Accessibility from Bang Sue Grand Station	○ 200 m from the station	△ Over 1 km from the station	○ Stop at the station	× Far from the station. If BT is close to the train station, passengers can access by train.
2	Comfortablity using the access road from Bang Sue Grand Station	○ Underpass	○ Underpass	○ Skywalk	— Depends on the location
		△ Ground level walkway（partially cross with road）	○ Skywalk and ground level walkway		
3	Accessibility to the center of Bangkok （ Accessibility to railway station）	△ Close to Blue Line and Red Line	× Disconnected by train	○ Close to two stations of Blue Line and Green Line	— Depends on the location
4	Accessibility to BMTA Bus Terminal （Terminal is planned between Zone A and B）	○ Close to BMTA Bus Terminal	× Far from BMTA Bus Terminal	△ Connects with Blue Line	— If BT is close to the train station, passengers can access by train
5	Accessibility to expressway	△ Connect if geometric design satisfied the necessary condition	× Difficult to connect with the expressway since several roads run complicated	× Disconnected with the expressway	— Depends on the location
6	Accessibility to commercial buildings	○ Easy access to commercial buildings around Bang Sue Grand Station	△ Access to commercial buildings in the north of Bang Sue Grand Station	○ Easy access to existing market and planned commercial buildings	— Depends on the location
7	Environment impact on bus terminal	△ Noise and vibration should be considered since railway facility is located nearby	○ No obstruction	○ No obstruction	— Depends on the location
8	Construction easiness	× Need to remove railway	△ Need to demolish the existing building or newly built building	○ No obstruction since it is currently used as parking space	— Depends on the location
9	Traffic congestion around the bus terminal	△	×	○	— Depends on the location
	Conclusion ※If several choices are presented in one item, adopt the better one	○：4 items △：4 items	○：2 items △：3 items	○：6 items △：2 items	No conclusion since most items depend on the location

Note:BT=Bus Terminal（Bus Platform）

Source: JST

(2) Development Phasing in the Thai Side's Existing Plan

The target year sectioning (short, middle, and long) that the Japanese side proposes is consistent with that of the Thai side. Table represents the development phasing of each zone according to the Thai side's existing plan.

Table 6.4.12 Development Phasing of Each Zone According to the Thai Side's Existing Plan

No.	Development Zone/ Facility	Short (-2022)	Middle (-2027)	Long (-2032)
1	Red Line/ Grand Station	Start-End	Operated	Operated
2	Airport Link	Start-End	Operated	Operated
3	Zone A	Start-End	Operated	Operated
4	Zone D	Start	End	Operated
5	Skywalk (A-D Intersection)	Start	End	Operated
6	Zone B	Start	Being constructed	End
7	Zone C	Start	Being constructed	End
8	KM11	Start	End	Operated
9	BKT (Old Mochit)	Start	End	Operated
10	BRT (Area Bus Service)	Start	End	Operated

Source: JST based on existing development schedule planned by Thai side (Start: Groundbreaking, End: Opening)

(3) Recommendable Stepwise Development

The stepwise development that is as shown in Table 6.4.13 is recommendable in terms of the following points of view: (a) inauguration of new urban mass transit railways, which are being constructed or will be constructed, (b) land status (availability, infrastructure including different types of utility), (c) market demand, and (d) financial arrangements.

Table 6.4.13 Recommendable Stepwise Development

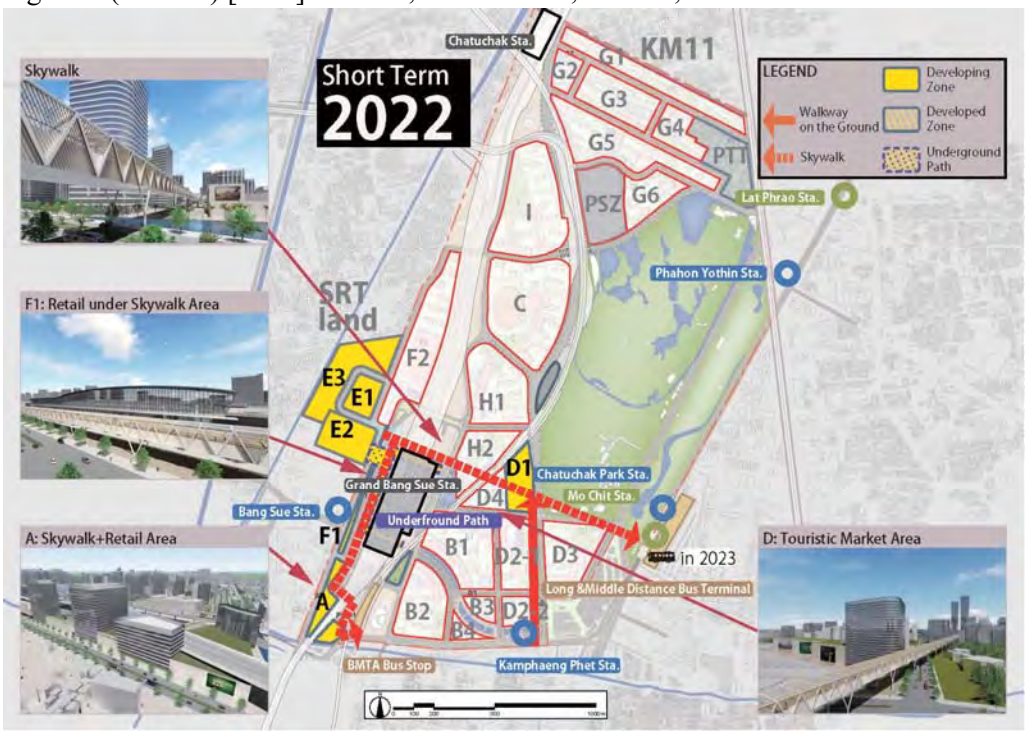
	短期・Short-term（～2022）	中期・Mid-term（～2027）	長期・Long-term（～2032）
Stepwise Development Concept	Establish key areas of the terminal station as the "core function" of development and create external links.	Expand office and commercial development in station surrounding area to strengthen "core function". Develop residential district and differentiating city function.	Obtain community feedback and further enhance integrated development
Concept1: To grow up to a centripetal urban core in BMA which plays an important role in the international community	Populate the station with zone A and Bang Sue Grand station ground/underground level commercial complex (for railway and inner city bus users). Establish international image with top class hotel (linked to station).	Develop advanced high-rise office complex, including land mark building (sky scraper). Commercial complex development to reach scale for shopping destination. （Zone F1, F2, SRT Land). Development of MICE related facilities and further strengthen attractiveness as visiting destination (Zone C).	University and Ministerial Building Complex development (Zone I, H).
Concept2: To create an eternally beloved new central district full of various attractiveness	Develop skywalk to connect Bang Sue Grand station with office, commercial complex and Mo Chit station. Create touristic market area (Zone D hotel, commercial, office) and strengthen links with Chatuchak Park.	Expand skywalk and ground walkway to connect multiple zones and create fun atmosphere for pedestrian. Develop green park and residential district (KM11).	Integrated development of area between Bang Sue station and Chatuchak (Zone B). (Note: This is only possible if current depot location is shifted to another place in the future)
Concept3: To create a visitor-friendly traffic terminal area comfortable for everyone	Station plaza, bus terminal (inner city) , taxi bay, transit-friendly pathway and signage. Start shifting mid-long distance bus terminal from Zone C to old Mochit.	Escalator, membrane roof, underground air ventilation, barrier-free facility. New mid-long distance inter-city bus terminal completed in old Mochit.	Install travellator and promote access between zones. Operate shuttle bus within Bang Sue redevelopment area for visitor circulation.
Funding Perspective	Utilize concession fee discounts to generate public infra funds. Also, upfront fee payment or FAR bonus could be used to pool fund for the next phase	Advance public infra development using pool fund. Extract premium concession for F2, SRT Land and pool for next phase	Advance green park development and enhance the value of residential district. With land value increase, pool part of property tax for sustainable maintenance.

Source: JST

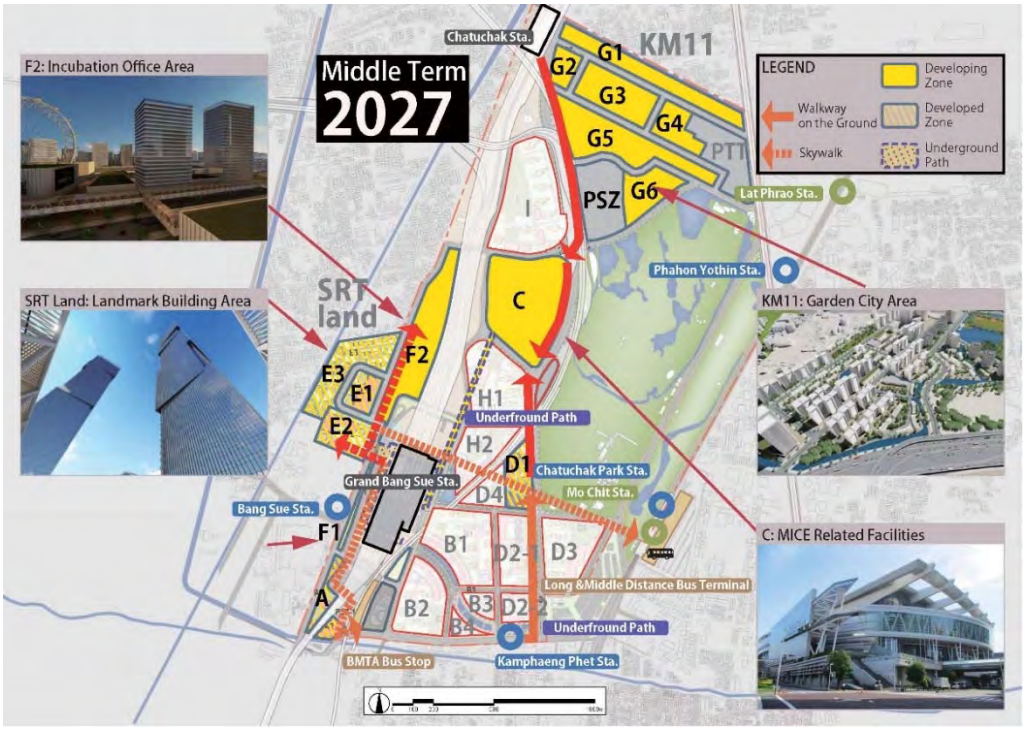
6.4.5 Stepwise Development by Zone

The recommendable stepwise development by zone is as shown in Figure 6.4.2.

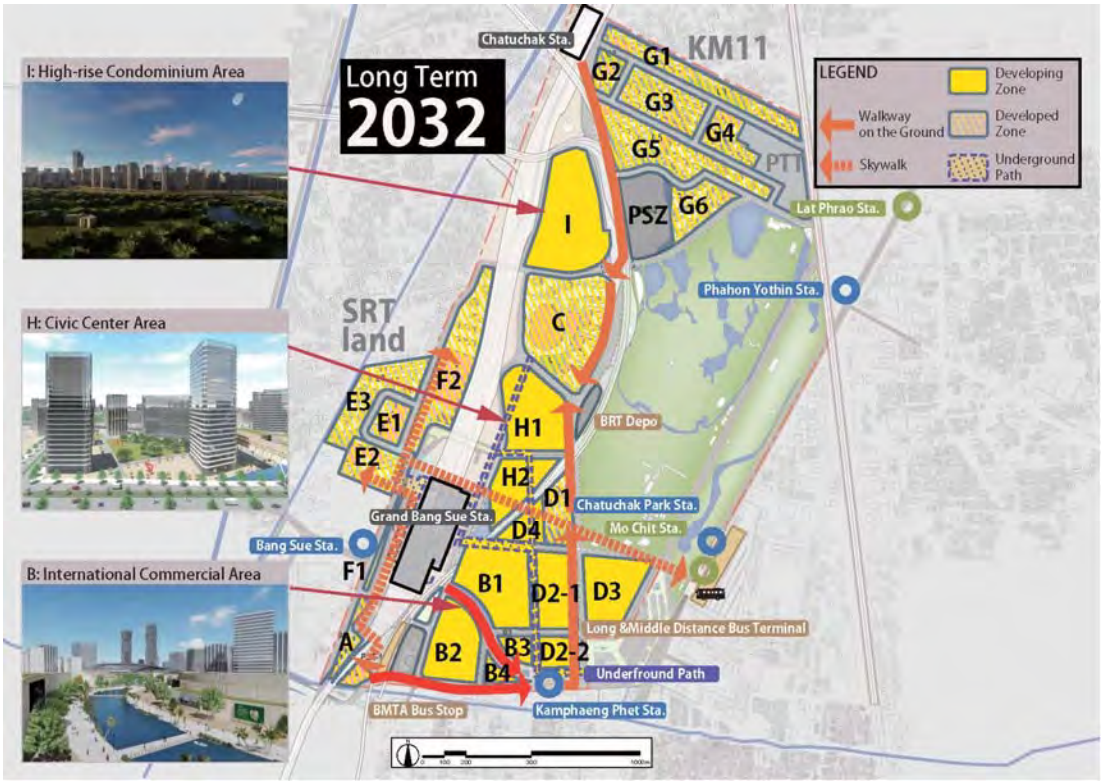
- Short term (Phase 1) [- 2022]: Zone A, Zone D1, Zone F1, SRT Land, underground shopping mall, and skywalks around Bang Sue Grand Station
- Middle term (Phase 2) [2027]:Zone C, Zone F2, KM 11, other skywalks, and sidewalks
- Long term (Phase 3) [2032]: Zone B, Zone D2/D3, Zone H, and Zone I



Short term (Phase 1) [- 2022]



Middle term (Phase 2) [- 2027]



Long term (Phase 3) [- 2032]

Source: JST

Figure 6.4.2 Stepwise Development by Zone

Table 6.4.14 Recommendable Stepwise Development by Zone

No.	Development Zone/ Facility	Short (-2022)	Middle (-2027)	Long (-2032)
1	Red Line/ Grand Station	Start-End	Operated	Operated
2	Airport Link	Start-End	Operated	Operated
3	Zone A	Start-End	Operated	Operated
4-1	Zone D1	Start	End	Operated
4-2	Zone D2/D3	-	-	Start
5	Skywalk (A-D Intersection)	Start	End	Operated
6-1	Zone B1,B2	-	-	Start-End
6-2	Zone B3,B4	-	-	Start
7	Zone C	-	Start-End	Operated
8	KM11(Zone G)	-	Start-End	Operated
9	BKT (Old Mochit)	Start	End	Operated
10	BRT (Area Bus Service)	-	Start-End	Operated
11-1	SRT Land (Zone E1,E3)	Start-End	Operated	Operated
11-2	SRT Land (Zone E2)	Start	End	Operated
12	Zone F	-	Start-End	Operated
13	Zone H	-	-	Start
14	Zone I	-	-	Start-End

Note: Colored cells were proposed by the Japanese side. Red printed cells are different from the Thai side's original ideas.
Note: Red Line, Grand Station, and Airport Link inauguration timing is consistent with that of Thai side's existing plan.
Source: JST (Start: Groundbreaking, End: Inauguration)

Chapter 7 Proposed Development Plan of Bang Sue Area

7.1 Basic Policies in the Development Plan

7.1.1 Basic Policies

In formulating a development plan (proposal) for the Bang Sue Area, with the objective of achieving the realization of the vision, the JICA Study Team (JST) made considerations based on various factors such as the content of the top-level plans, location-related conditions in the district, and socioeconomic trends. JST also referred to the contents of related plans that have been developed to date under organizations such as the State Railway of Thailand (SRT) and the Office of Transport and Traffic Policy and Plan (OTP) and introduce experience and know-how gained through past experiences of large-scale urban development projects in Japan. Basic policies for carrying out such considerations are shown in Table 7.1.1.

Table 7.1.1 Plan Formulation Policies

Policy	Matters for Care and Consideration
(1) To grow up to a centripetal urban core in Bangkok Metropolitan Area which plays important roles in the international community	• To elaborate an integrated master plan for successful redevelopment of the entire area. • To place core facilities including a landmark tower building, a smart city, etc. • To introduce attractive urban functions that boost development potential of the entire area.
(2) To create an eternally beloved new central district full of various attractiveness.	• To introduce the main facility to connect and organize each zones • To develop infrastructure and public spaces that make the entire area more attractive. • To prepare a guideline to promote a well-balanced area development. • Introduce upgraded infrastructure and facilities that will contribute to increasing the potential of the district. • Place (and guide people to) applications and functions that will increase the potential of the entire area. • Introduce guidelines for driving planned urban development.
(3) To create a visitor-friendly traffic terminal area comfortable for everyone.	• To ensure comfortable transfer between railway stations and other transport modes. • To construct pedestrian decks and plazas. • To introduce a feeder transport mode (ex. BRT) and make the best use of ITS in the area.
(4) To stepwisely realize the conceptual plan by both public and private sectors.	• To elaborate a stepwise implementation plan ensuring feasibility and viability. • Consider an appropriate division of labor to ensure a “win-win” To introduce vitality and resources of private sector. • To consider the best role-sharing system that ensure a win-win partnership for both public and private sectors.

Source: JST

7.2 Basic Plan

7.2.1 Basic Conditions for Plan Formulation

Before formulating a plan for the Bang Sue Area, the JST will summarize the main development bodies and division of cost burdens for each of the various city functions to be proposed in the development plan proposal. At the same time, the JST will outline the jurisdiction over these facilities to be transferred to the public bodies, and how these be maintained and managed in the future. These matters are outlined below.

(1) Envisaged Main Development Bodies and Division of Cost Burdens for City Infrastructure

As a general rule, the principal developers for supply and processing facilities (e.g., water supply and sewage processing) and other fundamental city infrastructure that are essential to city life should be the administrative bodies such as national and/or local government agencies, whose mission is to provide fundamental infrastructure for the citizens.

On the other hand, where urban development is being carried out on privately-owned land and utilizing various assets, there are some cases in which the rights of the owners stand to profit or otherwise benefit from the development bearing part of the development costs themselves.

In the case of the Bang Sue Area, all of the development land is owned by SRT, and so it can be envisaged that SRT will benefit from the development. Therefore, when developing roads, parks, supply and processing facilities and other city infrastructure, it is desirable for SRT to bear a certain portion of the cost burden, or to carry out the development in collaboration with the national government and/or local public bodies.

(2) Envisaged Maintenance, Management, and Transfer of Jurisdiction for City Infrastructure

Public land such as roads and parks are facilities that are made available for free public use. As such, it is desirable for these facilities to be maintained and managed by public bodies. As a general rule, the rights of ownership to the land on which the facilities are located are also typically transferred to the public bodies who are maintaining and managing them. However, in the preliminary meetings with SRT and Bangkok Metropolitan Area (BMA), JST saw many real examples in which existing facilities such as parks and roads in the district are being maintained and managed by BMA while the rights to the actual land itself remained with the ownership of SRT. For this reason, it is desirable for SRT and BMA to discuss and decide the issue on transfer of jurisdiction in the future.

7.2.2 Project Area

(1) Concepts on the Project Area

The project area is set to be the site owned by SRT. The boundary of the site is not clear, but it will be confirmed with SRT later. In the site, there are Bang Sue Grand Station, Chatuchak Park, and public roads (Figure 7.2.1). From the perspective of maintenance and management, it is expected that land for public roads would be transferred to the Bangkok government.

Source: JST

Figure 7.2.1 Project Area

(2) Settings of the Project Area

Areas before and after development are shown in Table 7.2.1

Table 7.2.1 Areas Before and After Development

	Usage	Area (ha)		Rate of Change
		Before	After	
Public spaces	Road	29	44.5	+53%
	Park, greenbelt	115	115	±0%
	River	1.5	1.5	±0%
	Subtotal	145.5	161	+11%
Residential area	Commercial and office	24	19.7	-18%
	Complex	0	98.8	—
	Residential	55	56	+2%
	Railway	198.6	94.3	-53%
	Expressway	11.8	11.8	±0%
	Other public facilities	18	11.1	-38%
	Subtotal	307.5	292	-5%
	Total	453	453	±0%

Source: JST

7.3 Concepts on Urban Infrastructure Development

In this section, plans such as fundamental urban infrastructure, environment and green network and transportation network are summarized. Infrastructure plan(Appendix 7-1) and facilities plan(Appendix 7-2) are attached as appendix.

7.3.1 Fundamental Urban Infrastructure

(1) Land Preparation Plan

As for flooding prevention, land height is 1 m above the height of road paving. In case of flooding, road surface can serve as emergency drains. Slope of land is planned to be at 0%. Land used for important facilities such as substations, water treatment plant, and wastewater treatment plant is 1.5 m above the height of road paving.

(2) Road Structural Plan

1) Road Alignment

Trunk roads of about 250 m wide will be constructed as zone boundaries. Existing road networks will be utilized and relocation of existing buildings will be minimized. In addition, as the land above the MRT is not allowed for buildings, it is planned for road construction. Zone C and Zone D will be separated by six-lane road, however, to ensure the integration of Bang Sue development, an underpass is planned for connections between two zones.

2) Typical Cross Section

Roads in the project area are planned with the following functions:

・Transport function (road ability, accessibility, and capacity)

・Space function (environment protection space, disaster prevention space, utility accommodation space, and urban landscape formation)

Typical cross section is planned as shown in Table 7.3.1.

Table 7.3.1 Typical Cross Section

Item	Width
Carriageway (two-lane/direction)	16 m(4 m x 4)
Central median strip	5 m
Sidewalk (utility zone)	14 m(7 m x 2)

Source: JST

(3) Storm Drainage Plan

Storm drainage plan is shown in Table 7.3.2.

Table 7.3.2 Overview of Storm Drainage Plan

Item	Contents
1) Plan area	170 ha
2) Storm water collection method	Separate system
3) Plan flow rate for storm drains	Flow rate of five-year flooding probability
4) Storm water retention pond	Capacity equivalent to ten-year flooding probability

Source: JST

The project area is generally flat. Storm water collection area is divided by trunk roads into four zones. At the end of each flow, there are retention ponds and drainage pumping station. Then, storm water is pumped from the station to existing rivers for discharge. The drains are constructed by concrete pipes or box culvert and installed on the road sides. Drains are planned to be continuous and connected to the pond in Chatuchak Park.

(4) Water Supply Plan

Demand forecast for water supply is shown in Table 7.3.3. In the table, Q=53,000 m^3/day.

Table 7.3.3 Demand Forecast for Water Supply

Type	Water Unit (L/person/day)	Population	Demand (m^3/day)
Office	70	44,230	3,096
Commercial	70	292,280	20,460
Residential	200	126,942	25,388
Hotel	375	9,373	3,515
Total		483,605	52,459

Source: JST

Water supplied for Bang Sue is treated at Bang Khen Water Treatment Plant (WTP) (3.9 million m^3/day) owned by BMA and delivered from Phahon Yothin Pump Station. Water supplied for Bang Sue is planned to be connected to the existing water supply pipeline under trunk roads in more than four points. The high-density polyethylene (HDPE) is used for supply pipes. From the water demand of the district, it is proposed that two water tanks with pressure pumps should be installed to prevent decrease in water pressure. These water tanks also have important role in emergency situations such as power cut.

To accommodate increased demand for Bang Sue Area, it is planned to expand Bang Khen WTP and increase the supply pipeline from Bang Khen WTP to Bang Sue Area. Distribution pipeline is planned as loop system so that the area to be affected by water cut will be minimized when there is accident damaging the water pipe. In each zone, it is compulsory to install

a water receiving tank.

(5) Sewage Plan

Plan sewage volume is 80% of the water demand; and capacity of the wastewater treatment plant (WWTP) is Q=53,000 x 80%=42,400 m^3/day.

The following is the sewage plan: Sewage collection area is divided into two blocks. The north block will discharge sewage to WWTP that will be constructed next to the existing Bang Sue WWTP. Sewage from the south block will be discharged to WWTP that will be constructed next to Block A. Plan sewage volume is 80% of water demand. Sewage system is separated system, thus, only wastewater will flow to WWTP. Sewage pipes are installed in utility space under sidewalks. Intermediate pump will be installed where the depth is more than 4 m. HDPE pipes will be used for sewage pipes. Manhole will be arranged in each 40 m and each zone will be connected to the nearest manhole. First stage treatment is not necessary in each zone. WWTP will be constructed in two locations.

(6) Power Supply Plan

1) Demand Forecast

Power peak load and power demand are predicted from power use unit and floor area. Power use unit is referred from the report of SRT in 2015 entitled “Study on Possibility of Commercial Area Development in Bang Sue Grand Station” and Guidebook on Plan-Design-Operation of City Gas Cogeneration by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan. The demand forecast is shown in Table 7.3.4 and Table 7.3.5.

Table 7.3.4 Power Load in Peak Time

Building Use	Power Consumption Rate [W/m^2]	Total Floor Area [m^2]	Peak Load [MW]
Office	62.500	884,600	55.3
Commercial	62.500	730,700	45.7
Hotel	34.375	364,500	12.5
Residence	30.000	3,626,900	109.8
Total	-	5,606,700	222.3

Source：The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan

Table 7.3.5 Power Demand Forecast

Building Use	Quantity of Power Consumption Rate [kWh/m^2・y]	Total Floor Area [m^2]	Peak Demand Amount [MWh/v]
Office	115	884,600	101,729
Commercial	284	730,700	207,519
Hotel	183	364,500	66,704
Residence	183	3,626,900	663,723
Total	-	5,606,700	1,039,674

Source：JST, Air-Conditioning and Sanitary Engineers of Japan

2) Policies on Developing Power Infrastructure

A transmission line is to be installed from the substation in the north of redeveloped area to the substation of the Red Line Project (220 kV/115 kV/24 kV). The other two 180 MVA substations (No.1 and No.2) will be constructed in the redeveloped area. From the perspective of infrastructure initial investment, the first one (Substation No.1) is proposed to be constructed near Zone A as it can be used in the initial development phase (Development Phase I). The required area is about 3,600 m^2 (60 m×60 m). The transmission line is 110 kV. From substation (220 kV/115 kV/24 kV) to Substation No.2, transmission line will be installed on the side of Red Line’s tracks. The route of transmission line is shown in the basic plan drawings while specifications and main equipment with quantities are shown in Table 7.3.6.

3) Overall Specifications and Main Equipment

The transmission line substation is two-wire. The main equipment is shown in Table 7.3.6.

Table 7.3.6 Main Equipment and Quantity

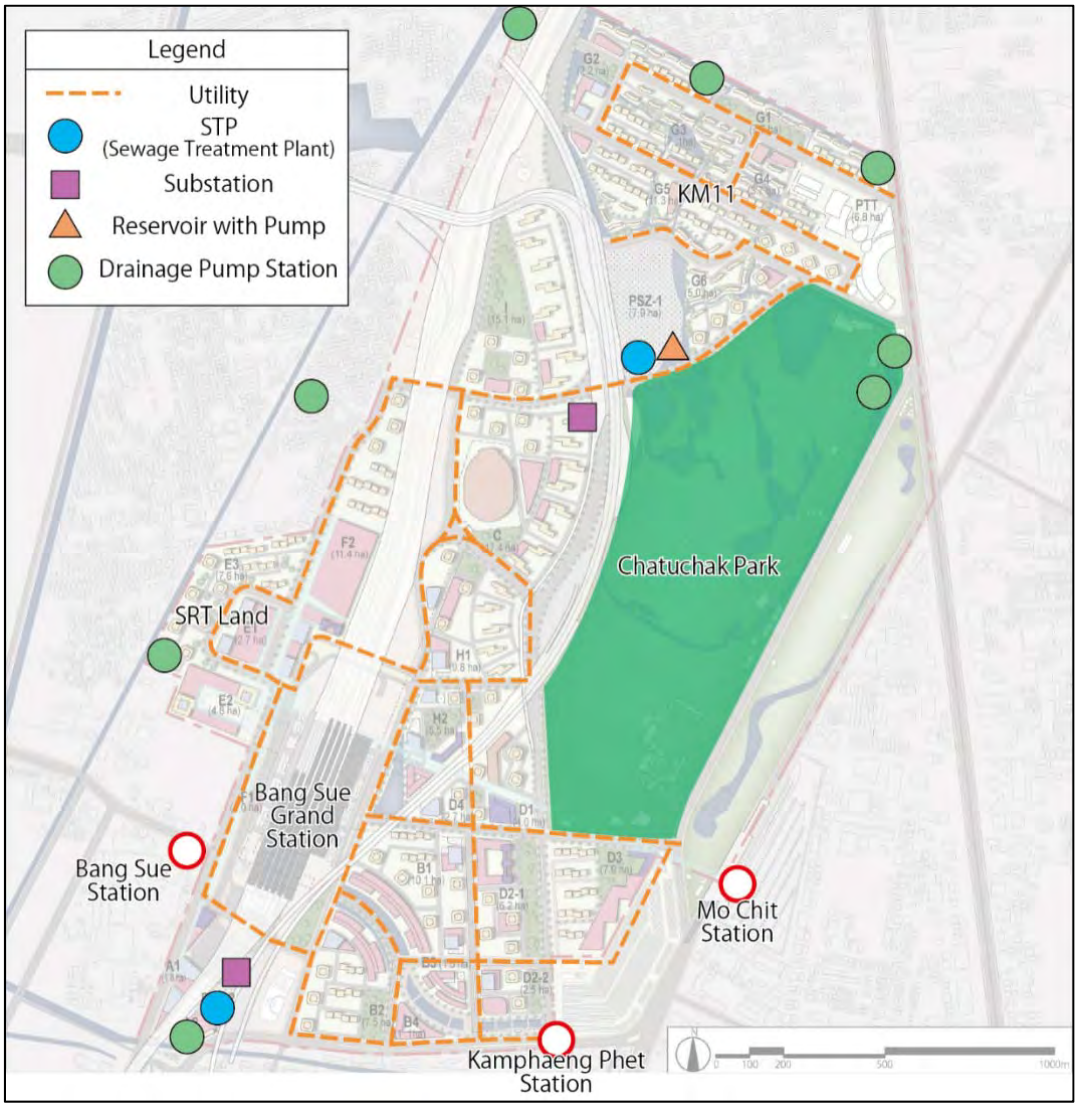
Items	Overview	Unit	Quantity
1.Substation	180 MVA（60 MVA×3）	location	2
2. Underground cable	Two-wire 110 kV	km	39
3. Pipeline	FEP, PV, etc.	set	1

4.Ring Main Unit	Switchgear, etc.	location	22
5. Accessories	Switch board, breaker, hand hole, etc.	Set	1

Source: JST

(7) Urban Infrastructure Plan

Placement of utilities, sewage and drainage pump, and reservoir pump is shown in Figure 7.3.1.



Source: JST

Figure 7.3.1 Urban Infrastructure Plan

(8) Communication Plan

1) Policies on Communication Plan

Besides the conventional voice communication, communication services that should be provided for end users in the future are multimedia communication services such as television meeting, IP TV, and data communication services such as large file transfer service. In the area of Bang Sue, there are three relay stations and communication cable that will be drawn in. The speed of existing relay station is 100 MB/s. The placement of substation is shown in Figure 7.3.2.

Source: JST

Figure 7.3.2 Relay Stations around Bang Sue Area

2) Overall Specifications and Main Equipment

Communication pipeline, optical fiber, and steel tower for antenna and other equipment are shown in Table 7.3.7.

Table 7.3.7 Main Equipment and Quantity

Items	Overview	Unit	Quantity
1. Communication line	Optical fiber	km	39
2. Pipeline	FEP、PV, etc.	set	1
3.Antenna tower	Independent steel tower	set	1
4.Station building	4 m x 4 m (reference)	set	1
5. Accessories	Hand hole etc.	set	1

Source: JST

(9) Energy Infrastructure (Cogeneration, District Cooling)

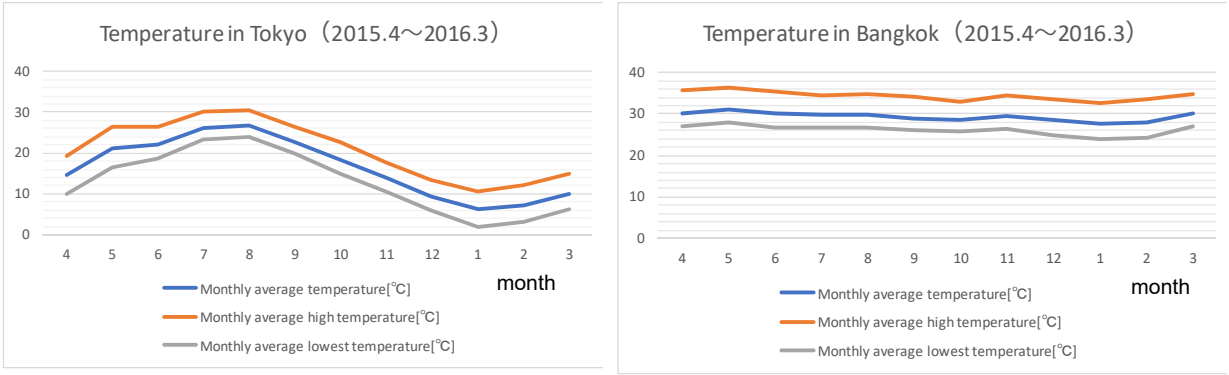
1) Overview of Cogeneration and District Cooling Facilities

Overview of the facilities is considered as follows:

(a) Characteristics of the Region and Possibility of Applying District Cooling

As shown in Figure 7.3.3, the weather in Bang Sue Area, or generally in Bangkok, has three seasons,

i.e., hot season, dry season, and rainy season. The average temperature is nearly 30 degrees C all year-round and the hottest month has an average temperature of about 35 degrees C. The difference of the hottest and coolest month is about 8.0 degrees C in Japan and 8.2 degrees C in Bangkok. In such conditions, the load for cooling is high all year-round and the demand period is expected to be longer than Japan as there is no middle period. Also, in some places such as in hotels where there is a demand for air-conditioning at night, there will be demand for cooling. From these situations, JST considers to apply smart city technologies to introduce an effective energy technology.



Source：Japan Meteorological Agency

Figure 7.3.3 Comparison of Temperature in Japan and Bangkok

(b) Consideration of Energy System

The JST considered energy supply method in Thailand as shown in Table 7.3.8. As infrastructure technologies have already been developed in commercial power supply, city gas, water supply and sewage, information communication, JST considers energy system from the perspective of optimization of regional energy use by district cooling and distributed energy. There are individual method and regional method of energy system. Individual method will equip packaged air-conditioner and independent heat source while regional method will equip regional heat source and utilize smart city technologies such as CEMS.

Table 7.3.8 Consideration of Energy System

	Individual Method	Individual and Regional Method	Regional Method
System characteristics	This is the conventional method. Recently, chiller efficiency (COP, IPLV, etc.) has been improved and able to be operated individually. Thus, it is easy to be introduced.	This is a balanced combination of district cooling and individual method for each area based on heat and power demand.	In dense urban areas where heat load density is high, introducing highly efficient cogeneration and heat sources may help increase energy efficiency, thanks to advanced operation management. However, in area with low heat load density, the ratio of benefit over cost is very small.
Initial cost	In building of medium size, cheap packaged air-conditioners are widely used.	Cogenerations and heat sources will be installed in machine rooms of large-sized buildings. They will be combined with cheap packaged air-conditioners to lower the cost.	It requires large-scale pipelines and energy center, thus, the cost is high.
	○	△	×
Running cost	As it can be operated individually, it is difficult to manage its operation. Thus, the running cost is rather high.	Central monitor and EMS will be installed in regions with high energy consumption while in medium and small-sized buildings, individual method will be used. By the combination, the running cost can be balanced.	With the operation management of central monitorand EMS, running cost can be cut down. However, the maintenance cost for pipelines to medium- and small-sized buildings will increase.
	△	○	△
Environmental friendliness and energy efficiency	As it can be operated individually, it is difficult to manage its operation. Thus, the energy use is rather high.	Central monitor and EMS will be installed in regions with high energy consumption while in medium and small-sized buildings, individual method will be used. By the combination, energy efficiency can be increased.	Running cost can be cut down thanks to advanced management by efficient equipment, central monitor, and EMS.
	△	△	○
Safety (disaster prevention, BCP)	Except for emergency cases, the operation is stopped in power cut.	If it is planned to cover the scope of emergency power sources and emergency capacity, it can both reduce the cost and function as disaster prevention and BCP measures.	As cogeneration can be utilized for emergency power sources while heat tank can be utilized for emergency water supply, this method is good for BCP. However, the cost is high.
	×	○	△
Sociality (to be popular as an advanced model for smart city)	As this is the conventional method, it is not considered as an advanced model for smart city	By introducing distributed energy, regional energy use can be optimized, and this method can be considered as an advanced model for smart city. In addition, it combines advantages of conventional method, thus, it may be popularized easily.	By introducing distributed energy, regional energy use can be optimized, and this method can be considered as an advanced model for smart city. However, as the cost is high, it may be difficult to be popularized.
	×	○	△
Recommendation	△	○	△

※Evaluation ○ : Good, △ : Normal, × : Poor
Source : JST

From the above results, it is proposed that for large-sized buildings and areas with high power and heat load density, regional energy will be supplied, while for medium- and small-sized buildings and areas with low load density, individual method will be applied.

(c) Methods of Supply and Installation Plan

There are three methods of supply in Japan for reference, i.e., heat supply project method, concentration plant method, and inter-building method. Energy center and route of district pipeline are considered based on the building's function, scale, heat demand, and arrangement. The location of energy center would be selected to be near the building with highest heat demand (use total floor area as a criterium) or in the center of a group of relatively big buildings.

In Bang Sue Area, land is divided into multiple blocks by railways and trunk roads. As for large-sized buildings, there will be relatively many high-rise buildings in each zone such as office buildings or commercial buildings. Currently, there is no example of district cooling in Thailand as well as related law. From these conditions, it is proposed that cogeneration and heat sources of district cooling will be installed in machine room of large-sized buildings or in energy plant and it will supply heat to surrounding area by concentration plant method. Electricity power is also supplied to surrounding area for private consumption. For low-rise buildings and buildings with low energy consumption density, individual heat sources and commercial power sources will be provided (Table 7.3.9).

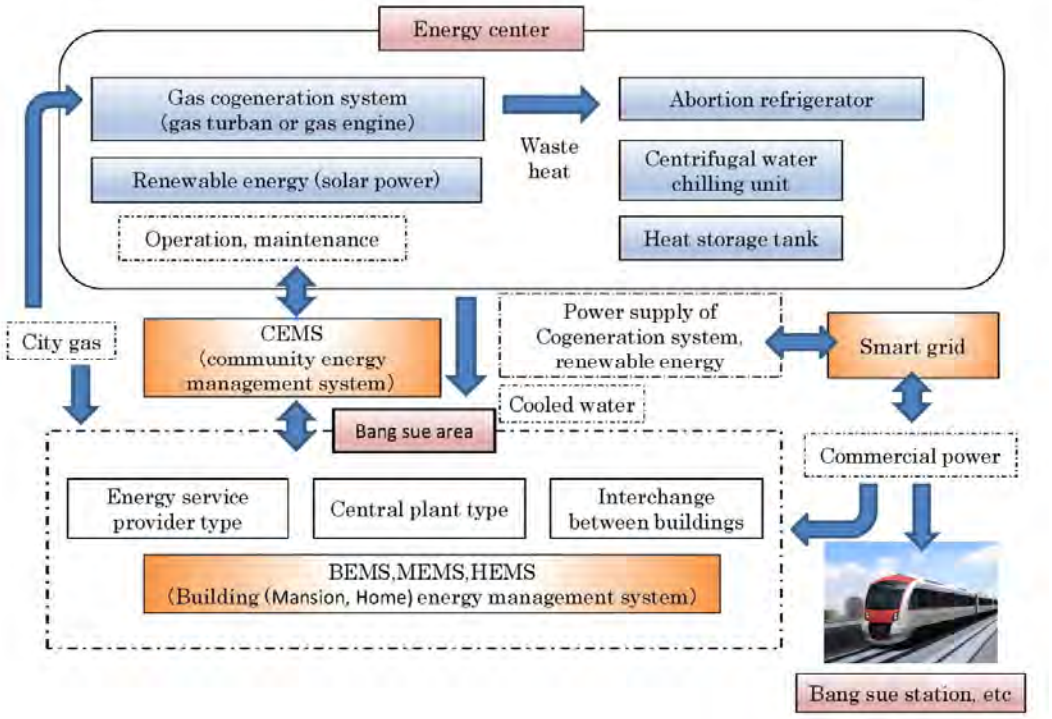
Table 7.3.9 Methods of Supply

Category	scale	Contract method	Supplier	Supply form
①Energy service provider type (Supplied from a large-scale energy plant to a wide supply area)	Large	Supply regulation based on heat supply business law	Energy service provider	Supply obligation based on thermal business law (supply provision is specified by supply provision).
②Central plant type (Supplied from an intensive energy plant into small and medium-sized specific areas)	Medium and small	Supplier-customer contract	Energy supplier based on contract	Supply obligation based on contract (constraint is less than ① Supply conditions are based on contract.
③Interchange bitween buildings tvpe (Cooperation of neighboring building owners, energy interchange or shared use of energy)	small	Mutual contract between building owners	Owner of multiple buildings	You can negotiate by mutual agreement.

Source : JST

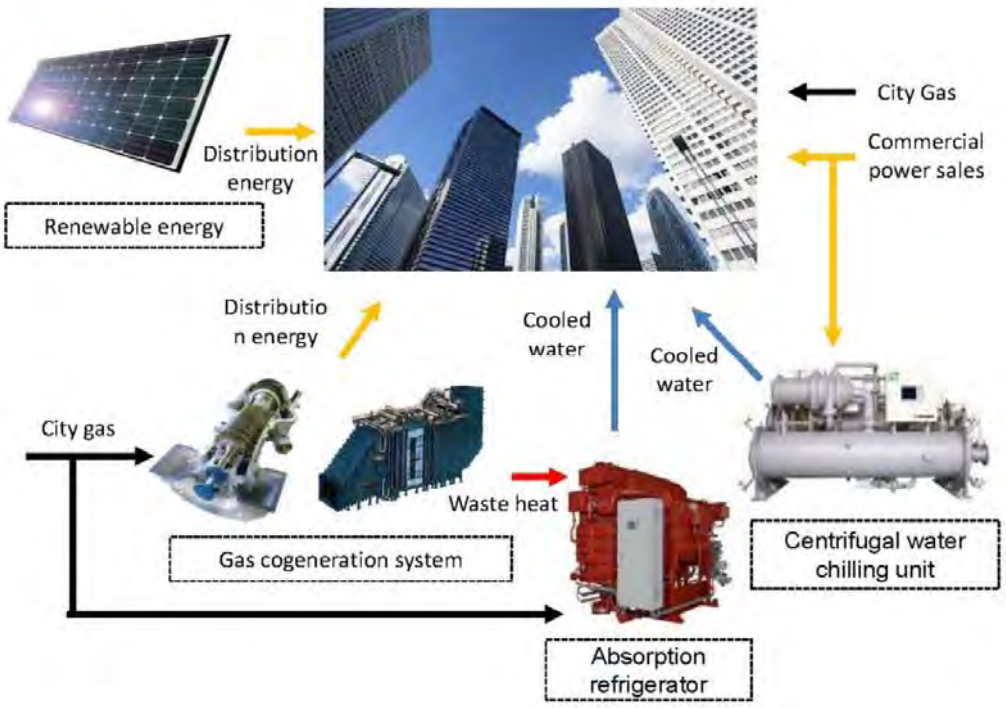
(d) System Image

The images of entire energy infrastructure and energy flow are shown in Figure 7.3.4 and Figure 7.3.5.



Source：JST

Figure 7.3.4 Images of Entire Energy Infrastructure



Source：JST

Figure 7.3.5 Image of Energy Flow

(e) Operation

To select the operation method, it is necessary to consider the ratio between heat and electricity use in facilities expected to be constructed in Bang Sue Area. As the fluctuation of temperature in a year is minimal, electricity will be mainly used and heat will be as supplement. Operation will be optimized by capacity sharing between absorption cooling machine and turbo cooling machine. Electricity will be generated by cogeneration as a base and commercial power supply will be controlled by grid. In addition, from the data on energy demand in each facility and the whole region, operation of cogeneration and heat sources will be optimized by CEMS and BEMS.

2) Estimated Capacities of Cogeneration and District Cooling Faciliites

Estimated capacities of facilities are considered as follows:

(a) Conditions for Estimation

Electricity and heat load [W/㎡] during summer in Japan are revised by outdoor temperature (The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan). Assuming that the average temperatures during summer in Japan and Thailand are 30 ℃ and 35 ℃, respectively, the revision ratio is (35-30)/30×100=17.8%. In addition, to supply for multiple buildings at the same time, a simultaneous usage ratio of 0.8 must be added.

Maximum load is calculated by electricity and heat load multipled by aggregated floor area. The ratio between heat and electricity use is calculated from electricity and heat load. Capacity sharing among cogeneration, absorption cooling machine, and turbo cooling machine will be implemented. For buildings outside the target area of district energy supply, individual method will be used. Calculation of energy efficiency is shown in collection of materials.

(b) Main Equipment and District Pipeline

Reference specifications of main equipment and district pipeline are summarized as shown in Table 7.3.10.

Table 7.3.10 Reference Specifications and Functions

Equipment and Pipeline	Reference Specifications	Functions
Cogeneration	Type: Gas turbine (or gas engine) Emitted gas boiler Output：15 MW～	Used as base operation. Supply for offices, commercial facilities and hotels, etc.
Absorption cooling machine	Type: hot water, vapor, genelink Cooling capacity: 80 USRT～	Used as base operation. Supply for offices, commercial facilities and hotels, etc.
Turbo cooling machine	Type: Inverter Cooling capacity: 150 USRT～	Response for load fluctuation due to outdoor temperature fluctuation in day time.
Cooling water heat storage tank	Type: RC constructed on-site Capacity: calculated from the number of people in emergency situations.	Fire fighting water and water supply in emergency (can be used for daily need with filtration equipment).
Solar power generation facilities	Type: roof-top or on the field Capacity: depends on the availability of vacant areas.	If the supply surpasses the household demand, electricity can be sold to others. In further discussion for adoption, it will also be considered as battery for emergency.
District pipeline	Material: SGP pipe Utility corridor: ready-made culvert	Insulation and corrosion protection based on site conditions.

Source：JST

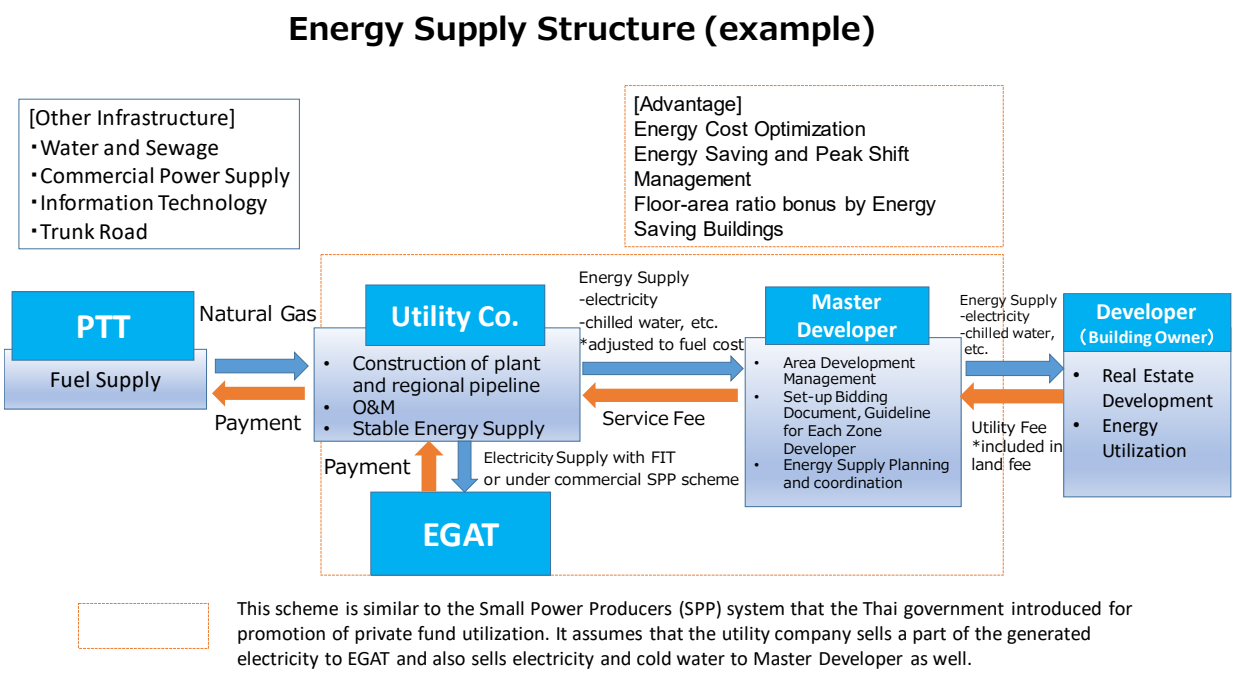
(c) Estimated Results of Feasibilty

The JST estimated the efficiency of conventional system (electric cooling machine and commercial power source) and GCS-DC system. The results are compared as follows: For primary energy, about 6～8% was reduced and running cost was reduced by 13～18%. The estimation was made based on demand, which was also estimated from the floor area, unit electricity, and heat consumption. Therefore, the results may have some differences with the real situation of the system. However, it can be predicted that the benefit in operation is significant because demand for cooling in Thailand is high, the running period is long, and electricity price is high while gas price is low. From these results, it can be concluded that it is possible to introduce facilities with high cost effectiveness and environmental friendliness such as cogeneration and absorption cooling machine to supply energy in the district.

3) Business Model for Energy Supply

The business model for cogeneration and district cooling is summarized as follows (Figure 7.3.6):

A) Supply method is concentration plant method.
B) Operation management is a 24-hour 365-daymonitoring system, which will be carried out by ESP of heat supply company.
C) In Thailand, there is a feed-in tariff (FIT) policy which allows electricity generated by cogeneration to be sold. Therefore, the electricity is not only for use inside the district, but it can also be sold to gain income.
D) For operating cogeneration and district cooling plant, spaces for chimney facilities are needed. These spaces can be rented from buildings by paying a rental fee. If pipelines are installed in utility corridors of the buildings, rental fee will also be paid.
E) For cooling water supply building, there is no need for machine room, thus, it can be utilized as shop space for office buildings or commercial facilities.
F) For cogeneration and district cooling, the energy supply company will carry out energy management to optimize district energy efficiency by CEMS and EMS. Demand response can be introduced, if necessary.
G) The facilities introduced must have high levels of energy efficiency to realize the concept of smart city. It is necessary to establish a maintenance structure at the area. Furthermore, to reduce initial investment cost, cogeneration and auxiliary equipment should be procured from the same manufacturer or from a group of manufacturers.



Source：JST

Figure 7.3.6　Business Model for Energy Infrastructure (example)

4) Renewable Energy

Solar radiation in Thailand is 1.5 times of that in Japan (reference from Solar GIS), thus, it is suitable to introduce solar power generation and use of solar heat. Solar power generation will give supply to park facilities or street lighting as part of environmental friendliness (Table 7.3.11).

Table 7.3.11　Overview of Equipment for Solar Power Generation

Items	Overview	Unit	Quantity
Solar power generation	Supply to park facilities or street lighting	MW	1
Battery	Capacity depends on the facility	set	1

Source：JST

(10) Energy Management（CEMS）

1) Energy Management System by Communication Infrastructure and Smart Grid

Energy management (CEMS, BEMS, MEMS) and smart-grid will be introduced. Energy management room of CEMS will be placed in SRT headquarters building to manage the whole zone independently. CEMS will help control energy data in facilities, cogeneration of energy center, and supply-demand of district cooling system. As developers in each zone introduce BEMS in offices, commercial buildings, and residential buildings, as well as introduce MEMS in condominiums, it would be possible to optimize energy use for each building.

2) Energy Management System

Specifications of energy management system are summarized as shown in Table 7.3.12. Equipment is referred from Yokomaha Smart City Project (YSCP).

Table 7.3.12 Specifications of Energy Management System

Equipment and Pipeline	Reference Specifications
CEMS, Integrated EMS	District EMS will install distributed power source, supply-demand adjustment facilities, and communications facilities and monitor from energy center. Target is to monitor distributed power sources such as cogeneration, district cooling, and solar power generators. With information sent by EMS in each area, energy consumption is made visible. The main functions of CEMS are as follows: (1) Demand and generation forecasting (2) Supply-demand plan (3) Controlling energy savings (4) Controlling voltage (5) Controlling generation (6) Demand response In addition, each EMS operator can cooperate with an energy service provider (ESP) that optimizes at the district level.
BEMS, FEMS, MEMS (Installed by architectural team)	Basic specifications are supposed to be in popular grade in Japan. However, the number of monitoring points must be in the range of optimization by CEMS. Also, EMS installed in each area must have the protocol that is interchangeable (BACnet, etc.). In each facility, a smart meter will be installed. Functions of EMS are as follows: (1) Measuring, monitoring, and controlling each equipment of the facilities. (2) Analysis tool based on visible energy consumption. (3) Support for optimal control based on energy efficiency evaluation (COP, etc.) of equipment and system. Each facility will have central monitoring devices to integrate with local control. Maintenance, including CEMS, will be managed by cooperation with ESP.

Source：JST

7.3.2 Environment and Green Network

(1) Measures against Floods (Disaster Prevention/BCP)

1) Measure with Retention Pond

As a measure against flood, 5% of developed land will be reserved for construction of retention pond. The pond must be capable for six hours of rainfall in peak with the probability of ten-year rainfall. Moreover, the pond inside Chatuchak Park can also be used as retention pond. Discharging waterway with a diameter of 5 m is under construction in the south of Bang Sue Area. It would significantly reduce the risk of flooding in Bang Sue Area.

2) Duplication of Power Sources by Commercial Power Source and Cogeneration

Duplication of power sources will ensure the reliability of power after disaster. For hospitals or headquarters of disaster response, cogeneration will also be used as emergency power source.

3) Elevation of Building Locations

Building locations can be evaluated by landfilling or raising floor. As the cost must be high, only power and air-conditioning facilities would be set on high floor depending on assumed water level.

4) Reduction of Flooding Damage

Power and air-conditioning facilities would be set on high floor. Cogeneration is placed in the machine room which must be flood resistant so that it can be used as emergency power source in

flooding period. For the outside wall, water-proof material will be used and drift-preventing fence will be installed, if necessary.

5) Flooding Measure

Waterstop and sandbag are being used for flood prevention in ventilation gate. Also, doors of underground rooms must be opened inward and evacuation route must be secured.

6) Issuance of Hazard Map

Issue the hazard map to confirm the risk of flooding damage in the redeveloped area.

7) Securing Headquarter ofDisaster Response and Information Communication Facilities

Ensure a structure functioning in flooding time, which is responsible in first action and emergency response.

8) Plan of Designated Evacuation Site

The area, which will not be damaged by flooding in the redeveloped area, will be designated as evacuation site.

(2) Green Network

1) Basic Policy

With regard to Chatuchak Park as a large green core and builds green network to place green path, wind path, and trees in Bang Sue Area. It creates a comfortable and convenient movement space for the entire area(Figure 7.3.7).

2) Green, Water, and Wind Network

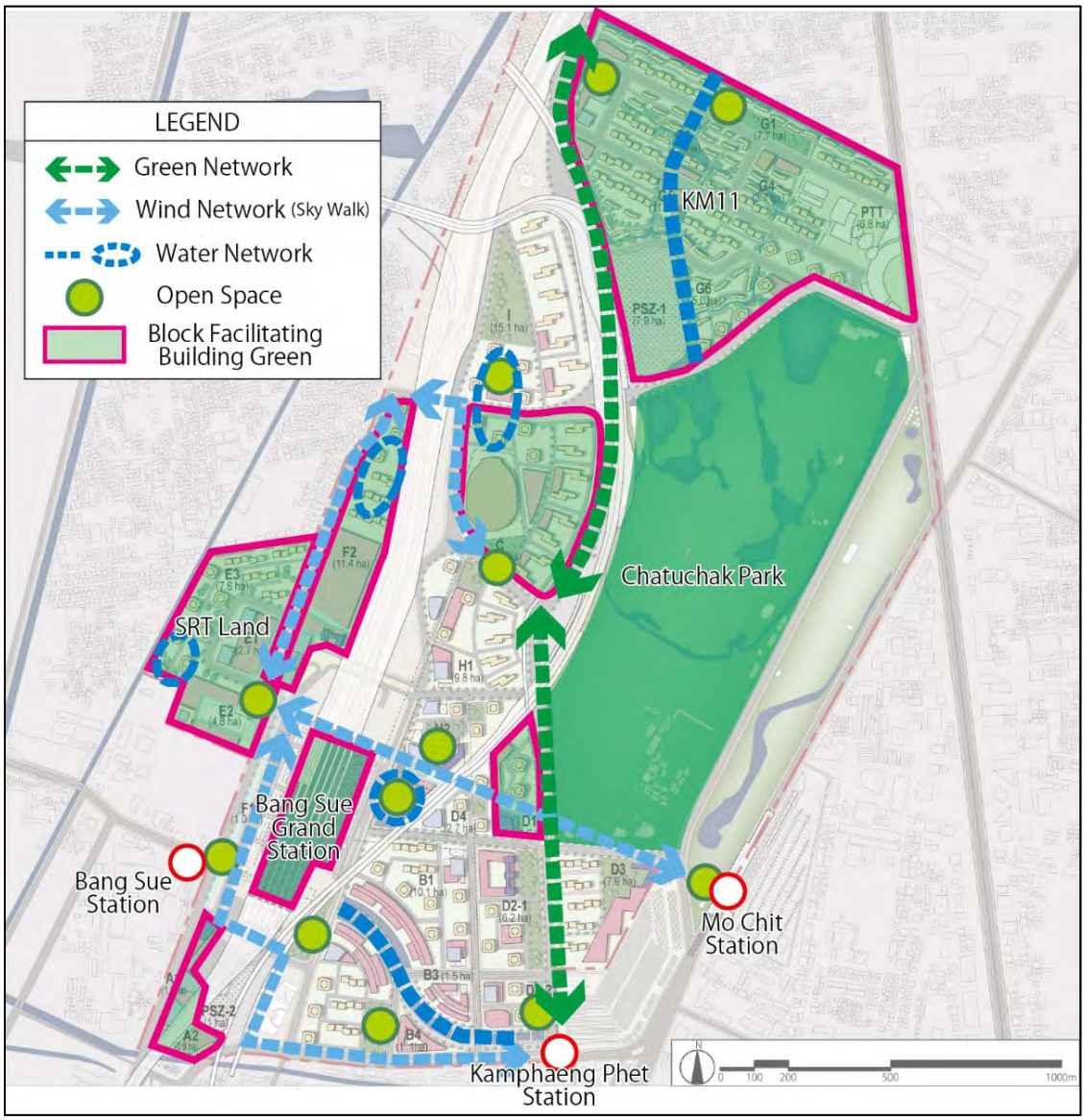
It obtains comfortable walking space and restrains an entire area of urban heat island by placing green shade of roadside trees and water space. For instance, for the green path making, roadside trees are planted along Kamphaen Phet Street, for the water path making, water spaces are placed on the ground above the subway, and for the wind path, roof is attachedand small plants are planted on the skywalk.

3) Creating Open Spaces

In the parts where people gather from the train and other places, improving comfortableness and convenience by making a space where people can gather under the greenshade.

4) Greening Buildings

By promoting green buildings in the initial development zones in Bang Sue Area, Green, which will be a future green core, is created. Especially, it is necessary to plant with greens for buildings (outside roof and wall of buildings) in Zones A,C, D, F, SRT Land, and KM11.



Source：JST

Figure 7.3.7 Green Network

(3) Landscape Creation

1) Basic Policy

To create a new Bang Sue landmark centered upon Bang Sue Grand Station considering the landscape of the entire area. (Figure 7.3.8)

2) Forming Landmark

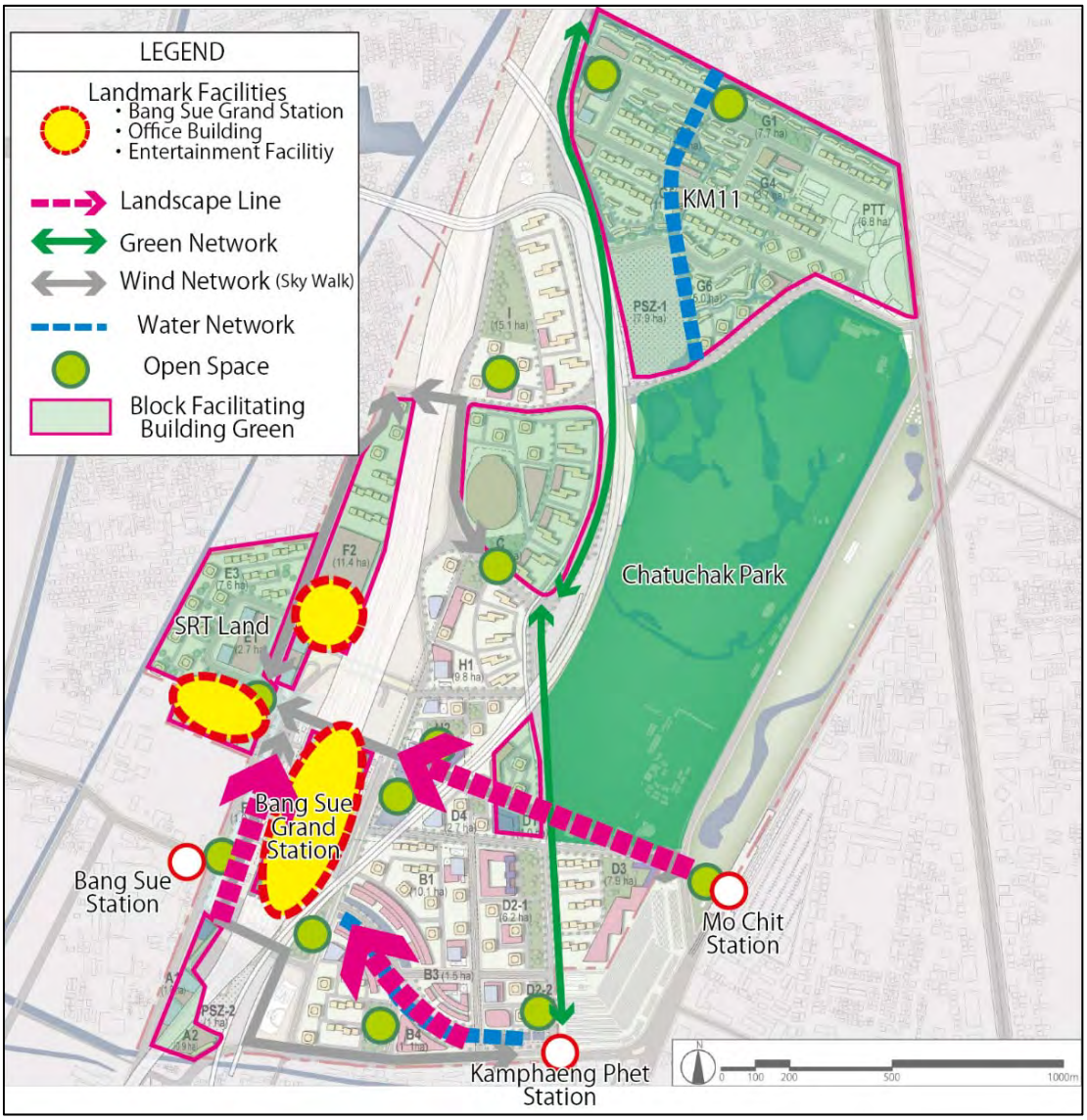
A peculiar landscape is created by building new landmark in Bang Sue Area. It is required to have retail and office buildings, which are high level and high volume, and entertainment facilities in SRT land and Sub Zone F2 that are adjacent to Bang Sue Grand Station.

3) Consideration for Building Color, Sign, and Advertisement

For the building color, attached sign and advertisement, in order to keep a beautiful landscape for the entire area, it considers good townscape creation, for instance, standardizes regular color range and shapes for buildings and needs consultation about concrete contents between the developer and local government.

4) Open Space and Walking Space

Create a landscape that is visually and physically appealing for pedestrians by doing setback for building and utilizing glass on the low floors of the retail and office buildings.



Source：JST

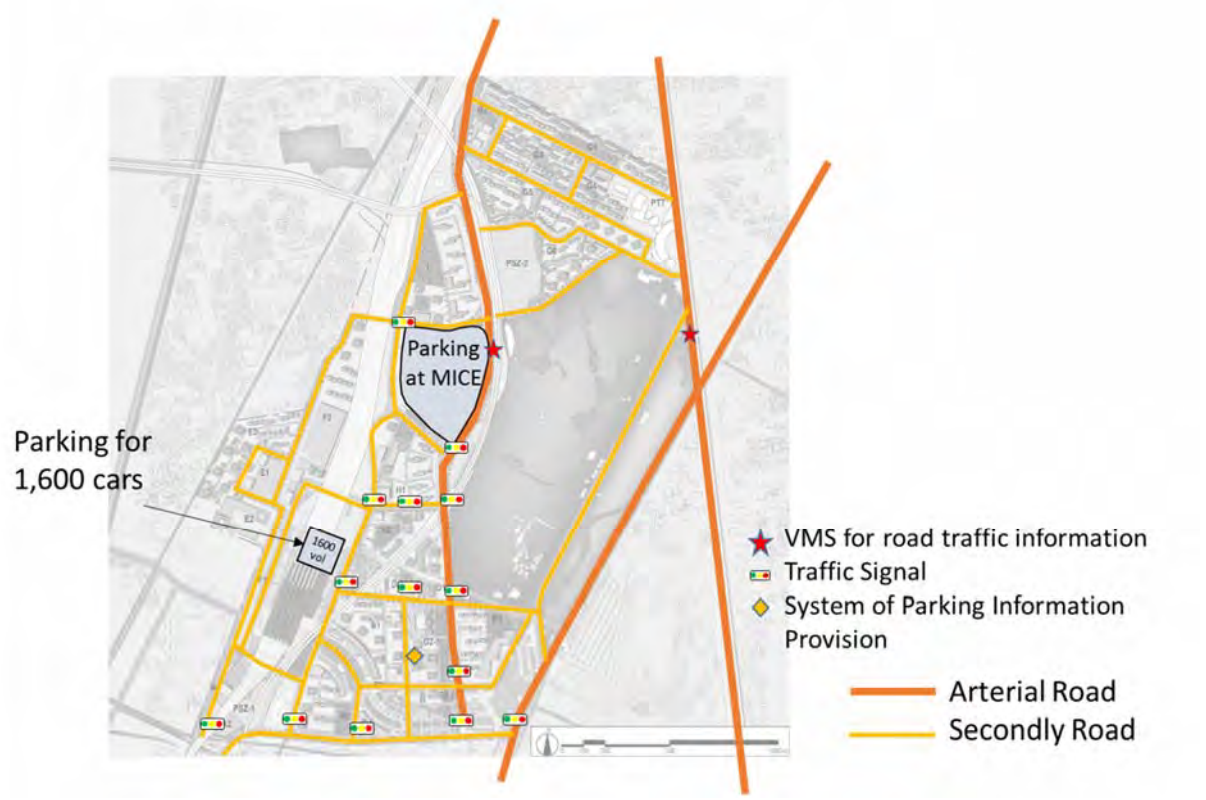
Figure 7.3.8 Landscape Creation

7.3.3 Transportation Network

(1) Road Planning

To reduce throughput traffic in Bang Sue District, in road planning, trunk roads are planned outside the district. Basically, roads inside the district are 2-lane/direction. Local roads are newly constructed or enlarged from the existing roads. In Red Line Project, there is also be a plan to construct roads in Bang Sue District. JST conducts road planning based on that plan.

As for the parking area, in the Red Line Project, there is a parking area of about 1,600 vehicles planned under Bang Sue Grand Station. Furthermore, in Bangkok, it is compulsory to secure a parking space for each building and the number of vehicles will be decided based on the building's functions and floor area.



Source: Study Team

Figure 7.3.9 Road Planning

(2) Sidewalk Planning

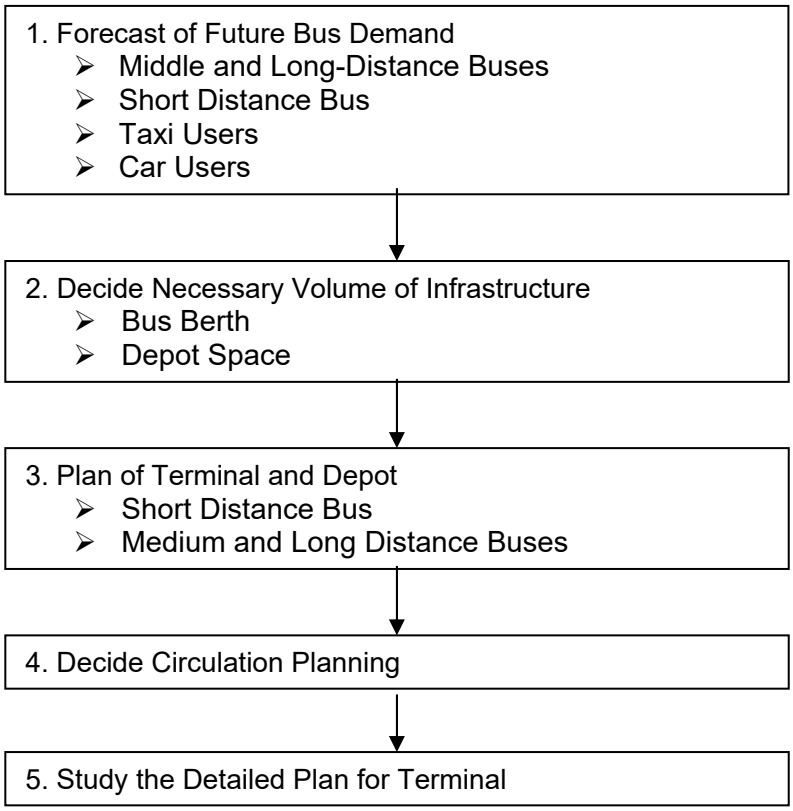
Sidewalk is planned along with road planning described in Section (1) above. In Bangkok, the separation between roadway and sidewalk is not clear in almost cases, however, as this is a transit-oriented development (TOD) project aiming to promote public transportation, the basic policy is to make the separation clear to provide a comfortable walking space for pedestrians. Sidewalks in Bang Sue District can be underground, on the ground or skywalk. On both sides of the road with a width of 7 m will be placed as ground sidewalk. Underground sidewalk and skywalk will be planned to ensure the accessibility to the facilities in the district. Details on underground sidewalks and skywalks will be described in Section 7.3.4.

(3) Public Transportation Planning

1) Middle and long distance buses, BMTA

Currently, middle and long distance buses, as well as BMTA are using Mo Chit 2 Terminal as platform and depot. However, there is a plan to relocate the terminal. To find an appropriate site for relocation, it is necessary to consider various factors as shown in Table 7.3.13. The number of bus demand in 2032 is forecasted. Also, it is noticed that in 2032, high speed railway will be opened, thus, number of passengers will choose high speed railway over middle and long distance buses. From the number of passengers estimated for middle and long distance buses, BMTA and taxis, areas of platforms and depots for these vehicles were calculated. From the calculation results, arrangement of facilities for each type will be planned as well as bus routes.

Table 7.3.13 Consideration Process for Bus Terminals



Source: JST

As there is no material available for bus demand forecast, the number of buses in 2032 is estimated from the population growth rate. Also, the interview with passengers using middle and long distance buses in Bang Sue District revealed that 78% of the passengers will transfer to high speed railway from buses and it showed that the users of high speed railway and middle and long distance buses are closed. As the number of middle and long distance bus passengers will decrease when high speed railway is ready, revision on bus demand forecast was made.

The number of berths for buses and taxis is calculated by using the formulas in the Guidebook for Station Plaza Planning.

Table 7.3.14 Formulas for Calculating Numbers of Berths for Buses and Taxis

Faciities	Estimation Fomula
On-board Berth	$\left\{\frac{(\text{Number of Boarding Bus Passengers per Peak Hour})}{(\text{Average Number of Bus Passengers per Bus})}\times(\text{Bus Service Time})\right\}1/60$ Bus Service Time = Frequency of Bus Operation
Off-board Berth	(Number of Peak Alighting Bus Passenger per Peak Hour)×(Average Alighting Time per Person)/60
On-board Berth (Taxi)	(Number of Peak Boarding Taxi Passenger) × (Average Boarding Time per Person)/60
Off-board Berth (Taxi)	(Number of Peak Taxi Alighting Passenger) × (Average Alighting Time per Person)/60
Parking Space for Taxi	$\frac{(\text{Number of Waiting Passenger per Peak Hour})}{(\text{Average Number of Taxi Passengers per Taxi})}$
Boarding and Alighting Berth	$\frac{(\text{Car Users per Peak Hour})}{(\text{Average Number of Vehicle Passengers per Vehicle})}$

Source: Guidebook for Station Plaza Planning

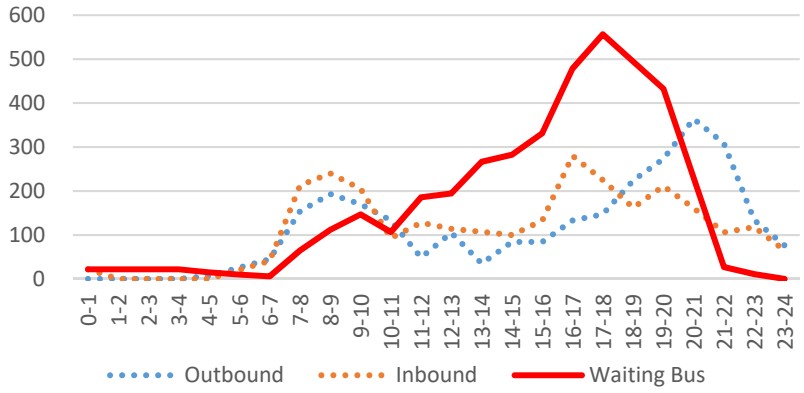
The results for middle and long-distance buses are shown in Table 7.3.15. In total, there will be 84 berths, which are reduced by more than 60% from the present number of 263 berths. The reason is that in the formula, the operation interval is set to be 10 minutes and thus, the number of buses using one berth is increased. At the current terminal, the operation interval is too long and the buses must wait for a long time at berths, thus, the total number of buses is small. Therefore, if the number of buses increases using one berth, it would be possible to increase the operational efficiency.

In the calculation of the depot area, the JST estimates are based on the number of waiting buses. The waiting buses are calculated by considering departing bus volume and arriving bus volume. As shown in Figure 7.3.10, Number of Waiting Bus Volume became maximum from 5:00 pm to 6:00 pm. The result is 33,026 m^2, which is only half of the present area of 71,980 m^2. The current depot is located under Sirat Expressway and inside Mo Chit 2 Terminal but there are multiple areas left unused, thus, only in peak hours, buses will be gathered in Old Mo Chit.

Table 7.3.15 Calculation Results of Facilities (Middle and Long Distance Buses)

Faciities	Spec of Facilities	Current Mo Chit 2
On-board Berth	(1) Outbound passenger volume per day : 42,159 vol/day (Total 83,146 vol/day) (2) Peak bus passenger volume: 5,607 vol/h ←(1)*0.133 Peak Ratio 13.3% (3) Average passenger volume per bus : 16.6 people/bus (4) Service interval : 10 min Necessary berth = (2)/(3)×(4)×1/60= 56 berths	263 Berths (long distance 130 berths 、 middle distance 133 berths)
Off-board Berth	(1) Inbound passenger volume per day : 40,987 vol/day (Total 83,146 vol/day) (2) Peak bus passenger volume: 5,082 vol/h ←(1)*0.124 Peak ratio 12.4% (3) Average off-board time : 0.333 minute Necessary berth = (2)×(3)/60 = 28 berths	
Depot	Space per 1 bus : 59.4m^2 ((13+5)*3.3 m) Bus peakvolume : 556 vol (Maximum waiting bus volume) 59.4×556 = 33,026 Necessary depot space : 33,026 m^2	71,980 m^2 *Under Sirat Toll Way and Mo Chit 2

Source: JST



Source: JST

Figure 7.3.10 Time Variation on the Number of Waiting Bus Volume

Results of caluculation done by BMTA is shown in Table 7.3.16. The current BMTA terminal is located near the current Mo Chit 2 Terminal; however, the future depot of BMTA terminal is also planned in the Red Line Project, which is under construction now. The results of depot are fit with the planning. Next to BMTA depot, there is a plan for a touristic bus terminal.

Table 7.3.16 Calculation Results ofFacilities (BMTA)

Faciities	Spec of Facilities	Planning in Red Line Project
On- and off-board Berths	Total bus volume per day: 3,458 vol/d Peak bus volume per hour: 209 vol/h (Peak ratio 6%) Service interval: 10 min = Necessary berth : 35 berths	None
Depot	Necessary space perbus : 59.4m^2 ((13+5)*3.3 m) Peak bus volume : 209 vol/h (Peak ratio 6%) = Necessary depot space : 12,456 m^2	1.4ha

Source: JST

Bus terminals and depots will be arranged based on calculation results above. Figure 7.3.11 indicates the bus route example in Japan.

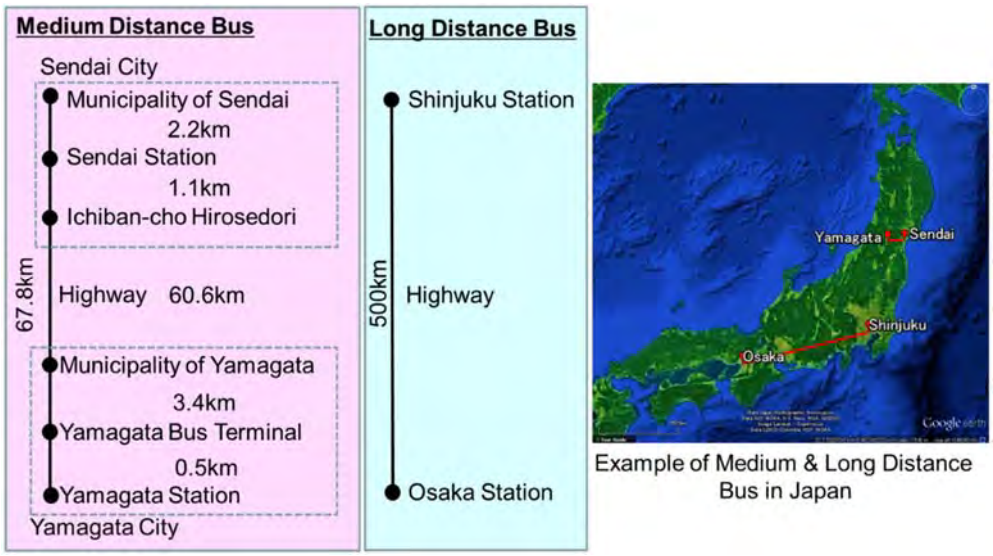
Basically, a distance of over 200 km from Bang Sue Grand Station is covered by high speed railway, while the distance within 200 km is covered by middle distance buses and commuter trains such as MRT, BTS, and BMTA. Terminal and depot for middle and long distance buses will be planned in Old Mo Chit. This is accordance with the planning proposed by OTP and SRT, in which the area will be opened from 2023 with taxi platform, BMTA platform, middle and long distance buses platform and commercial facilities. BMTA depot will be located in Bang Sue Grand Station as planned in the Red Line Project. However, the depot for BMTA is not planned clearly and it is recommended to locate it within walking distance from Bang Sue Grand Station.

The direct distance from Bang Sue Grand Station to Old Mo Chit is about 1.2 km. Although Old Mo Chit is next to MRT Mo Chit Station, it is important to provide access between Old Mo Chit and Bang Sue Grand Station, which is a railway connection point.

According to OTP, there will also be 50 berths for middle distance buses inside Bang Sue Grand

Station as shown in Table 7.3.11.

Those berths will be utilized for on-board berth for middle distance bus coming from Old Mo Chit. Besides Old Mo Chit, some of the buses would be arranged to stop at Bang Sue Grand Station. The number of berths is estimated at 30 berths. That number is calculated by dividing the number of on-board berth into middle and long distance buses.

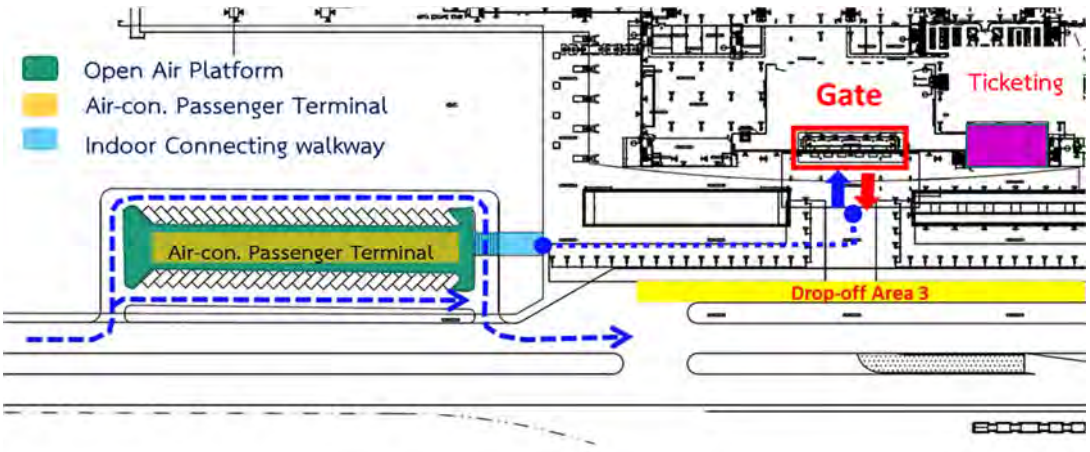


Source: JST

Figure 7.3.11 Example of Middle & Long Distance Bus Route in Japan

Similarly to middle & long distance bus, BMTA will mainly stop at Bang Sue Grand Station, but some of them would be arranged to stop at Old Mo Chit. Number of berth is estimated based on the percentage of passengers using Bang Sue Station for transshipment by highspeed railway or middle distance bus and passengers heading to a facility inside Bang Sue Area.

Above arrangement is shown in Table 7.3.17 and Table 7.3.12.



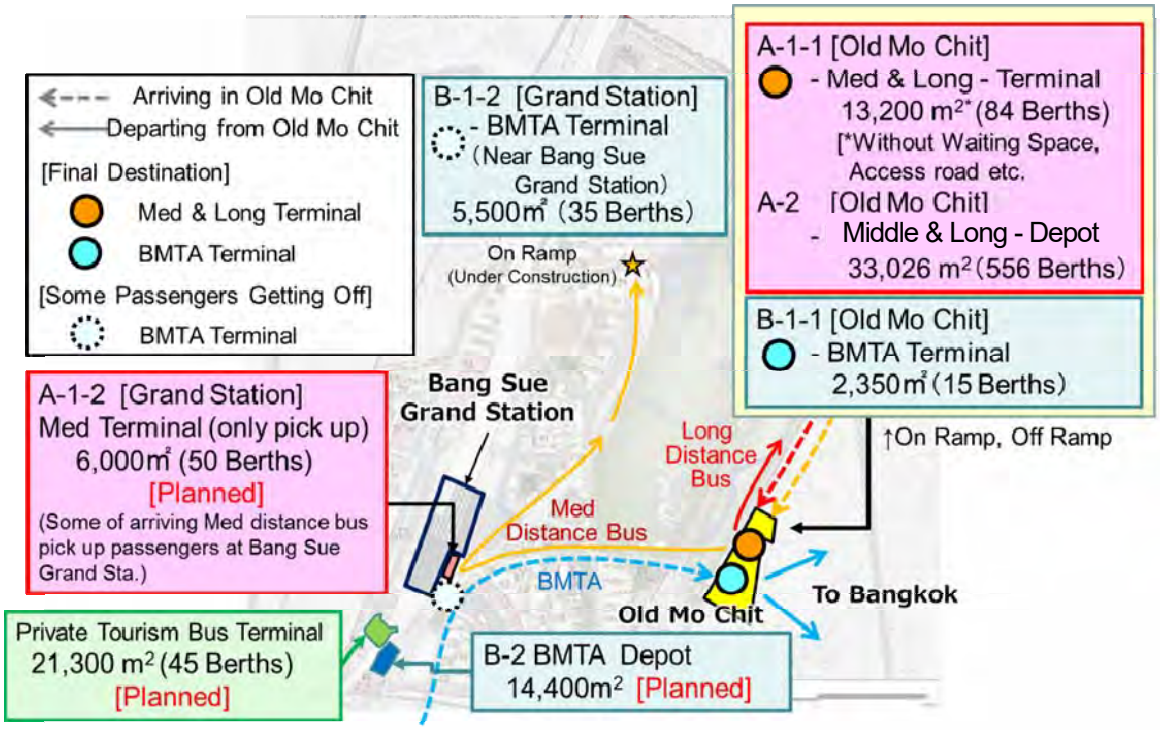
Source：OTP

Figure 7.3.12 Berths for Middle and Long Distance Buses in Bang Sue Grand Station

Table 7.3.17 Results of Facilities for Middle and Long Distance Buses and BMTA

	1.Terminal			2. Depot		
	Location	Volume		Location	Volume	
		Need	Existing /Planned		Need	Existing /Planned
A. Middle and Long Distance Buses	A-1-1 - Old Mo Chit	84 berths (On 56+ Off 28)	263 berths (Existing, Mo Chit 2)	A-2 - Old Mo Chit	33,026 m^2 (556 berths)	71,980 m^2 (Existing)
		Feasible (84<263)			Feasible ($33,026 m^2$<$71,980 m^2$)	
	A-1-2 - Bang Sue Grand Station*1	30 berths	50 berths			
		Feasible (30<50)				
B. BMTA	B-1-1 - Old Mo Chit	15 Berths*2	No Plan	B-2 -Bang Sue Grand Station	12,456 m^{2*3}	14,400 m^2 [Planned] (Red Line PJT)
		Need a new plan				
	B-1-2 - Place within walking distance from Bang Sue Grand Station	35 berths	No Plan		Feasible ($12,456 m^2$<$14,400 m^2$)	
		Need a new plan				

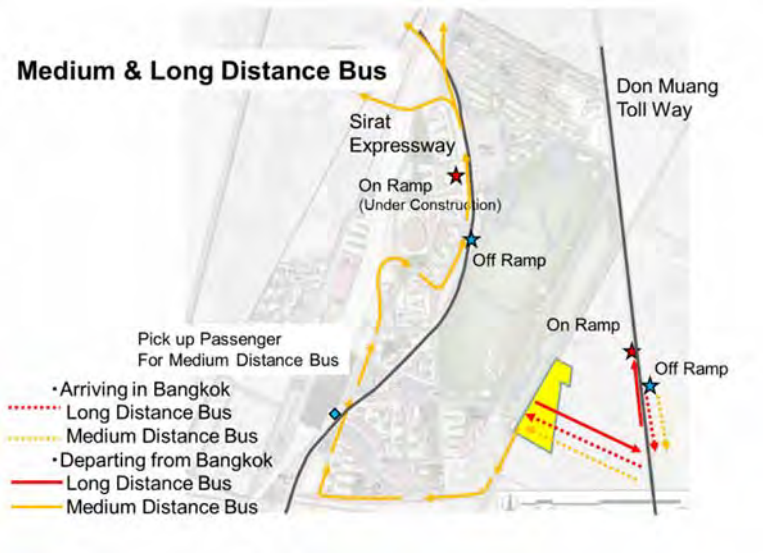
Source: JST



Source: JST

Figure 7.3.13 Arrangement of Bus Facilities

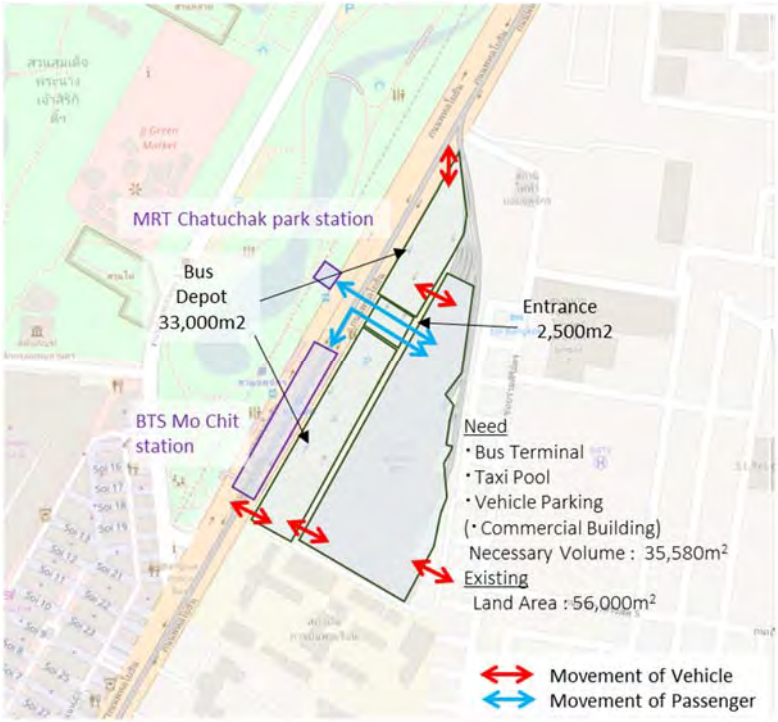
The routes of middle and long-distance buses are shown in Figure 7.3.14. These routes are the same with those proposed by OTP.



Source: JST

Figure 7.3.14 Routes of Middlem and Long Distance Buses

Berths and depot of middle and long distance buses are arranged in Old Mo Chit. However, space for taxi and vehicle for pick up should be considered. The layout plan of these facilities is shown in Figure 7.3.15. This layout plan assumed that the existing BTS depot building will be revitalized. The building accommodates commercial space, bus terminal of BMTA,middle and long distance buses, taxi bay, and vehicle parking. In addition, the currently used parking space is assumed to be revitalized as depot for middle and long distance buses.



Source: JST

Figure 7.3.15 Layout Plan of Old Mo Chit Bus Terminal

In the current Mo Chit 2, ticket counters for buses are divided into booths and they occupy a lot of space. Also, the users are having difficulty in finding out the right booth to buy their tickets. Therefore, when transferring to Old Mo Chit, it is proposed that ticket counters are arranged into one window only.

Source: JST

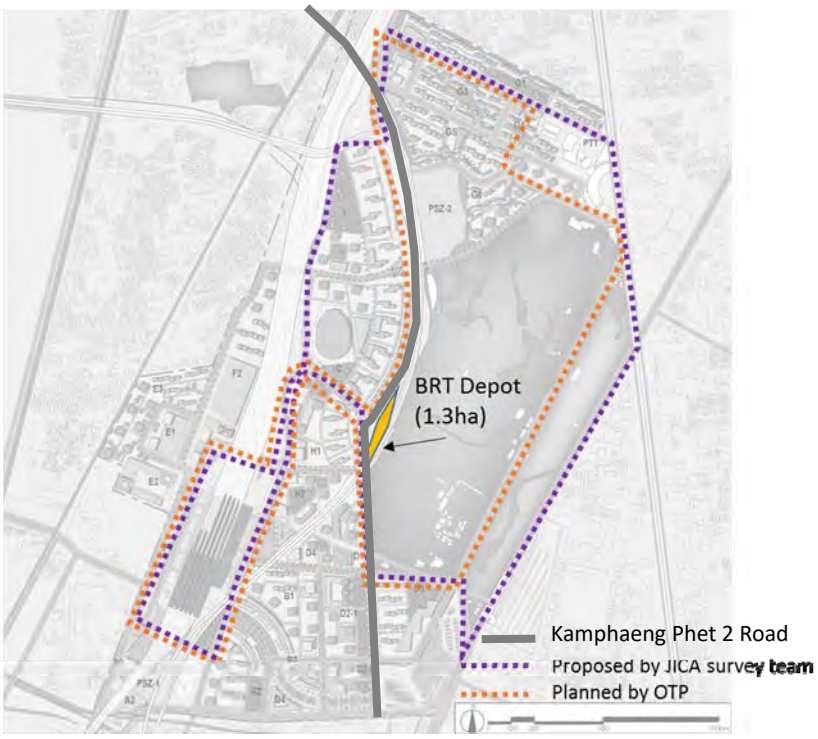
Figure 7.3.16 Reorganization of Ticket Counters (Left: Mo Chit 2; Right: Shinjuku Bus Terminal)

2) Circulating Buses in Bang Sue District

Circulating buses are already considered in the OTP survey. However, to avoid chronic congestion on Kamphaeng Phet 2 Road and increase the connection with Old Mo Chit, some of the routes are proposed to be changed as shown in Figure 7.3.17. Especially, for Kamphaeng Phet 2 Road, bus rapid transit (BRT) might affect the existing traffic flow. Therefore, route is planned except for Kamphaeng Phet 2 Road.

In BRT development, it is necessary to construct exclusive lanes, bus shelters, and depots. According to OTP, BRT is expected to be opened in 2022. However, based on the development scenario described above, in 2022, only the development of surrounding area of Bang Sue Grand Station will be reached and the increase in benefit from BRT development is limited. Therefore, the target year for operation is set at 2027. Until 2027, civil works and procurement of vehicles will be done by 2032, extra buses will be put into operation.

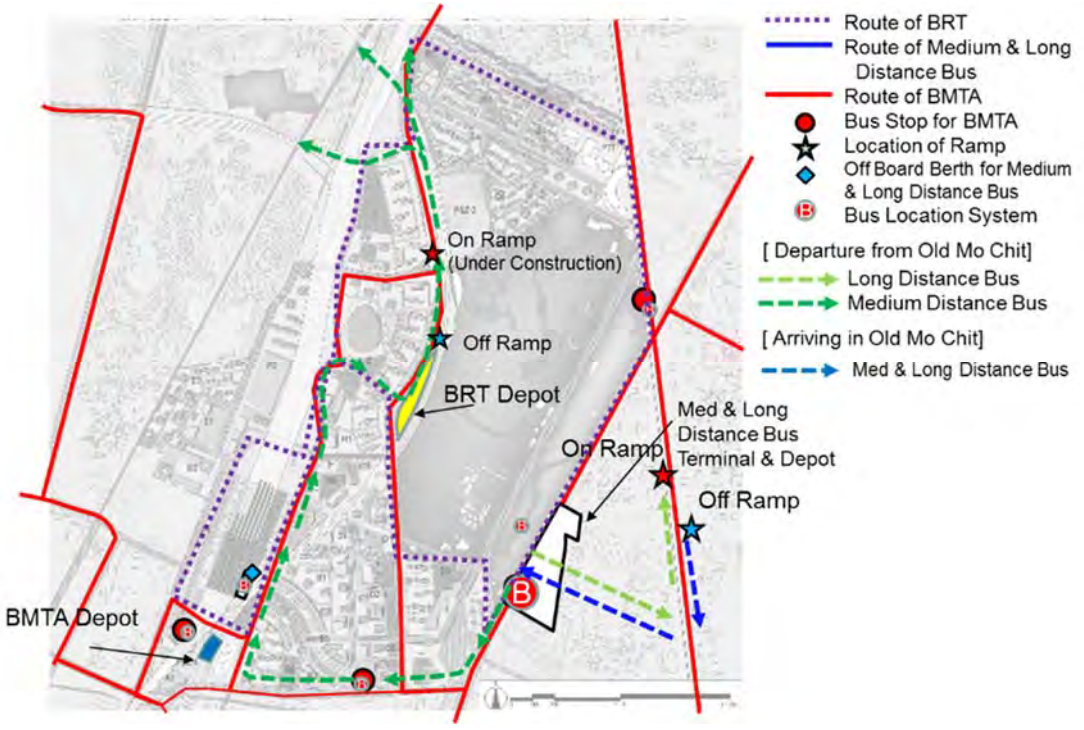
In short period, BRT is the possible mode of transport. If traffic demand will be increased, introducing monorail is one of the options.



Source: JST

Figure 7.3.17 Routes of Circulating Buses

Considerations for middle and long-distance buses, BMTA, and circulating buses are summarized in Figure 7.3.18. Berths and routes of BMTA are set to be the same as present. Routes and number of buses need to be considered later.



Source: JST

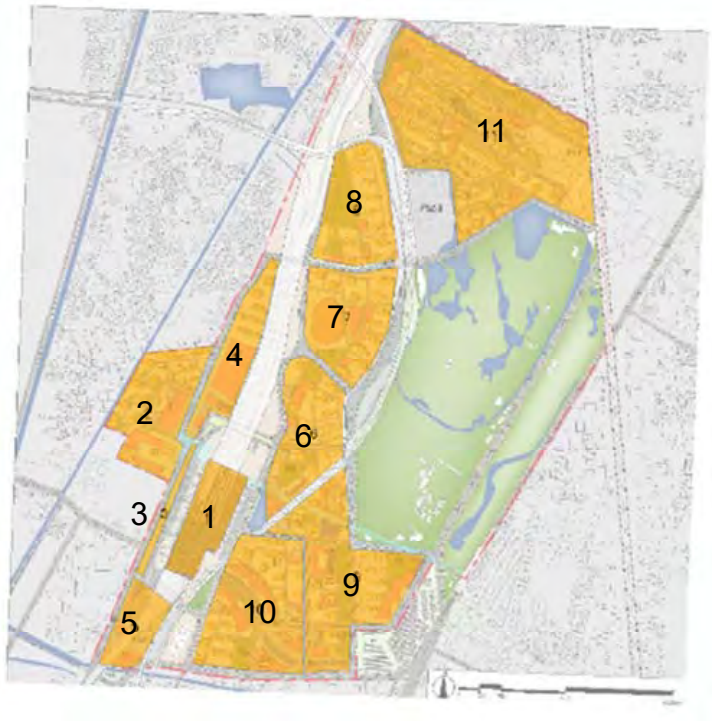
Figure 7.3.18 Public Transportation Planning

(4) Result of Traffic Demand Forecast

Based on road planning and public transportation planning, traffic flow in 2037 is forecasted. Forecast method is based on the four-step method using JICA STRADA. The objective is to judge the road plan and public transportation plan whether these satisfy the traffic demand or not.

1) Traffic Zone

Traffic zone shown in Figure 7.3.19 was adopted based on zoning category used in the development plan.



Source : JST

Figure 7.3.19 Traffic Zone in Bang Sue Area

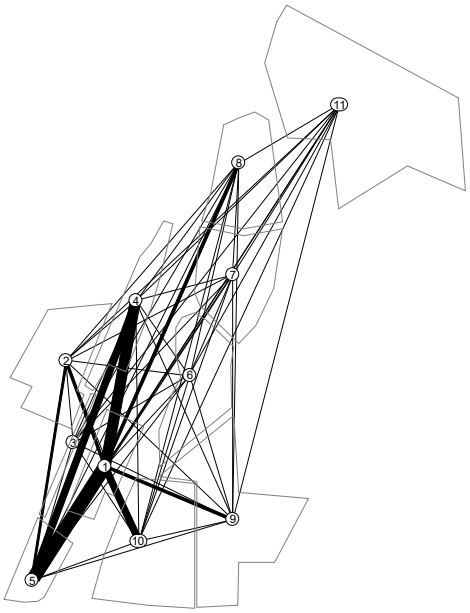
2) Trip Distribution

Trip generation was estimated in Chapter 5. As presented in Chapter 5, the projection result depends on the number of visitors and residents in Bang Sue Area. The numbers of visitors and residents were projected from area of each planned landuse and unit of trips per area. trip distribution is estimated based on gravity model. The result is shown in Figure 7.3.20.

The biggest traffic demand appeared in Zone A – Bang Sue Grand Station.

$$T_{ij} = a\frac{T_i T_j}{C^b{}_{ij}}$$

a, b = parameters
C_{ij} = Travel Cost (distance)
T_i = Total Number of Attracted Trips
T_j = Total Number of Generated Trips

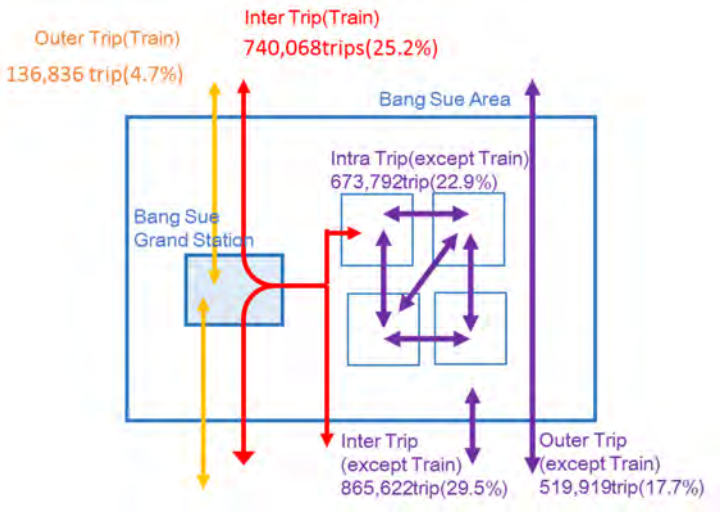


Source : JST

Figure 7.3.20 Desire Line for Inner Trip

On the other hand, trip generation inside Bang Sue Area is insufficient, since it is necessary to consider some vehicles just passing through the Bang Sue Area. Therefore, the demand forecast takes in consideration those passing through vehicles as well. To estimate the amount, the JICA Survey Team referred to the intersection count survey data taken by OTP at eight locations in Bang Sue Area. The JICA Survey Team regarded the survey data as passing through vehicles and calculated the future traffic volume by using population projection. Estimated trip number is indicated in the following figure.

Intra trip means trip generated and attracted inside Bang Sue Area. Inter trip means that origin or destination is inside Bang Sue Area and the other is outside Bang Sue Area. Outer trip means trip passing through Bang Sue Area.

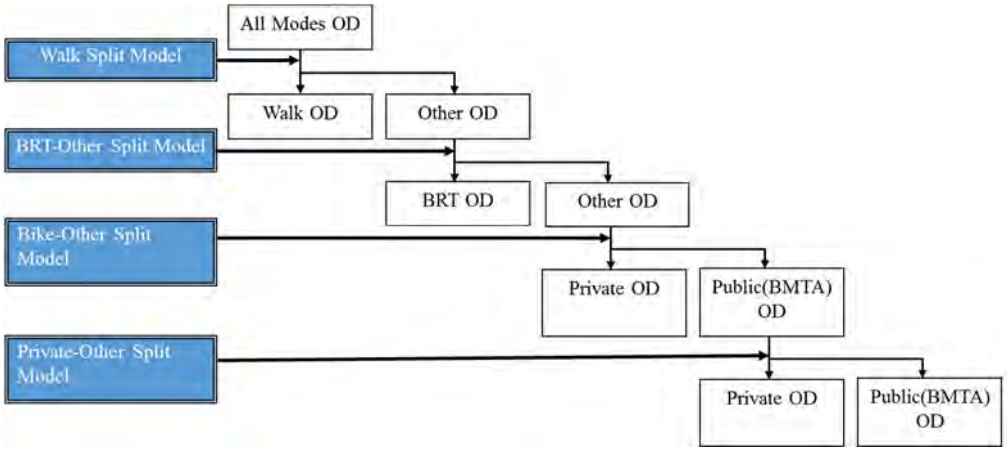


Source : JST

Figure 7.3.21 Trip Number in Bang Sue Area in 2032

3) Mode Choice

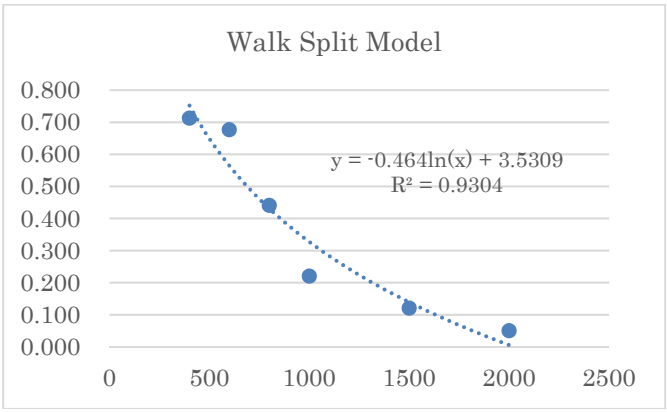
After the estimated trip distribution, modal split was assumed to each trip. Binary choice model is adopted to classify the trip mode. Modal share of train is basically assumed at 40% as shown in Chapter 5.



Source: JST

Figure 7.3.22 Estimation Flow of Traffic Modal Split

Modal share of walk was calculated from the interview survey result. Interview survey collected the maximum walking minutes. Walk split model is estimated as shown in Figure 7.3.23. As shown in the following figure, modal share of walk decreases as distance between origin and destination becomes long. Coefficient of determination is judged at 0.93, thus, the model describes the survey result.

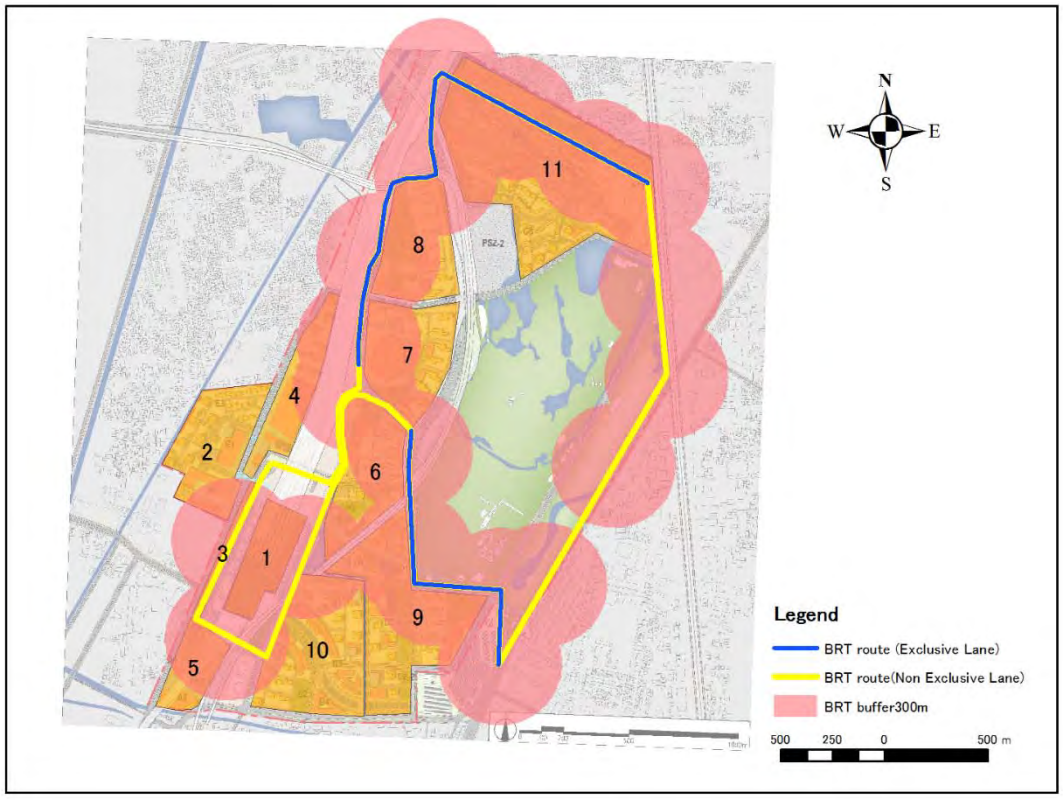


Source: JST

Figure 7.3.23 Walk Split Model

Modal share of BRT depends on the BRT fare, comfortability, and punctuality. However, detailed information of BRT is unclear. Accordingly, the JICA Survey Team assumed BRT station sphere and calculated an overlapping area of each zone and station sphere. In short, modal share is increased as overlapping area becomes bigger. As a result, BRT trip accounts for 26% of the total inner trip.

Number of BRT passengers are estimated 2,400 PPHPD as maximum. JICA survey team assume that the articulated bus are operated at interval of three minutes.



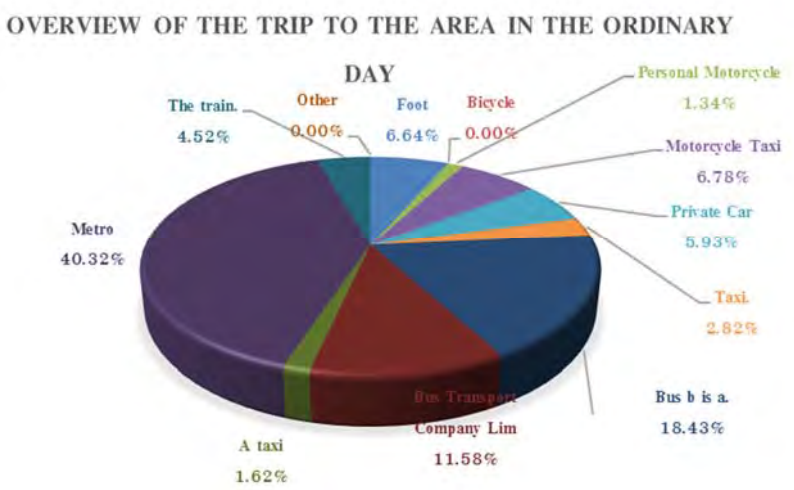
Source: JST

Figure 7.3.24 BRT Station Sphere

Finally, modal shares of automobile, motorcycle, and BMTA were estimated. OTP conducted origin-destination (OD) interview at the Bang Sue Area to grasp trip behavior. The JICA Survey Team assumed modal share based on the OD interview result. Figure 7.3.25 shows modal share of visitors to Bang Sue Area on weekdays.

As mentioned in Chapter 5, modal share of train accounts for 40%; therefore, 40% of inflow population will basically use public transportations such as bus, BRT or taxi when they move inside Bang Sue Area. Modal share of motorcycle is approximately 8% (personal motorcycle 1.34% + motorcycle taxi 6.78%) in Figure 7.3.25.

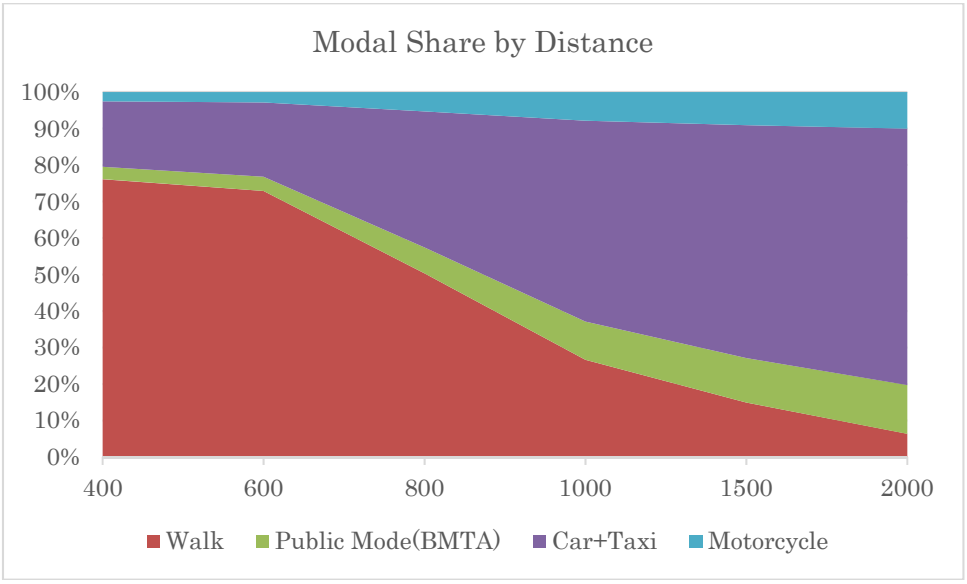
The reason is Bang Sue Area will be developed based on TOD concept. It means use of public transportation will be promoted, consequently, motorcycle ratio will be suppressed around Bang Sue Area. Therefore, modal share of motorcycle was not set beyond 8% in the future. However, passing through vehicle is not related to the TOD concept itself. Modal share of passing through is set separately.



Source: OTP

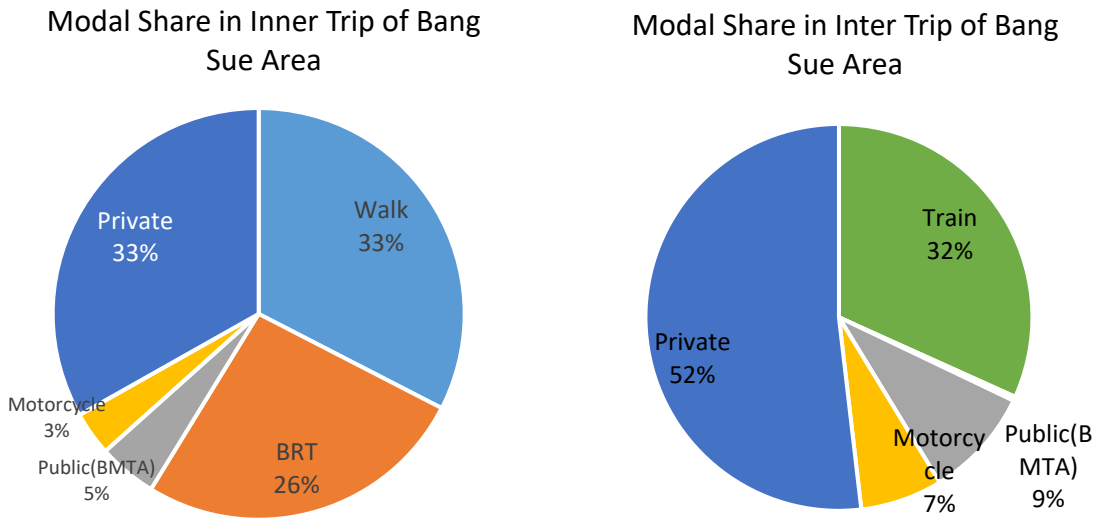
Figure 7.3.25 Modal Share by Transportation Mode by OTP Interview Survey

Considering the above conditions, modal share was analysed as below. Modal share varies according to the distance between origin and destination. As distance becomes farther, share of automobile and taxi becomes higher. Shares of BRT and train relied on the station sphere. Therefore, modal shares of BRT and train are omitted in the following figure.



Note: Shares of BRT and train relied on station sphere. Therefore, modal share of BRT and train are omitted in the figure.
Source: JST

Figure 7.3.26 Modal Share by Transportation Mode



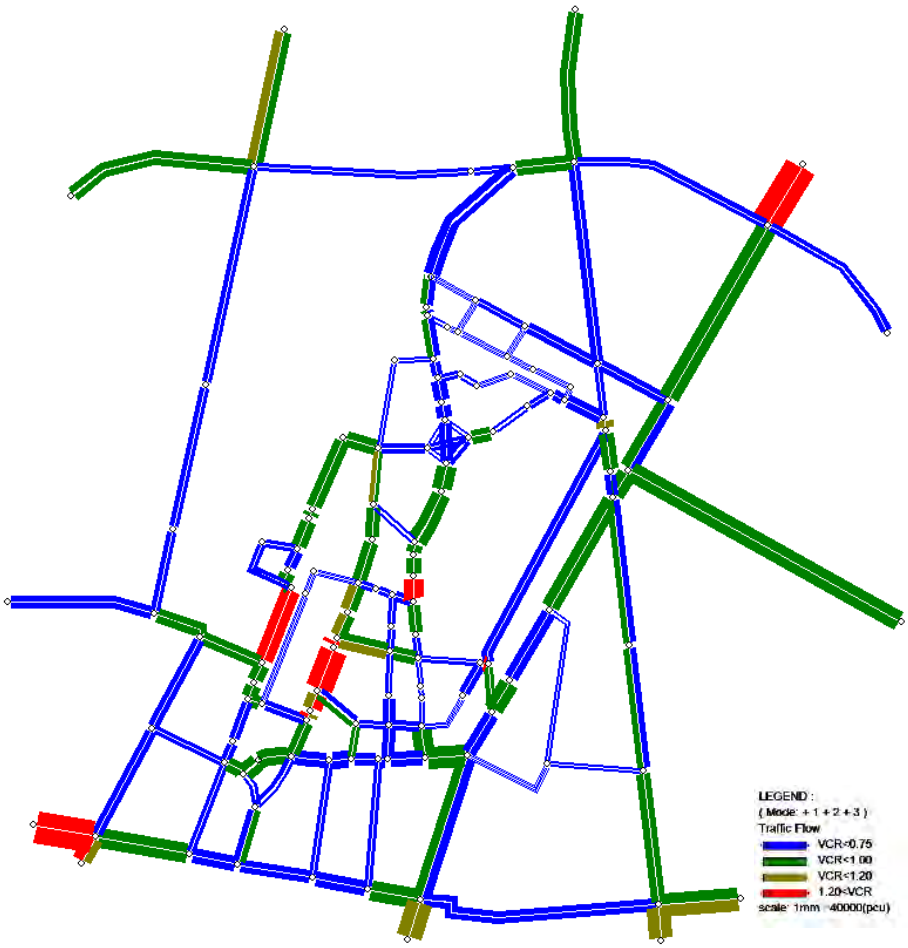
Source : JST

Figure 7.3.27 Modal Share (Left : Inner Trip, Right : Inter Trip)

4) Trip Assignment

All trips are sorted by transportation mode. After sorting all trips into each mode, trip assignment process was proceeded by user equilibrium assignment. The result is shown in Figure 7.3.28.

All roads do not exceed their road capacity. On the other hand, some roads around Bang Sue Grand Station exceed their road capacity. The reasons are the generated trips around Bang Sue Grand Station is huge, and supply of road infrastructure is not enough compare to traffic volume. The countermeasure is to increase the bus volume to decrease the number of private vehicles.



Source:JST

Figure 7.3.28 Result of Traffic Demand Forecast

Table 7.3.18 Trip Assignment Result

Year of Traffic Demand Forecast	Vehicle – km Total (PCU-km) ('000)	Vehicle-hours Total (PCU-Hour)	Average VCR*	Average Speed (km/h)
2032	2,837,767	66,604	0.62	42.6

Source:JST

7.3.4 Grade Up Facilities

(1) Sky Bridges

JST proposes to construct skywalks in the west of Bang Sue Grand Station in the south-north direction and in the east of the station in the east-west direction. The former will be constructed in 2022 while the latter will be constructed in 2027.

Sky bridges will be covered with roof to shelter pedestrians from sunlight. There will be mist spray on some locations to provide cool feelings.

(2) Underpass

The objective of constructing underpass is to ensure the accessibility from Bang Sue Grand Station to commercial facilities.

(3) ITS

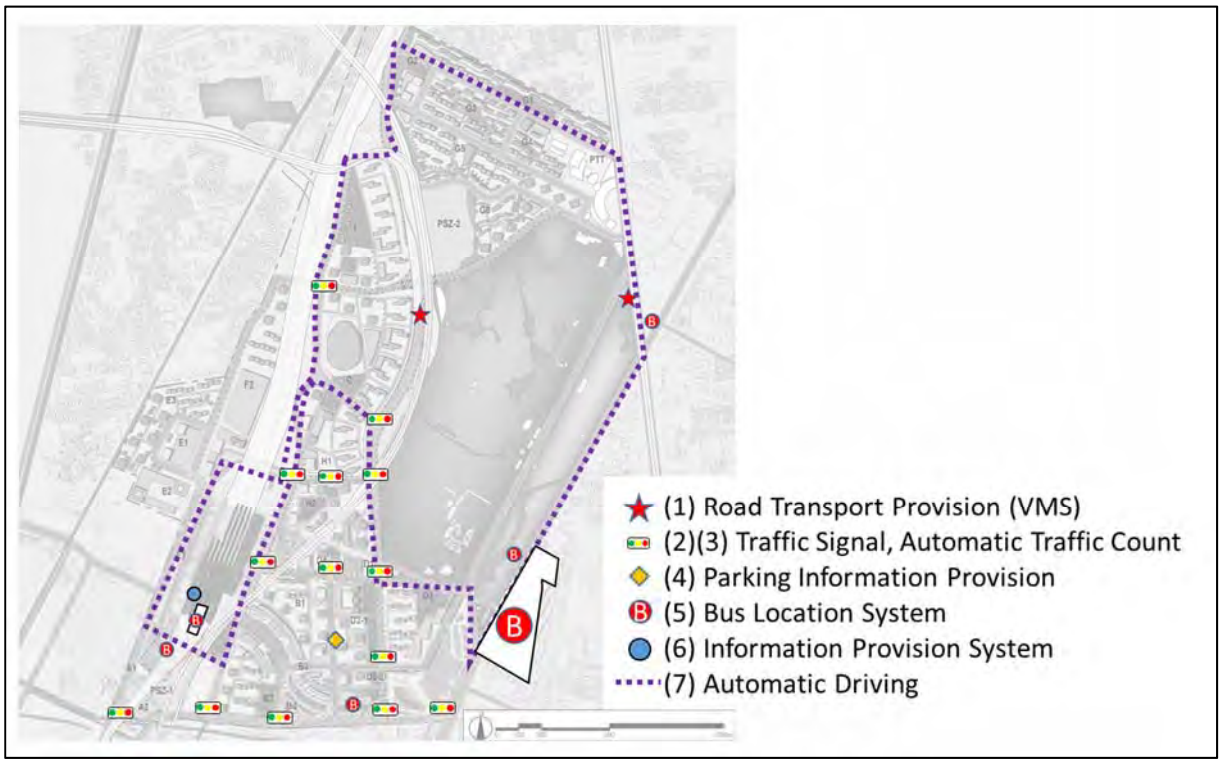
ITS facilities that can be applied in Bang Sue Area could be variable message sign (VMS), signal coordination system, parking information system, bus location system, information provision system, and autonomous driving technologies. As VMS and parking information system are already applied in Bangkok, it would be possible to apply these facilities in Bang Sue. Bus location system will be installed in circulating bus stops and terminals of middle and long distance buses. Autonomous driving technology could be applied in circulating buses (Figure 7.3.29, Figure 7.3.30, and Figure 7.3.31).

Source：JST

Figure 7.3.29 Parking Information System in Bangkok (Lumpini Park)

Source：JST

Figure 7.3.30 VMS in Bangkok（ChalermMaha Nakhon Expressway）



Source：JST

Figure 7.3.31 ITSPlan

(4) Data Center

1) Background for Activating Information Industry as Part of Smart City

Thailand 4.0 aims for economic growth in information industry by listing digital industry as one of the target groups of industry education. The target areas for digital industry regulated in the policy are Chiang Mai and Phu Khet. Bang Sue is not listed as a target area. However, it is listed as the target area for innovative industry promotion in the “smart up” program ofthe National Innovation Agency (NIA). Therefore, JST proposes to activate information industry as part of the smart city

To activate information industry, it is necessary to attract investors such as IT companies by providing reliable big data management, reducing intitial investment cost, and high level of security. Data center may be one of the ways to realize the concept.

2) Performance of Data Center

Reference for performance of data center is shown in Table 7.3.19. It is necessary to consider construction cost and required specifications to decide the appropriate grade.

Table 7.3.19 Performance of Data Center (Reference)

Cetegory	Description
Duplication of power system	The power will be supplied from two different substations by two systems. If incident occurs and one of the systems is stopped, power supply will be switched to the other automatically. As for the short period of switching, UPS will be used to maintain the power.
Duplication of main power facilities	There will be duplicated power system inside the center. Power sources for important equipment such as server roomand air-conditioning system will be duplicated to provide usability and stability in 24-hour, 365 days.
Emergency power generation	Install emergency power generatorto back up in case both main system and supplement system are cut. Also, expansion space for emergency power generator will be secured.
UPS	In case power cannot be supplied from outside, it will need a short period of time for emergency power generator to operate. In this period, UPS will be used. UPS is the back up device. As for emergency power generator, expansion space for UPS will be secured.
Measures against water leakage	In the designstage, measures against water leakage must be considered. Water leakage sensor, emergency drainage facility, and dike will be installed.
Measures against fire	Firefighting will use inert gas. Also, ultra sensitive smoke sensor which can detect cigarette smoke will be installed.
Measures against floods	Data center floor will be constructed higher than the sea level and important facilities will be placed on the first floor to prevent flood damage.
Management of temperature and humidity	Temperature and humidity inside the server room must be maintained constantly regardless of outdoor temperature or facility damages.
Prevention of static charge	To prevent damages from static charge,static-charge-proof floor is used.
Measures against electro-magnetic noises	Electricity line will be on the ceiling while communication line will be installed in cable racks under the floor. This will increase safety against electro-magnetic noises occurring in the electricity line.
Measures against crime	Besides the 24-hour 365-day monitoring, a strict process for entering/exiting (management by untouched card reader), camera recording, continuous presence of safeguards will be implemented to increase security.

Source：JST

3）Characteristics of Data Center

The characteristics of the data center are summarized as shown in Table 7.3.20 Characteristics of the Data Center. At present, as information industry is not developed enough, if the data center business is carried out by a private company, it would be difficult to join because the construction cost is high. Bang Sue Area development would need subsidies from the government as part of the special economic zone (SEZ).

Table 7.3.20 Characteristics of the Data Center

Merits	Demerits
➢ Facilities investment and personnel cost can be reduced. ➢ There is no need to open a server room in each company. ➢ Can be maintained with high level security. ➢ Can be operated continuously in 24- hour 365-day. ➢ Air-conditioning management, fire resistant, and earthquake resistance are considered thoroughly. BCP measures are implemented such as data back up. Risk for business can be reduced.	➢ High level facilities, duplication, back up, and BCP measures will be very costly. ➢ Energy consumption for maintenance would be high. ➢ It is not responsible for bankruptcy and unpredictable disaster. ➢ Procedures for entering server room are time consuming.

Source：JST

7.4 Land Use Planning

7.4.1 Basic Policies for Land Use Planning

JST will consider land use plans towards achieving the realization of the vision for the future for the Bang Sue Area based on the “Matters for Care and Consideration” outlined in the basic policies section.

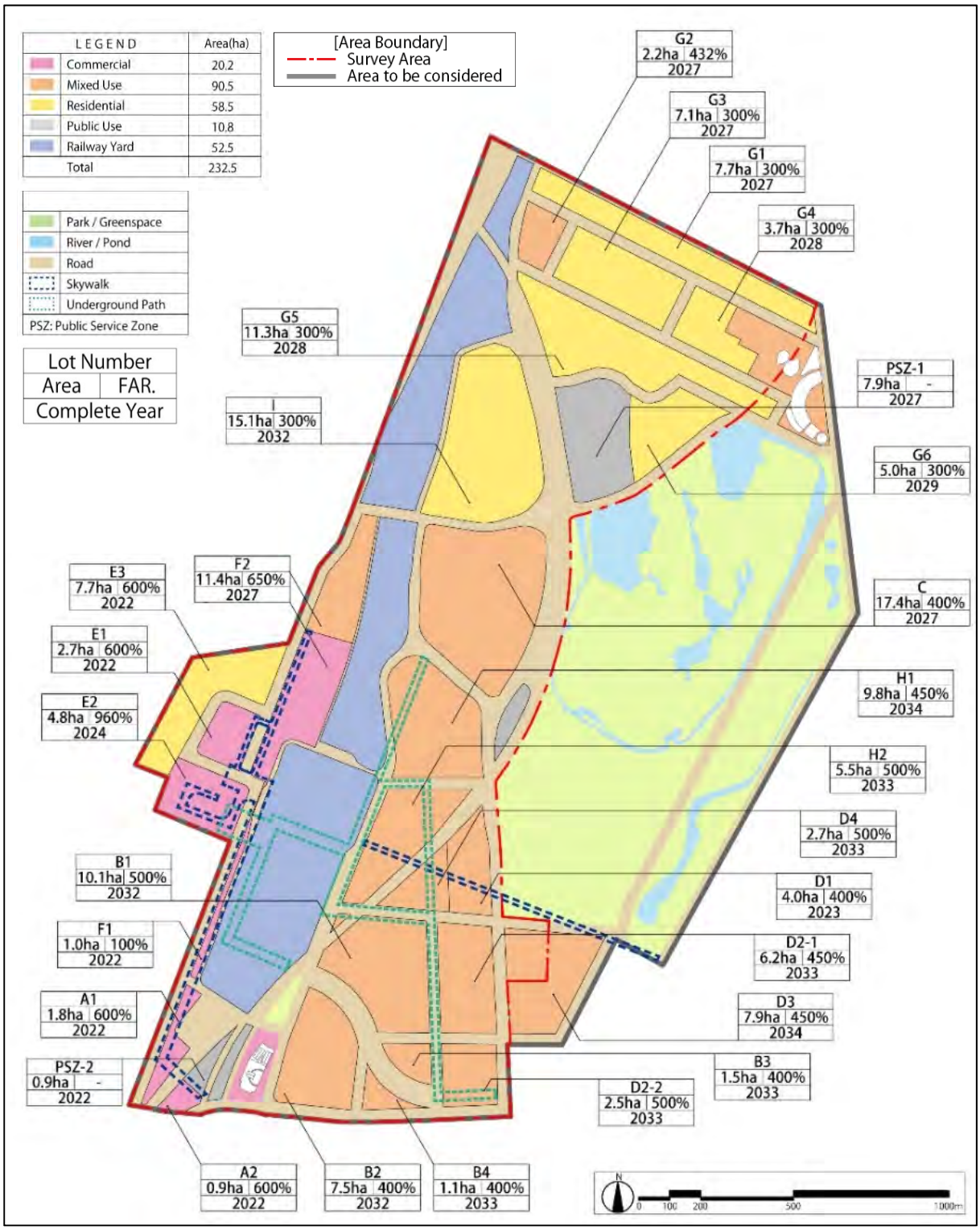
Land use will be divided into three distinct categories: (1) Commercial land (locations inducive to the development of commercial and business facilities of the kind that will form the central core of the city district), (2) Multi-purpose land (land for which the main application of use is for commercial and business purposes, but where residences will also be introduced for the purposes of creating liveliness—making the city feel busy and bustling—and ensuring a settled resident population), and (3) Residential land (with the aim of creating good quality residential zones in the Greater Bangkok area).

With regard to placement, commercial land will be located in the SRT land and areas surrounding Bang Sue Station, multi-purpose land will be located in the central part of the district that connects Bang Sue Station with Chatuchak Market, and residential land will be located in the western side of the SRT land (near to the border of the district), and in the northern part of the district.

7.4.2 Land Use Plan

Land use plan is shown in Figure 7.4.1. Proposed arrangement of future facilities based on the land use plan as shown in Figure 7.4.2. Based on the arrangement of future facilities, development images are as shown in Figure 7.4.3 and Figure 7.4.4.

These images including buildings and facilities are all for illustration, thus the contents will not be given conditions(Appendix 7-3).



Source : JST

Figure 7.4.1 Land Use Plan

Source : JST

Figure 7.4.2 Image of Future Development

Source：JST

Figure 7.4.3 Image Pers [Bang Sue Area]

Source：JST

Figure 7.4.4 Image Pers [Around Bang Sue Grand Station]

7.5 Volume Study

From the market research and interviews with real estate companies, JST calculates the floor area for office, commercial facilities, hotels, and residential buildings. Based on the land use plan, JST planned arrangement of buildings in each zone. Population forecast for each zone is shown in Table 7.5.1.

(1)Office

1) Floor area×0.6 (Effective ratio)＝Exclusive area
2) Exclusive area÷12 ㎡/ person＝Number of people in the office

(2)Commercial facilities

1) Floor area×0.5 (Effective ratio)＝Tenant area
2) Tenant area×0.8 person/㎡＝Number of customers

(3)Hotel

1) Floor area×0.6 (Effective ratio)÷35 ㎡＝Number of rooms
2) Number of rooms×1.5person＝Number of people

(4)Residential buildings

1) Floor area×0.7 (Effective ratio）÷80 ㎡＝Number of rooms
2) Number of rooms×4 persons＝Number of residents

Table 7.5.1 Volume Study

Land Use	Contents	Scale (m^2,rooms, people)
(1) Office	Exclusive Area	530,760 m^2
	Number of People in the Office	44,230 people
(2) Commercial Facilities	Tenant Area	365,350 m^2
	Number of Customers	292,280 people
(3) Hotel	Number of Rooms	31,735 rooms
	Number of People	9,373 people
(4) Residential Facilities	Number of Rooms	6,249 rooms
	Number of Residents	126,942 people

Source：JST

7.6 Cost Estimate

(1) Basic Policies for Cost Estimate

Estimate with assumption on international contractors.

(2) Cost Estimate Items

Estimation is made for civil works and architecture works. Items included in the construction of the Red Line Bang Sue Station will be excluded. As land is owned by SRT, land use fee is excluded.

(3) Currency Unit

Use THB with conversion ratio of USD 1＝THB33.92 (July 13th, 2017)

(4) Estimate Time

July 2017

(5) Estimate Unit Price

Unit price is set based on the interview with related agencies in Thailand (MEA, BMA) and Thai consultants. The unit prise for infrastructure is as shown in Table 7.6.1. The unit price for buldings is as shown in Table 7.6.2.

Table 7.6.1 Unit Price for Infrastructure

Large category	Middle category	Item	Unit	Unit Price (USD)
Basic Urban Infrastructure	Land reclamation	Earth fill	m^3	12
	Road	Road	m	1,800
		Road lighting	point	750
	Water supply	Filter plant	m^3	300
		Water tank	m^3	130
		Water pipe	m	200
	Sewage	Sewage pipe	m	200
		Manhole	point	1,000
		Sewage treatment plant	m^3	300
	Drainage	Drainage pipe	m	1,000
		Pumping station	point	1,000,000
	Electricity	Transmission line	m	3,000
		Substation	point	10,000,000
		Circuit breaker	point	50,000
		Distribution line（24kV）	m	200
	Communication	Duct	m	10
		Optical fiber cable	m	10
Transport Network	BRT	BRT station	set	15,869,960
		BRT car	car	473,200
	Underground passage	Underground passage	m^2	1,000
	Bas	Middle-Long distance bus terminal / Depot	m^2	500
	Paking	Underground parking	m^2	1,000
	Road facility	Traffic light etc.	point	1,000,000
Green Network	Green space	Park	m^2	10
Smart Infrastructure	Co-generation system	Gas pipe	m	50
		Cooling pipe	m	50
		Gas co-generation sysytem/ District cooling system	set	63,709,000
		Common duct	m	1,000
	CEMS	CEMS	set	34,058,000
	Solar power	太陽光発電装置	MW	1,820,000
Disaster Prevention	Regulation pond	調整池	ha	100,000
	Private power generation	Solar power generation facility	point	1,000,000
Upgrading Facility[1]	Underpass	Underpass	m^2	3,000
	Pedestrian road	Sky walk	m^2	500
	ITS	ITS	set	12,000,000
		Data center	m^2	3,800

Source：JST

[1] High value-added facilities for enhancing urban function and well-planned area development.

Table 7.6.2 Unit Price for Buildings

Large category	Item	Unit	Unit Price（USD）
Office	Office	m^2	1,500
Commercial Facilities	Commercial facilities	m^2	1,500
Residential Facilities	Condominium	m^2	1,500
Hotel	Hotel	m^2	1,500
Cultural Facilities	Arena	m^2	2,000
	Exhibition hall	m^2	500
	School, hospital	m^2	1,500
Public Offices	Government office /SRT head office	m^2	1,500

Source：JST

(6) Maintenance Cost

Refering to other examples, maintenance cost is assumed to be 2% of the total cost.

Details on cost estimate are shown in Table 7.6.3 and Table 7.6.4.

Table 7.6.3 Details on Cost Estimate for Bang Sue Area Redevelopment (Category)

Category	Small Category	Cost (USD 1,000)
Basic Urban Infrastructurte	-	159,371
Transport Network	-	309,432
Green Network	-	6,100
Environment	-	103,127
Disaster Prevention	-	11,000
Upgrading Facilities	-	81,500
Buildings	Office	2,653,800
	Commercial Facilities	2,189,400
	Residential	10,880,700
	Hotel	1,093,500
	Cultural Facilities	550,000
	Public Offices	300,000
Total		18,337,930

Source：JST

Table 7.6.4 Details on Cost Estimate for Bang Sue Area Redevelopment (Detail)

		Category	Detail	Standard	Number		unit price (USD)	Total (USD)
					Total			
Basic Urban Infrastructure	1	Embankment		fill (average 1.0m)	1,400,000	m3	12	16,800,000
	2	Road		4Lane W= 35m	12,700	m	1,800	22,860,000
			Street lighting	per20m／both side	1,270	spot	750	952,500
	3	Water	Water plant	Q=60,000m3/day	60,000	m3	300	18,000,000
			Reservoir with Pump	V=10,000m3	10,000	m3	130	1,300,000
			water pipe	HDPE pipe (D=300)	25,400	m	200	5,080,000
	4	Sewer	sewer pipe	RC pipe (D=600)	25,400	m	200	5,080,000
			manhole	per 40m	635	spot	1,000	635,000
			Sewege treatment plant	Q=48,000m3/day	48,000	m3	300	14,400,000
	5	Drain	Drainage	Box Culvert (2mx2m)	25,400	m	1,000	25,400,000
			Pumping station	Q=1M3/s	4	spot	1,000,000	4,000,000
	6	Power	Transmission cable	110kV(2lines)	5,000	m	3,000	15,000,000
			Substation	180MVA(60MVAx3)110/	2	spot	10,000,000	20,000,000
			RMU(switch)		22	spot	50,000	1,100,000
			24kVcable		38,100	m	200	7,620,000
	7	Telecom	Cable conduit		76,200	m	10	762,000
			Optic fiber cable		38,100	m	10	381,000
							Sub Total	159,370,500
Transport Network	1	BRT	BRT station/Road Improvement		1	unit	15,869,960	15,869,960
	2	BRT	Vehicle		44	train	473,200	19,874,400
	4	Underground passage		20mx3m	63,600	m2	1,000	63,600,000
	5	Medium & Long dista	Bus Terminal／Bus Depot(Bang Sue Grand		372,175	m2	500	186,087,500
	6	Underground parking	SRT land (Park&Ride)		10,000	m2	1,000	10,000,000
	7	Road facility	Traffic Signal etc	Traffic signal (Multi Color Graphic) , Traffi	14	spot	1,000,000	14,000,000
							Sub Total	309,431,860
Green Network	1	Green/Plantation	Park	5% of whole area	14	m2	10	6,100,000
							Sub Total	6,100,000
Environment	1	Co-generation	Gas pipe	D200	25,400	m	50	1,270,000
			Cooling pipe	D200	25,400	m	50	1,270,000
			GCS,DC		1	unit	63,709,000	63,709,000
			common duct		1,000	m	1,000	1,000,000
	2	CEMS			1	unit	34,058,000	34,058,000
	3	Solar power generati	common equipment	1.82millionUSD/MW	1	MW	1,820,000	1,820,000
							Sub Total	103,127,000
Disaster Prevention	1	Retention Pond			10	ha	100,000	1,000,000
	2	Generator		1MVA	10	spot	1,000,000	10,000,000
							Subtotal	11,000,000
Upgrading Facilities	1	Underpass	Intersection Underpass		3,000	m2	3,000	9,000,000
	2	Pedestrian Road	Skybridge	W=15m, L=3000m	45,000	m2	500	22,500,000
	3	ITS	bus location system, Parking information system, VMS		1	式	12,000,000	12,000,000
	4	Data center		3,800USD/m2	10,000	m2	3,800	38,000,000
							Sub Total	81,500,000
		Total						670,529,360

		Category	Detail	Standard	Number		unit price (USD)	Total (USD)
					Total			
Buildings		Office			884,600	m2	1,500	2,653,800,000
		Commercial Facilties			729,800	m2	1,500	2,189,400,000
		Residential			3,626,900	m2	1,500	10,880,700,000
		Hotel			364,500	m2	1,500	1,093,500,000
		Cultural Facilities	Arena		50,000	m2	2,000	200,000,000
			Exhibition Center		50,000	m2	500	50,000,000
			Educational Facilities, Hospital		100,000	m2	1,500	300,000,000
		Public Offices	BMA/SRT		100,000	m2	1,500	300,000,000
					5,905,800			
		Total					Buildings	17,667,400,000
							Whole Total	18,337,929,360

Source : JST

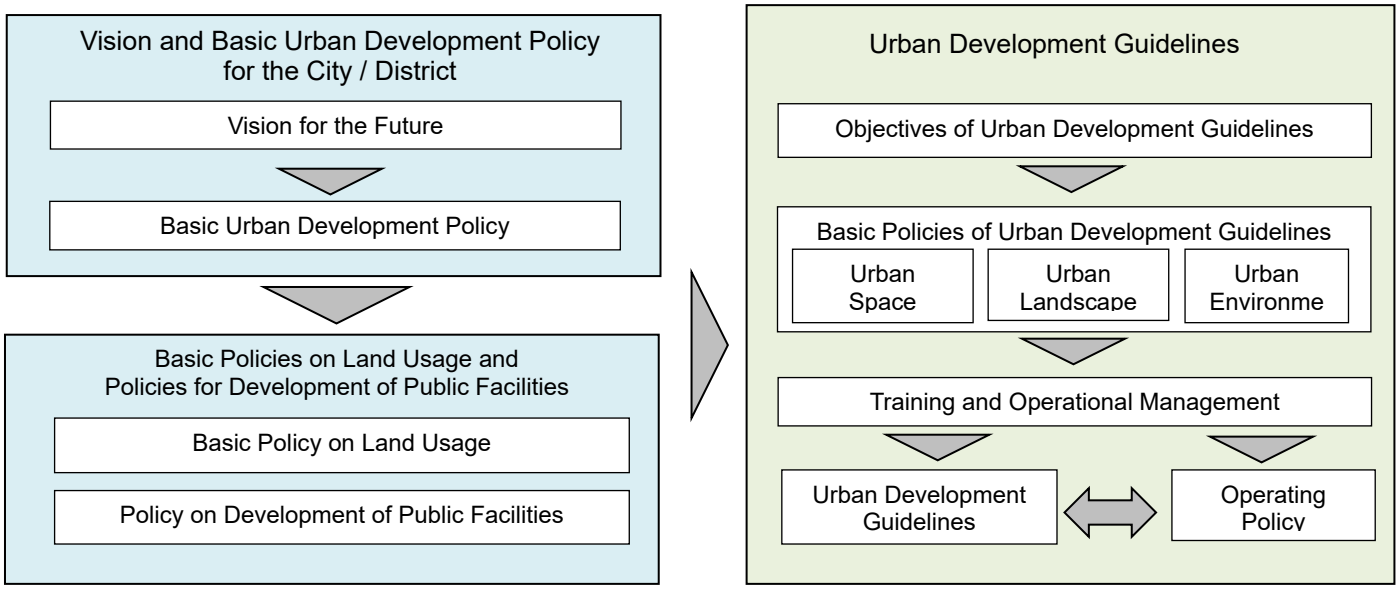
7.7 Guideline for Town Development

7.7.1 Objectives of Creating Urban Development Guidelines

(1) What are Urban Development Guidelines?

The urban development guidelines are guidelines that are formulated when carrying out urban development projectsin a specific district. They essentially constitute a plan document, which maps out the urban space that is considered necessary in order to achieve the successful realization of the development; stipulates basic policies related to urban landscape and urban environment; cultivation and operation of the district towards the future; and sets forth guidelines and operating policies to guide the development in the desired direction based on the future vision and basic policies for what the developers aim to achieve through the development of the district, basic policies regarding land usage, and the development of public facilities, and the intentions of the developers (or development organization), local government bodies, and other relevant parties.

Flowchart for Creation of Urban Development Guidelines is shown in Figure 7.7.1.



Source: JST

Figure 7.7.1 Flowchart for Creation of Urban Development Guidelines

(2) Benefits of Introducing Urban Development Guidelines

Introducing urban development guidelines—along with the mechanisms for ensuring that not only the developers conducting development projects in the target district but also other business operators involved in land utilization and construction of facilities, etc., in the district reliably observe and adhere to the basic policies and guidelines set forth in the urban development guidelines—enables developers to guide the urban development in the desired direction (i.e., in line with the future vision and basic policies) over an extended period of time, even with the involvement of multiple organizations. It also makes it possible to achieve a high quality urban development that feels coherent and harmonious in terms of the look and feel of the district as a whole, including the shaping of the urban space, urban landscape, and urban environment.

Good management with urban development guideline will enhance the magnetism of the project, the value of property, and it support qualified investors to invest to the project.

7.7.2 Case Studies on Urban Development Guidelines in Japan

(1) Framework of Urban Development Guideline

An urban development guideline generally consists of land use policy, public facility development policy, policy for space management, land scape, and environmental concideration. Major contents of each policy are as shown in Table 7.7.1.

Table 7.7.1 Plan Formulation Policies

Component	Main Cotntents
Land Use Policy	・Positioning of the project area ・Development concept, goal
Public Facility Development Policy	・Road, Park ・Guiding board
Space management Policy	・Land zoning ・Urban design for a good urban space
Land Scape Policy	・Architecture design, regulation on color ・Lighting, planting, landscape planning
Environmental Consideration Policy	・Energy saving, Low carbon, recycling ・Environmental concervation

Source: JST

(2) Minato Mirai 21 Central District (Figure 7.7.2 and Figure 7.7.3)

The Minato Mirai 21 (MM21) Central District of the city of Yokohama (in Kanagawa Prefecture) was developed primarily in old industrial sites, including the Mitsubishi Heavy Industries Yokohama shipyard and the Japanese National Railways classification yard for the Takashima Freight Line; with the objective of reducing the overconcentration of business in the central Tokyo by creating an economic hub in Kanagawa that would help lead the economy of the Greater Tokyo area. It is a large-scale urban development project in which the accumulation of corporate head offices, meeting, incentive tour, conference, exhibition (MICE), and hotel functions is progressing; a project that is truly representative of the Greater Tokyo area, and one which could be said to be very similar to that of the Bang Sue Area.

The MM21 Central District aims to become a “future city worthy of the 21st century,” and various progressive efforts are being advanced there, including the introduction of joint-use utility tunnels and district heating and cooling (DHC) systems and other initiatives geared toward creating a "smart city”. In order to create a dignified high-quality urban landscape in the district and maintain (and improve) the quality of the landscape, developers have created the Minato Mirai 21 Central District Urban Landscape Guidelines—a collection of landscape-related guidelines including landscape standards for the district’s symbolic main street (Minatormirai O-dori) and other areas—and are advancing their urban development efforts in accordance with those standards.

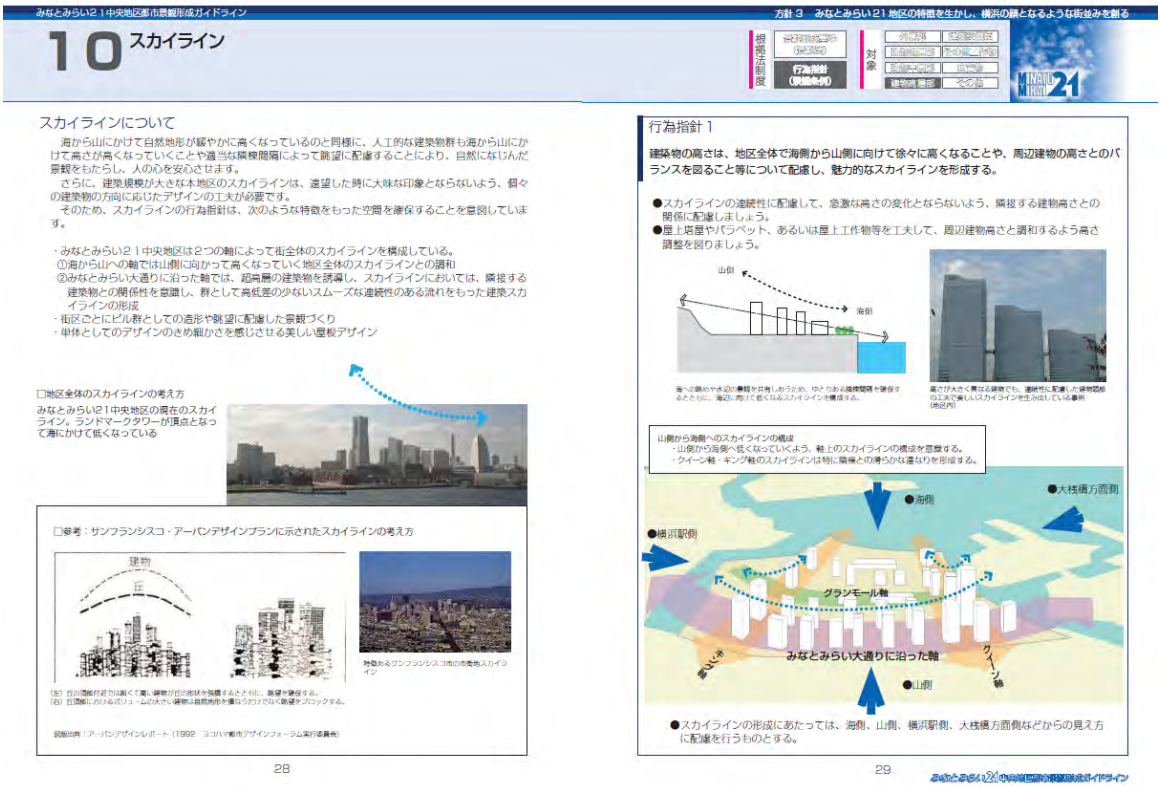
The guidelines stipulate three key policies: (1) the creation of a lively and energetic district accumulating a wealth of advanced city functions, (2) the shaping of an urban environment that is

pleasant, comfortable, and people-friendly, and (3) the formation of a cityscape that will be the new "face" of the city of Yokohama and set forth strategies for the creation of an urban landscape focusing primarily on areas along three "urban axes" within the district and the single main street.

Specifically, the guidelines outline the expected action guidelines in relation to various aspects of development including "shaping a lively atmosphere on the lower floors of the buildings", "creating walkway and plaza-type open spaces on private land", "establishment of parking areas for cars and bicycles", "use of color and lighting", "building design and skylines", "outdoor advertisements", and "creating a lively and bustling atmosphere".

Source: Urban Development Bureau, City of Yokohama

Figure 7.7.2 Creation of Walkway-type Open Spaces



Source: Urban Development Bureau, City of Yokohama

Figure 7.7.3 Skylines

(3) Toyosu 2 and 3-Chōme District (Figure 7.7.4, Figure 7.7.5)

The Toyosu 2 and 3-Chōme District projects are large-scale land use transformation projects the likes of which are rarely seen in Tokyo. It is a 50ha development centered on the site of the old Ishikawajima-Harima Heavy Industries Plant located in the Tokyo Rinkai (or “waterfront”) District. It is an urban development project that could be said to be very similar to that of the Bang Sue Area.

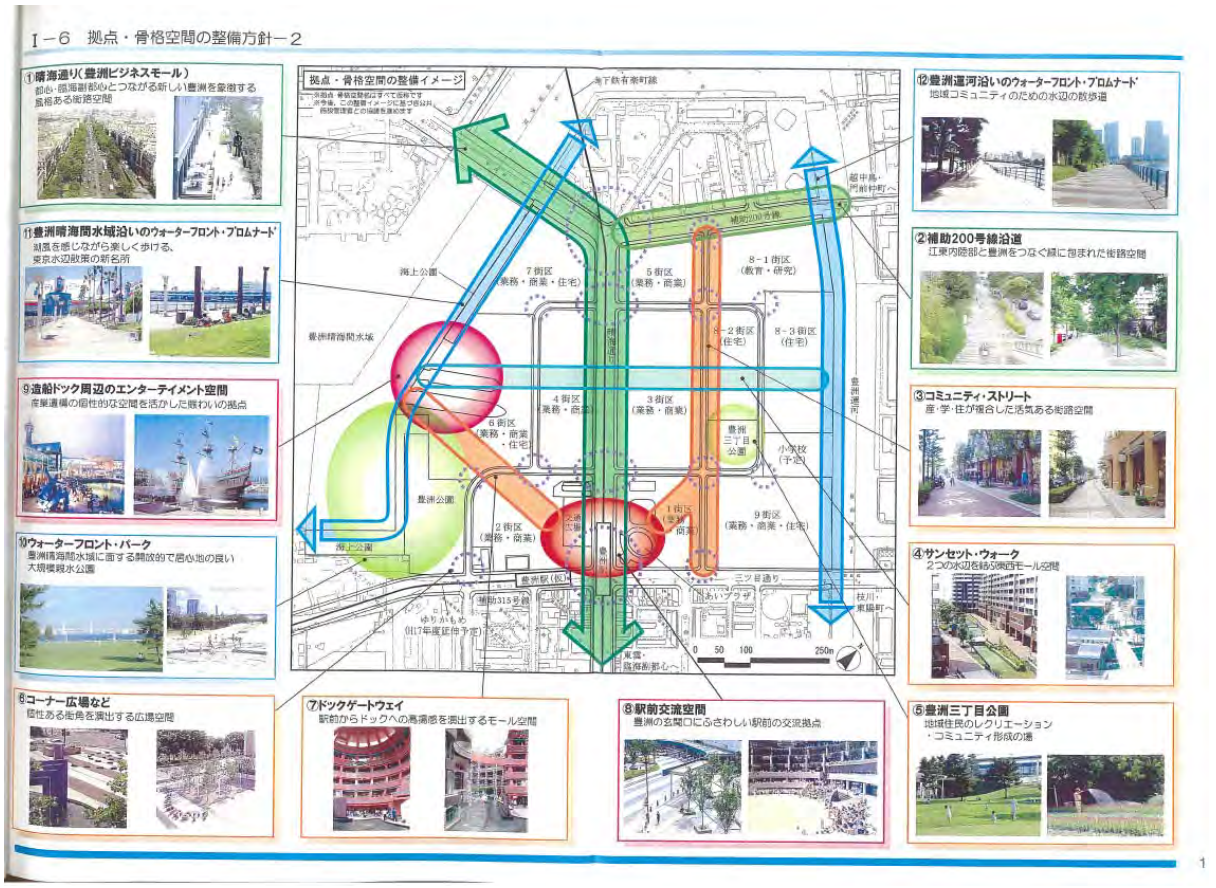
The Toyosu 2 and 3-Chōme projects seek to drive forward new urban development around the key concept of industry, based on the concept of a new industrial motherland; the background to this being location-related conditions such as the district’s close proximity to the Central Tokyo area, its convenience of access via subway trains and other public transportation, and its rich urban environment surrounded by the waters of Tokyo Bay. The developers have raised five urban development themes pertaining to the district (1) as an industrial hub, (2) as a city on the water, (3) as a living space, (4) as a center for various activities, and (5) as part of the wider environment; and have established guidelines setting targets for the creation of urban spaces in relation to each of these themes.

Specifically, the basic urban development policy that outlines the overall picture of the development sets forth policies relating to “networks and pedestrian spaces” and “open spaces such as plazas and parks,” while the basic policy for hubs and structural spaces outlines policies regarding the “creation of cityscapes” and “water, greenery, and light.”

The project’s Policy for the Development of Public Facilities stipulates basic policies for the local public bodies that construct, maintain, and develop city infrastructure in relation to features such as

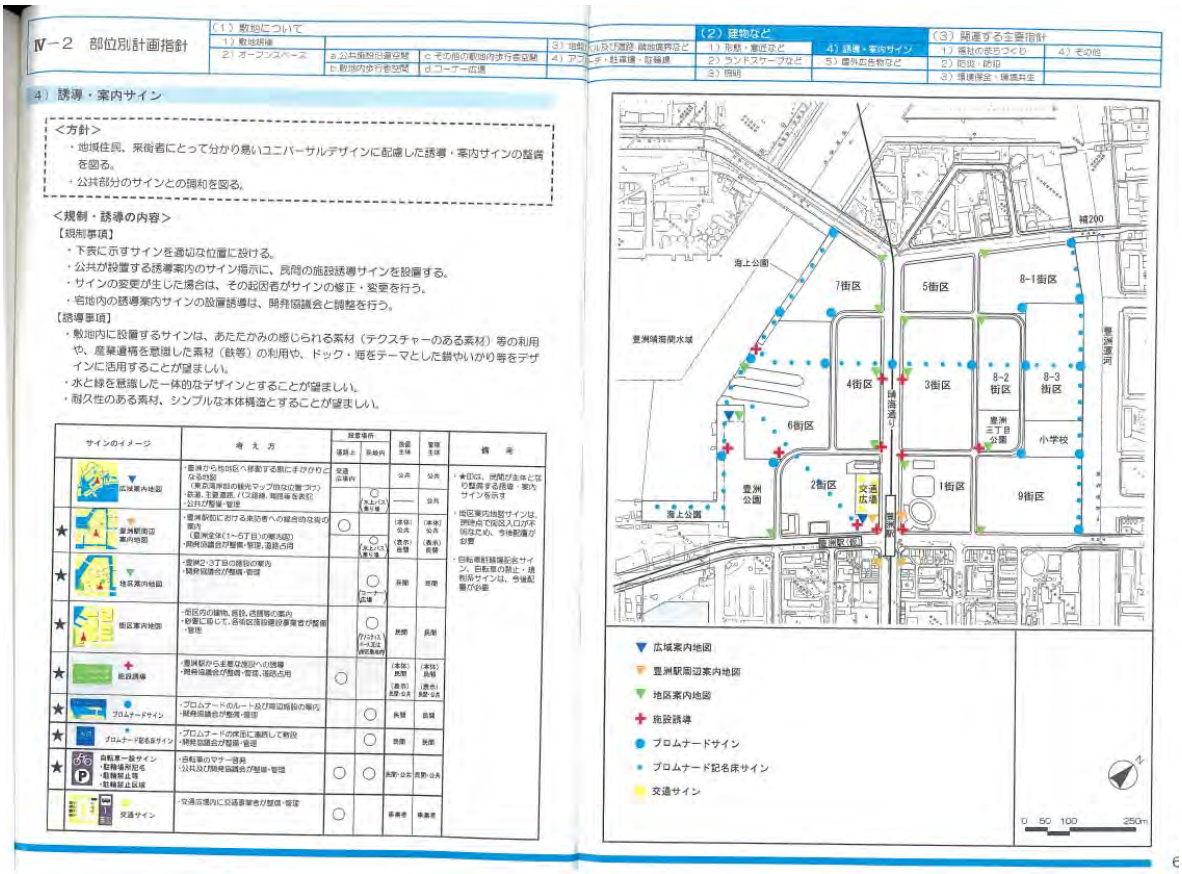
roads, parks, plazas, and promenades; and outlines landscaping, planting of plants and trees, and the use of lighting, etc. The project also has Premises Usage Plan Guidelines aimed at the business operators that develop invidual blocks or zones within the district, which stipulate rules with regard to securing open spaces, walkways/passageways and plazas, plant and tree planting design and shaping, landscaping, guidance, informational signs, and outdoor advertisements in each zone.

The developers have also established an operational framework and operational workflow, etc., towards insuring the reliable operational implementation of these guidelines.



Source: Urban Renaissance Agency

Figure 7.7.4　Basic Policy for Hubs and Structural Spaces



Source: Urban Renaissance Agency

Figure 7.7.5 Guidelines for Guidance and Informational Signs

(4) Kamakura Fukasawa District (Figure 7.7.6, Figure 7.7.7)

The Kamakura Fukasawa District is a 32 ha large-scale land usage transformation project focused primarily on the site of an old JR Railyard (a former Japanese National Railway Settlement Corporation site) located in the city of Fujisawa (in Kangawa Prefecture), which again could be said to be very similar to that of the Bang Sue Area.

The district has set urban development targets for energetic urban development, safety and peace of mind, utilization of local resources, coexistence with the natural environment, and partnership between the public and private sectors, and is advancing its urban development efforts based on a future image of Fukasawa as a “healthy lifestyle hub.”

The project’s urban development guidelines contained an urban space formation policy, urban plan development policy, and urban environmental development policy based on the basic policies pertaining to the top level project plan itself, as well as land usage and public facility development. An operational policy has also been established with regard to the operational implementation of the guidelines, with a view of ensuring sustainable development of the district.

The urban development guidelines also provide an outline with regard to the development of distinctive roads (such as symbolic main roads in the district) and areas along those roads, and for the development of public spaces such as parks and street corner squares/plazas; along with matters for care and concern on spaces, landscapes, and environment that apply to all buildings and structures in the district.

図 ― まちづくりの指針概要

Source: City of Fujisawa

Figure 7.7.6 Urban Development Guidelines

図 ― 都市環境づくりのイメージ

Source: City of Fujisawa

Figure 7.7.7 Illustrative Image for Development of Public Spaces

7.7.3 Desirable Guidelines for the Bang Sue Area

(1) Distinctive Features of the Bang Sue Area

The Bang Sue Area development is a leading TOD-type urban development project in Bangkok. The district has a number of appealing features that include spacious land, highly convenient transport access, attractive urban parks, and tourist hubs; and there are high hopes that by making fully effective use of these features, the district will play a major role in forming a multifunctional city area with high-level hub-like attributes that will bring new energy and vitality to Bangkok.

To achieve this, in carrying out the development of this district, it will be effective to formulate a basic urban development policy and grand-scale vision for the future of the district as a whole, and to create unified, district-wide development plans (such as land usage plans and public facilities development plans) based on a more advanced concept of planned "integrated development" that will enable the maximization of the city's attractive features and added value; rather than the conventional style of "individual development" in which various business operators enter private-public partnership (PPP) bids as and when land becomes available for use and carry out development based on their own respective ideas, on an individual block-by-block or zone-by-zone basis.

Furthermore, in order to ensure proper realization of the plans relating to this integrated development under the Bang Sue Area development project, which will involve a diverse range of key entities and organizations including government agencies, SRT and private sector companies, it will be necessary to formulate a set of Bang Sue Area Urban Development Guidelines and to ensure reliable operation of these guidelines.

(2) Structure of the Bang Sue Area Urban Development Guidelines

The Bang Sue Area Urban Development Guideline aims to archieve a well planed, quality development and enhance magnetism of the project, the value of properties. Especially, it will mention on better management of public space, landscape and environment based on the feature of the area as transportation hub and having good parks. In addition, it will mention on implementation mechanism for the sustainable development of the whole area.

The following section is the proposed table of contents of the guidelines:

Bang Sue Area Urban Development Guidelines
Table of Contents and Major Items to be Listed (Proposal)

■ Introduction

1. Urban Development Guidelines
   (1) How Urban Development Guidelines are Regarded
   (2) Purpose of Urban Development Guidelines
      → Lists of objectives that are aimed for in establishing and utilizing these guidelines
   (3) Areas to Which the Urban Development Guidelines Apply
      → Lists of areas of the district, where it is expected that the guidelines will be utilized. As a general rule, the areas to which the guidelines will apply are equivalent to the entire project district

2. Urban Development of the Bang Sue Area

(1) How Bang Sue is Regarded Spatially and Socially

→ Describes the top level plan and future concept, how the Bang Sue Area is regarded as part of Bangkok within the various plans, and what kind of possibilities and potential the district offers in terms of its location conditions and surrounding environment

(2) Vision for the Future

→ Rather than how Bang Sue Area is regarded as described above, this section describes how the district should be in the future

(3) Basic Urban Development Policy

→ Describes the direction that the development will take and policies towards achieving the realization of the vision for the future described in the above section

(4) Basic Policy on Land Usage

- Land Usage Plan

→ Describes the way that land usage should be implemented and functions that should be introduced based on the vision for the future and the basic development policy

(5) Basic Policy on Development of Public Facilities

- Public Facilities Development Plan
- Upgrade Facilities Plan

→ Describes the development of public facilities (e.g., roads, parks, plazas, supply and processing facilities) to be established and developed in the Bang Sue Area, and with regard to the introduction of upgraded facilities towards improving the beneficial effects of development

3. Basic Policies for these Urban Development Guidelines

(1) Basic Policy on Urban Space Formation

- Transportation network (public transport, cars, people, bus stations, transportation plazas, car parks, etc.)
- Green network (ecological corridors, ventilation paths for cooling breezes, parks, and green spaces)

→ Describes (in pictorial and textual form) basic development policies and matters for attention regarding the development of transportation and “greenery” networks in the Bang Sue Area, towards the formation of urban spaces in the district

(2) Urban Landscape Development Policy

- Landscape formation (open spaces, height, design, use of color, greenery, etc.)

→ Describes (in pictorial and textual form) basic development policies and matters for attention regarding the formation of landscapes, such as city infrastructure and various buildings/structures that will be developed in the Bang Sue Area, with the objective of developing and creating urban attractive landscapes in the district

(3) Urban Environment Development Policy

- Care and concern for the environment (improving energy efficiency, energy-saving, water percolation, and underground accumulation, etc.)
- Care and concern for disaster prevention and readiness

→ Describes (in pictorial and textual form) basic development policies and matters for attention regarding care and concern for environmental issues, such as improving energy efficiency and energy saving measures, and initiatives regarding disaster prevention and readiness in the Bang Sue Area

4. Cultivation and Operation of the District
   (1) Creation of Mechanisms for Sustainable Development
   (2) Creation of Such Mechanisms
      → Describes the way that organizations concerned with the management of the district should be, soft (i.e., non-hardware-based) mechanisms relating to such management, and matters pertaining to the creation of such mechanisms, etc.; for the purpose of facilitating attractive, energetic, and sustainable urban development in the Bang Sue Area, and carrying out continuous initiatives towards the future advancement of the district

5. Urban Development Guidelines
   (1) City Infrastructure and Facilities Plan Guidelines
   (2) Architectural Guidance Guidelines (for buildings and other structures)
   (3) Low Carbon City Development InitiativeGuidelines
   (4) Safe and Secure Urban Development Initiative Guidelines
      → Lays out specific rules and standards as guidelines to be observed and adhered to when advancing the formulation of specific plans, design, development and construction work, etc., in relation to matters set forth in the basic urban development policies in Section 3 above

6. Operation of Urban Development Guidelines
   (1) Operational Framework
   (2) Operational Methods
      → Describes the organizations, frameworks, specific approvals, and licenses and the desired state of management in order to appropriately operate and implement the guidelines summarized so far, and achieve the actual realization of the urban development put forward in the vision for the future

(3) Future Initiatives Towards the Formulation of Urban Development Guidelines

In this survey, JST has made considerations (in Chapters 1 to 4) regarding basic matters in the content set forth in the proposed table of contents presented earlier. However, with regard to items 5. Urban Development Guidelines and 6. Operation of Urban Development Guidleines (which are detailed, technical guidelines) JST has chosen not to do so. Typically, the formulation of the content of these guidelines would entail a certain amount of time and labor after the formation of an expert committee including members of the development project organization(s), local public bodies, experts, and experienced academe. For this reason, JST has chosen not to carry out this step in the course of conducting this survey.

Moving forward, in laying out the urban development guidelines toward the determination of specific details of the urban development, it will be necessary to form a committee for the formulation of such guidelines, incorporating members from SRT, BMA, and experts in urban planning and urban development field, and so on, in order to advance concrete discussions with regard to the creation of such guidelines.

Chapter 8 Implementation Plan

8.1 Project Implementation Mechanism

In order to implement the Bang Sue Redevelopment Project, organizational and funding arrangements are essential. In this section, the project implementing organizaton and project funding mechanism are proposed.

8.1.1 Project Implementing Organization

(1) Overall implementation structure

The Bang Sue Redevelopment Project is a massive project both in terms of size and complexity. It involves many stakeholders at each of the development layers. As described before, in the JICA Study Team (JST) view, there are five layers of development:

Layer 1: Basic Public Infrastructure

Layer 2: Green Network and Environment Management

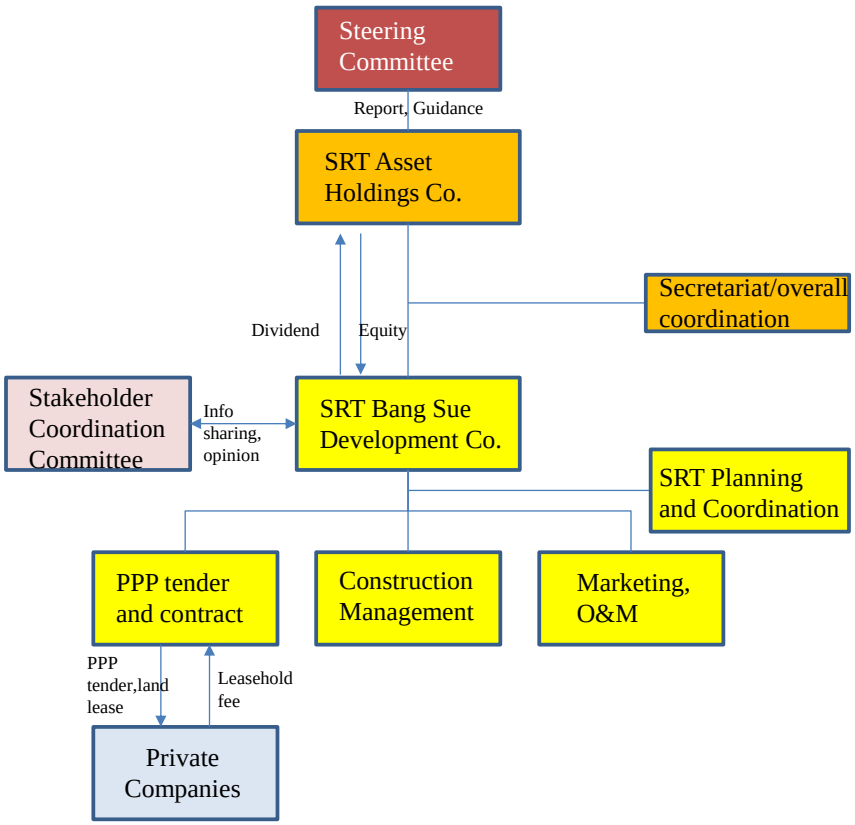
Layer 3: Transportation Network

Layer 4: Upgrade Facilities for Transit-oriented Development (TOD) and Smart City

Layer 5: Commercial and Magnetic Facilities

These development layers are all implemented on the State Railway of Thailand (SRT) land, which also add complexity. For example, trunk road (in Layer 1) is typically developed on top of the lands owned by the government. Trunk road development on SRT land requires a memorandum of understanding (MOU) between SRT and Bangkok Metropolitan Administration (BMA), to clarify the responsibility sharing of construction, and operation and maintenance (O&M). Such coordination between SRT and each government department require very strong coordination mechanism. Otherwise, the development will just take too much time and energy.

Therefore, government “top-down” implementation structure involving all key stakeholders is essential to successfully develop the Bang Sue area. JST’s suggested implementation structure is described below (Figure 8.1.1).



Source: JST

Figure 8.1.1 Project Implementation Organization

The key functions of this implementation structure are embedded in the following six key organizations:

1) Steering Committee

This committee supervises the overall project implementation from the viewpoint of city planning, transport planning, and state asset utilization. It needs a top-down decision-making authority to coordinate across different ministries and agencies. Hence, it should be chaired by the Vice Prime Minister. Key committee members include the National Economic Development Board (NEDB), Ministry of Finance (MOF)/ State Enterprise Policy Office (SEPO), Ministry of Transport (MOT)/ Office of Transport and Traffic Policy and Planning (OTP), Ministry of Energy, Ministry of Digital Economy, BMA, and SRT. A stakeholder chart is as shown in Figure 8.1.3.

2) SRT Asset Holding Company

This legal entity will be established to manage SRT's land asset as 100% subsidiary of SRT. It focuses on maximizing the value of SRT land. It manages all public-private partnership (PPP) contracts and provides transparent accounting on SRT land utilization status. For the Bang Sue Project, it monitors the progress of project implementation and reports to the steering committee to trigger actions for any debottlenecking required for the project.

3) Secretariat/Overall Coordination

JST suggests the project implementation secretariat and overall coordination function to be structured within the SRT Asset Holding Company. It will act as the secretariat for the steering committee to ensure

that all committee activity preparations and arrangements are well organized. Initial scope of coordination will be for the Bang Sue Project but could also expand to work on other land redevelopment project areas such as Makkasan and Maenam areas. In this way, coordination can be made between the Bang Sue Project and the development projects for Makkasan/Maenam. In the future, it could be provided with the authority to act as "one window" that will administrate all necessary permits required for the projects.

4) SRT Bang Sue Development Company

This legal entitiy will be established as a 100% subsidiary of the SRT Asset Holding Company. It is the driving force of the implementation of the Bang Sue Project. It leads the day-to-day activities of planning, marketing, tender, contract, construction management, and O&M. (This legal entitiy could be a special-purpose company (SPC) to utilize knowhow of a private company which has experience of integrated development. However, in this study, it is based on the premise that this legal entitiy will be established as a 100% subsidiary of the SRT Asset Holding Company.)

5) Planning and Project Coordination

This is the orchestrating function of implementation within the SRT Bang Sue Development Company. It integrates and manages all the project plans including the overall master plan (M/P) and zone-by-zone development plan. It acts to ensure that the project is implemented in accordance with the M/P and any other agreed guidelines.

6) Stakeholder Coordination Committee

This committee is formed and chaired by the SRT Bang Sue Development Company. It is a mechanism to receive input from project stakeholders on city design concept. Committee members could include academic group, neighbor land owners, existing and surrounding residents, shop owners, and transportation-related groups.

(2) Steering Committee and Working Group

The Steering Committee could have several working groups to provide means for technical level discussions by specific themes. In JST's view, the following three working groups could be conceived:

1) TOD and Transportation Network Working Group

It discusses activities in relation to the enhancement of Bang Sue Area TOD and transportation network development.

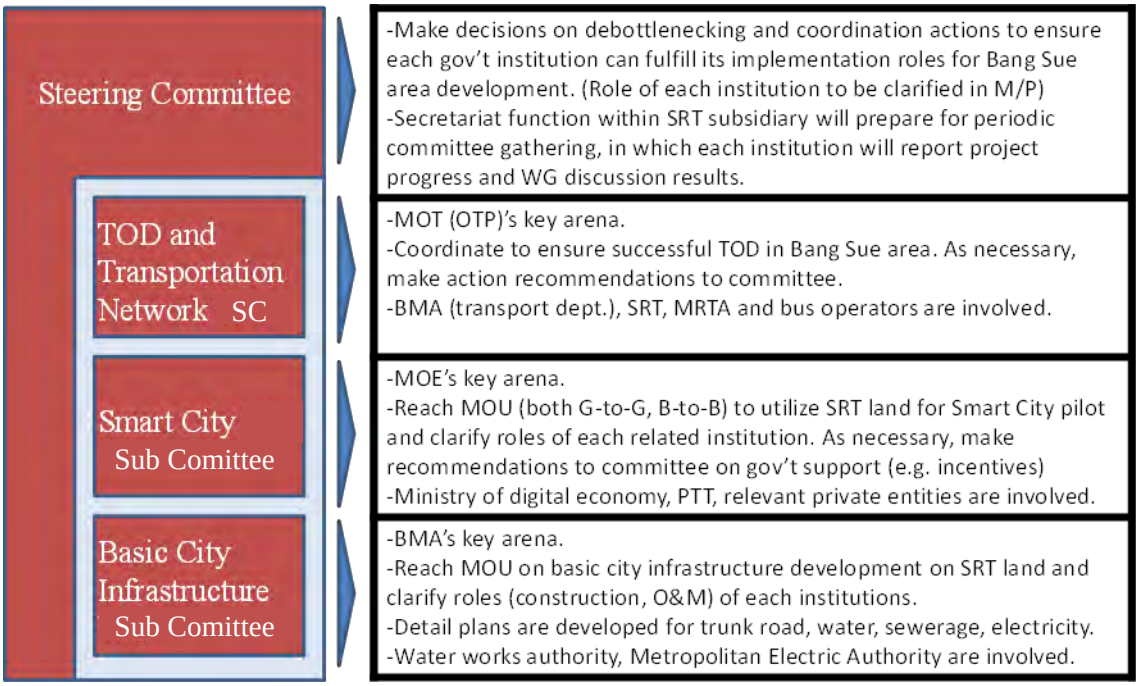
2) Smart City Working Group

It discusses the Bang Sue area as a pilot model for the implementation of the smart city concept.

3) Basic City Infrastructure Working Group

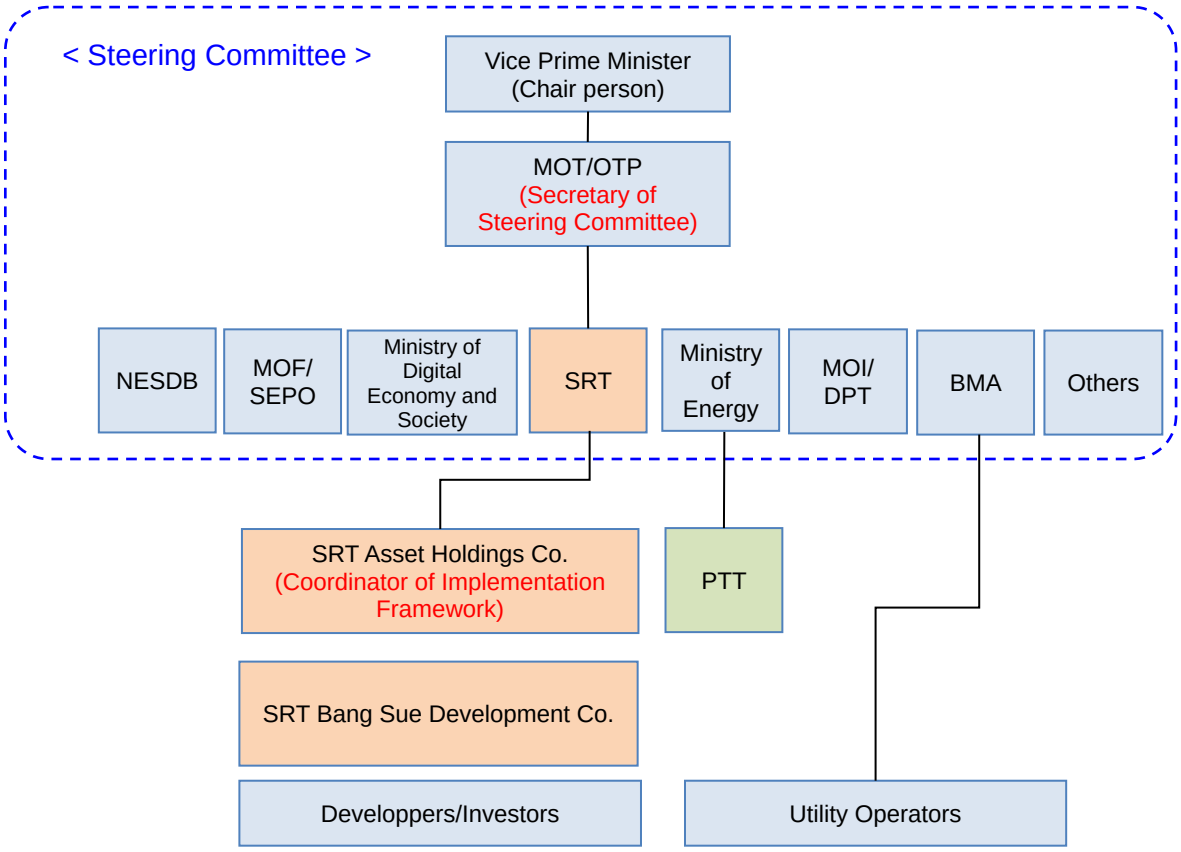
It coordinates cross-ministerial/agency plans and required MOU to accelerate basic city infrastructure development in Bang Sue.

Further details of the working group are described below (Figure 8.1.2).



Source: JST

Figure 8.1.2 Steering Committee and Working Groups



Source: JST

Figure 8.1.3 Stakeholder Chart

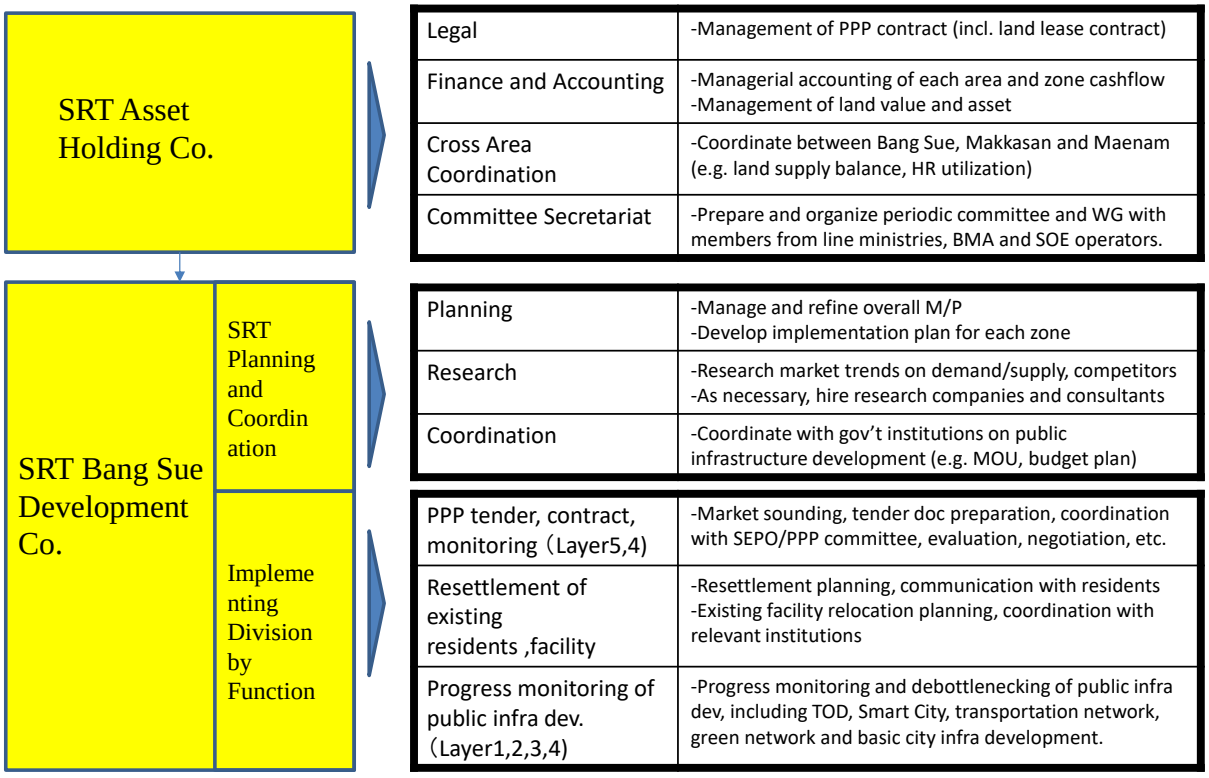
(3) Required Functions within SRT Subsidiary Organization

SRT subsidiary organizations will lead and orchestrate this massive project. It is extremely important to ensure that these organizations are equipped with the right functions and sufficient capacity. The key required functions of each subsidiary are the following:

Key Organizational Functions of SRT Asset Holding Company: This subsidiary entity provides transparency on how the land asset of SRT is being managed from legal and accounting aspects. In addition to legal, finance, and accounting functions, it also needs cross area coordination and steering committee secretariat functions.

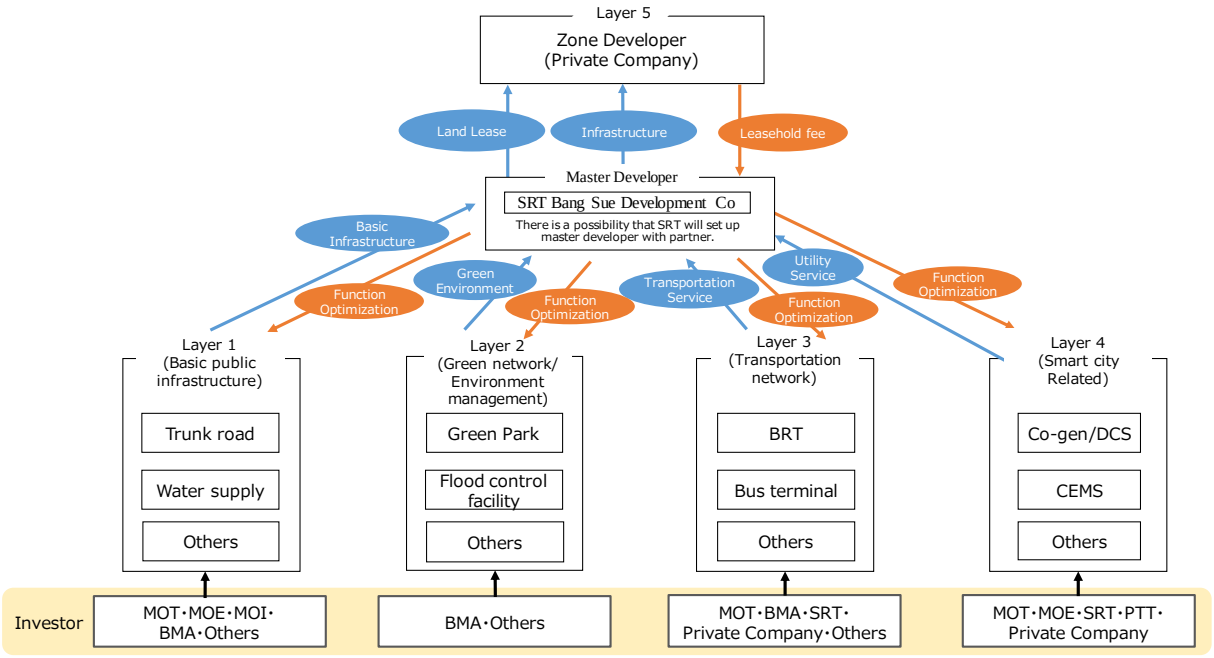
Key Organizational Functions of SRT Bang Sue Development Company: This subsidiary should have the essential business functions required to be the "Master Developer" and "Orchestrator" of this project. It should have planning, research, and coordination functions to ensure that the project is implemented and coordinated under robust plans. It should have implementing divisions by functions, which includes PPP tender and contracts, resettlement management, construction monitoring, and debottlenecking functions.

The details of the key functions are described below (Figure 8.1.4), and an image of overall project coordination leaded by SRT Bang Sue Development Company as a master developer is shown in Figure 8.1.5.



Source: JST

Figure 8.1.4 Required Functions within SRT Subsidiary Organization



Source: JST

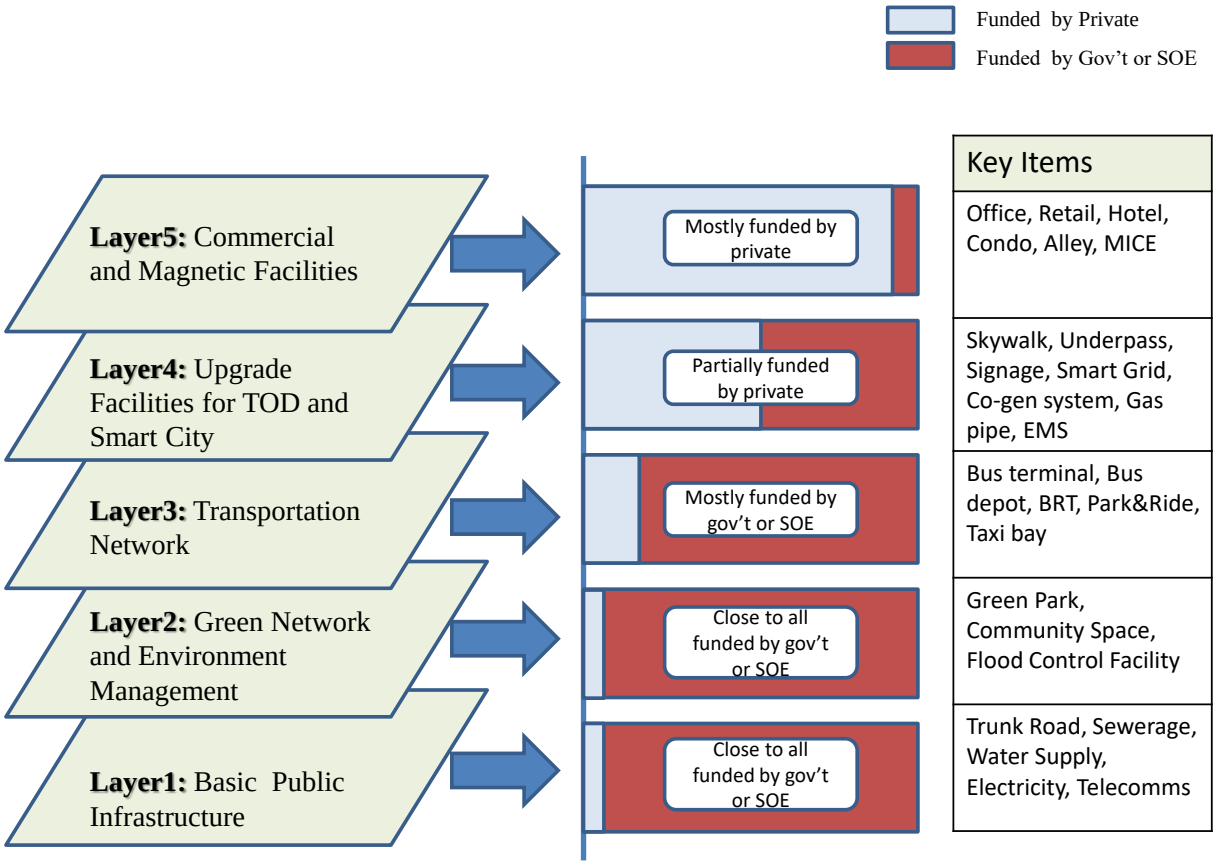
Figure 8.1.5 Image of overall project coordination leaded by SRT Bang Sue Development Co.

8.1.2 Funding Mechanism

(1) Funding Principles

Funding for this project will inevitably be a combination of private funding via PPP, government funding, and state-owned enterprise (SOE) funding. This is because the project is not merely about developing commercial facilities on top of the SRT land. As described before, the project has five layers of development. Each layer will have different funding characteristics.

The basic fund allocation principles are described in Figure 8.1.6.



Source: JST

Figure 8.1.6 Basic Funding Allocation Principles

Layers below (layer 1, 2, 3) should mostly be funded either by government budget or SOE expenditures. This is because the nature of the bottom three layers is public infrastructure with broad public beneficiary. (Although, the possiblility of orivate undertaking can not be completely denied.) Layer 4 (Upgrade Facilities for TOD and Smart City) will be a mix funding between private, government, and SOE. This is because part of the facilities could be bundled together within PPP tender scope. For example, skywalk connecting the station and commercial facilities could be funded by private because the commercial facility is the largest beneficiary under the TOD concept. Layer 5 will primarily be funded privately. There could be some room for incentives or subsidies from government to promote private investment.

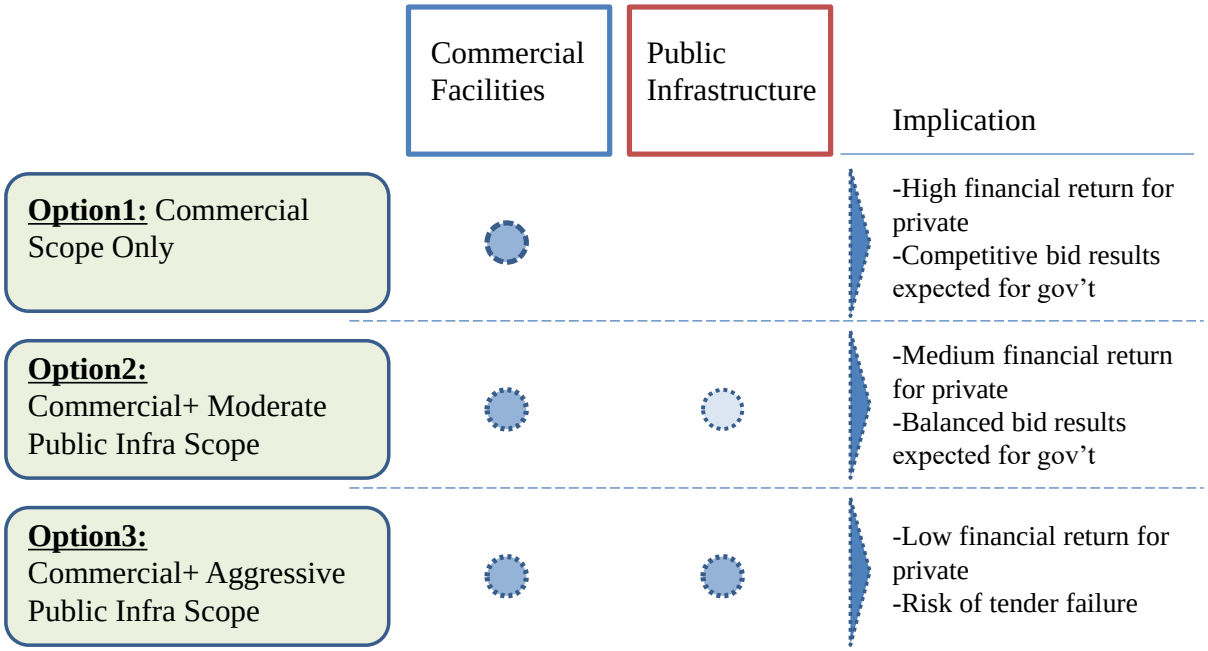
Therefore, the scope of private funding could partially include public infrastructure in the form of PPP bundling. However, this should not be done too aggressively as it may dampen the private's appetite for investment. As described below in Figure 8.1.7, there are three options for private funding scope:

Option 1: Commercial Scope only.

Option 2: Commercial + Moderate Public Infrastructure Scope

Option 3: Commercial + Aggressive Public Infrastructure Scope

Option 2 is most balanced and recommended. The exact level of PPP bundling should be determined thru interactive request for proposal process (RFP). In this process, potential bidders will have an opportunity to shape the PPP scope and enhances the success ratio of PPP tender.

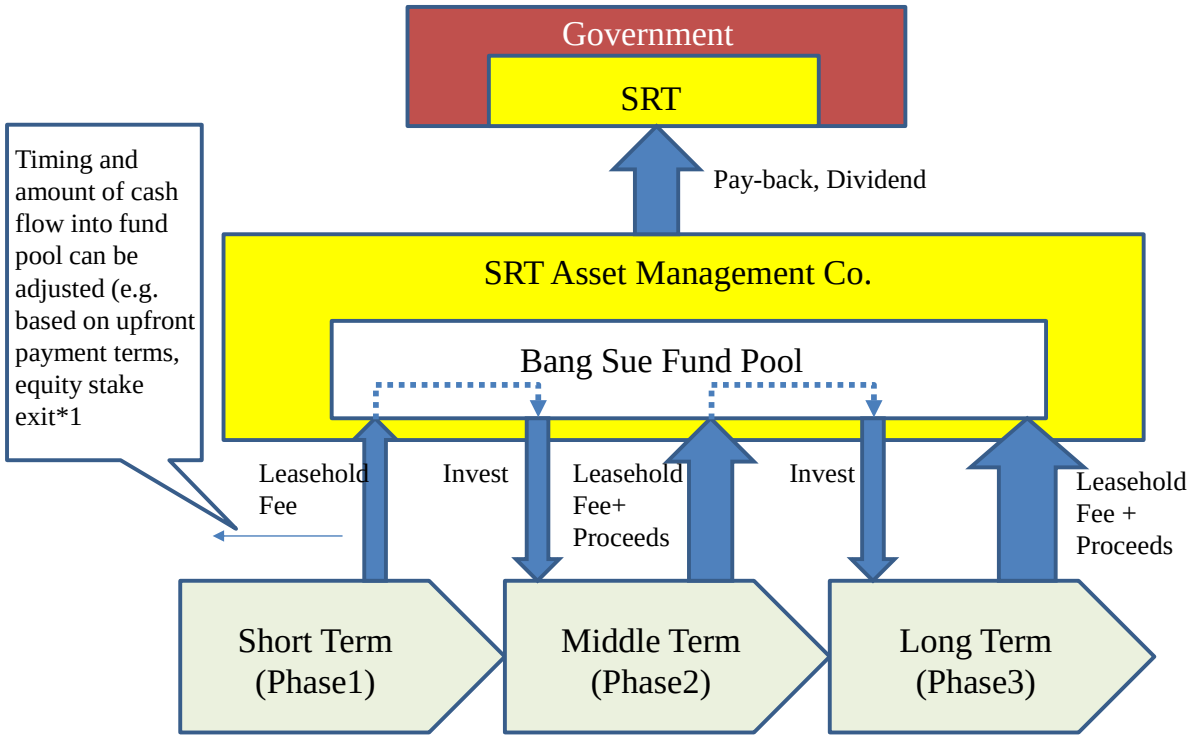


Source: JST

Figure 8.1.7 Scope of Private Funding

Successful PPP tender in the initial phase of project will be critically important. This is because early success will build momentum for enhancing the overall image of the project. Leasehold fee from phase 1 could be pooled to fund for the following phases of development. This "fund pool" concept is described below in Figure 8.1.8.

This pool fund could be developed inside the SRT Asset Management Company either in the form of separate managerial accounting or even in a separate bank account. Leasehold fee rights could partially be converted into private consortium's shareholding so that SRT can also benefit from overall property value increase. The proceeds from shareholding could further be pooled for the following phase of development. This shareholding could be liquidated earlier once sufficient project cashflow from tenant is proven to be stable.



*1 SRT could convert leasehold rights into equity portion of SPC. Once SPC realizes stable operating cashflow, then, this could be sold to infrastructure fund (e.g. REIT)

Source: JST

Figure 8.1.8 Phased Usage of Fund Pool

(2) Funding Amount Requirements

Based on preliminary estimates, the overall funding requirements for this project is approximately THB 360 billion. In the order of size, Layer 5 (Commercial and Magnetic Facilities) requires THB 300 billion, Layer 3 (Transportation Network, mostly BRT funding requirement) requires THB 30 billion. Layer 4 (TOD and Smart City-related facilities) requires THB 20 billion. Layer 1 and Layer 2 requirements are not so large. This means that PPP funding for Layers 5 and 4 will have significant weight on the success for project funding.

Funding requirement by development step are the following: Short Term (Phase 1) THB 40 billion, Middle Term (Phase 2) THB 167 billion, and Long Term (Phase 3) THB 152 billion.

Please refer to Figure 8.1.9 for overall funding requirement. Detailed information is as shown in Appendix 8-1.

Overall (Billion Baht)		*Short Term (Phase1)*	*Middle Term (Phase2)*	*Long Term (Phase3)*	*Total*
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	34.7	129.2	136.5	300.4
	MICE, others				
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	0.9	2.8	12.6	16.3
	Smart City facilities*3	0.7	1.7	1.1	3.5
Layer3: Transportation Network	Bus terminal/depot, BRT	0.9	30.6	0.0	31.5
	Park&Ride, Traffic signal				
Layer2: Green Network and Environment Management	Green Park	1.0	0.1	0.2	1.3
	Retention Pond				
	Back up generator				
Layer1: Basic Public Infrastructure	Embankment	1.9	2.3	1.3	5.4
	Trunk Road				
	Sewerage and Drainage				
	Water Supply				
	Electricity				
	Telecomms				
Total		40.1	166.7	151.5	358.4

*1 Accompanied with inner roads and parking
*2 Skywalk, Underground Passage, Travellator, Signage, Station Plaza, ITS
*3 CGS (Co-generation system), gas pipe, cooling pipe, solar power, CEMS (Coomunity Energy Management System), data center

Source: JST

Figure 8.1.9 Overall Funding Requirement

In terms of funding allocation to organization, there are four organizational categories: Central Government, BMA, SOE operator, and a Private Company.

The details of funding allocation to organizations are described in Figure 8.1.10.

Overall (Billion Baht)		***Central Gov't***	***BMA***	***SOE operator***	***Private Company***
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo				**PPP main scope**
	Alley (Inner road)				**PPP sub-scope**
	MICE + others	**Tourism related**	**Tourism related**		**Finance only, no demand risk**
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*1	**MOT**	**Traffic and Transport**	**SRT**	**PPP sub-scope**
	Smart City facilities*2	**MOE**		**PTT**	**PPP sub-scope**
Layer3: Transportation Network	Bus terminal/depot, BRT	**MOT**	**Traffic and Transport**	**BoKoSo, BMTA**	
	Park&Ride, Traffic signal		**Traffic and Transport**	**SRT**	**PPP sub-scope**
Layer2: Green Network and Environment Management	Green Park		**Environment**		
	Retention Pond		**Environment**		
	Back up generator	**MOE**		**EGAT**	
Layer1: Basic Public Infrastructure	Embankment			**SRT**	
	Trunk Road	**MOT**	**Public Works**		
	Sewerage and Drainage		**Sewer and Drain**		
	Water Supply	**Ministry of Interior**		**Water Works Authority**	
	Electricity	**MOE**		**Metropolitan Electric Authority**	
	Telecomms	**Ministry of Digital Economy**			

Note: Business system between SOE operators and users (e.g. user payment mechanism of utilities to SOE operators) will need to be clarified within MOU.
Source: JST

Figure 8.1.10 Funding Allocation by Organization

Funding requirements for each of the organization categories are shown in Table 8.1.1:

Table 8.1.1 Funding Requirements for Each of the Organization Categories

Organization	Funding Requirements
Central Government	THB 46.3 billion
BMA	THB 3.3billion
SOE Operator	THB 9.5 billion
Private Company	THB 299.3 billion

Source: JST

The details of overall funding requirements by organizations are described in Figure 8.1.11.

Also, phase-by-phase funding requirements by organizations are described in Figure 8.1.12 (Short Term), Figure 8.1.13 (Middle Term), and Figure 8.1.14 (Long Term).

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	285.9	285.9
	MICE, others	2.6	0.0	2.6	9.4	14.5
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	1.1	0.0	2.7	1.2	4.9
	Smart City facilities*3	0.7	0.1	0.0	2.8	3.5
Layer3: Transportation Network	Bus terminal/depot, BRT	42.1	0.0	0.0	0.0	42.1
	Park&Ride, Traffic signal	0.0	0.5	0.3	0.0	0.8
Layer2: Green Network and Environment Management	Green Park	0.0	0.2	0.0	0.0	0.2
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	1.0	0.0	1.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.6	0.0	0.6
	Trunk Road	0.0	0.8	0.0	0.0	0.8
	Sewerage and Drainage	0.0	1.7	0.0	0.0	1.7
	Water Supply	0.0	0.0	0.8	0.0	0.8
	Electricity	0.0	0.0	1.5	0.0	1.5
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		46.3	3.3	9.5	299.3	358.4

Source: JST

Figure 8.1.11 Overall Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	34.7	34.7
	MICE, others	0.0	0.0	0.0	0.0	0.0
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	0.0	0.0	0.5	0.4	0.9
	Smart City facilities*3	0.0	0.0	0.0	0.7	0.7
Layer3: Transportation Network	Bus terminal/depot, BRT	0.3	0.0	0.0	0.0	0.3
	Park&Ride, Traffic signal	0.0	0.3	0.3	0.0	0.6
Layer2: Green Network and Environment Management	Green Park	0.0	0.0	0.0	0.0	0.0
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	1.0	0.0	1.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.0	0.0	0.0
	Trunk Road	0.0	0.1	0.0	0.0	0.1
	Sewerage and Drainage	0.0	0.5	0.0	0.0	0.5
	Water Supply	0.0	0.0	0.4	0.0	0.4
	Electricity	0.0	0.0	0.9	0.0	0.9
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		0.3	0.9	3.1	35.8	40.1

Source: JST

Figure 8.1.12 Short Term (Phase 1) Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	114.7	114.7
	MICE, others	2.6	0.0	2.6	9.4	14.5
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	1.1	0.0	1.0	0.8	2.8
	Smart City facilities*3	0.6	0.0	0.0	1.1	1.7
Layer3: Transportation Network	Bus terminal/depot, BRT	30.4	0.0	0.0	0.0	30.4
	Park&Ride, Traffic signal	0.0	0.2	0.0	0.0	0.2
Layer2: Green Network and Environment Management	Green Park	0.0	0.1	0.0	0.0	0.1
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	0.0	0.0	0.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.2	0.0	0.2
	Trunk Road	0.0	0.4	0.0	0.0	0.4
	Sewerage and Drainage	0.0	0.8	0.0	0.0	0.8
	Water Supply	0.0	0.0	0.4	0.0	0.4
	Electricity	0.0	0.0	0.5	0.0	0.5
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		34.6	1.4	4.6	126.0	166.7

Source: JST

Figure 8.1.13 Middle Term (Phase 2) Funding Requirements by Organization

Overall (Billion Baht)		Central Gov't	BMA	SOE operator	Private Company	Total
Layer5: Commercial and Magnetic Facilities	Office, Retail, Hotel, Condo*1	0.0	0.0	0.0	136.5	136.5
	MICE, others	0.0	0.0	0.0	0.0	0.0
Layer4: Upgrade Facilities for TOD and Smart City	TOD related facilities*2	11.4	0.0	1.2	0.0	12.6
	Smart City facilities*3	0.0	0.1	0.0	1.0	1.1
Layer3: Transportation Network	Bus terminal/depot, BRT	0.0	0.0	0.0	0.0	0.0
	Park&Ride, Traffic signal	0.0	0.0	0.0	0.0	0.0
Layer2: Green Network and Environment Management	Green Park	0.0	0.1	0.0	0.0	0.1
	Retention Pond	0.0	0.0	0.0	0.0	0.0
	Back up generator	0.0	0.0	0.0	0.0	0.0
Layer1: Basic Public Infrastructure	Embankment	0.0	0.0	0.3	0.0	0.3
	Trunk Road	0.0	0.3	0.0	0.0	0.3
	Sewerage and Drainage	0.0	0.4	0.0	0.0	0.4
	Water Supply	0.0	0.0	0.1	0.0	0.1
	Electricity	0.0	0.0	0.1	0.0	0.1
	Telecomms	0.0	0.0	0.0	0.0	0.0
Total		11.4	1.0	1.7	137.5	151.5

Source: JST

Figure 8.1.14 Long Term (Phase 3) Funding Requirements by Organization

8.2 Financial Analysis

8.2.1 Objective and Approach

(1) Objective

The objective of financial analysis is to check financial feasibility and affordability of the project. That must be a critical factor for future success.

If the financial feasibility for private investor is not adequate enough to attract powerful private investors, tenders would fail or assumed the amount of lease fee, and tax revenue cannot be achieved. As a result, the project will fail.

In case that financial feasibility is adequate enough to attract private investors, tender would become competitive and powerful investor with financial power and know-how of urban development would be awarded. As a result, the project would be successful.

From a government point of view, it would be necessary to check the cost-benefit against the expense for project implementation.

(2) Scenario

There are two scenarios to be verified on this financial analysis: 1) Individual development and 2) Integrated development.

Individual development, i.e. Scenario-1 is a kind of “Without-Project scenario” where each zone would be developed separately only by the private investor without commitment from neither the government nor the integrated implementation scheme. As a consequence of Scenario-1, it is assumed that the land value increase of Bang Sue area would become insufficient to turn the project successful.

Integrated development, i.e. Scenario-2 is the major scenario where land value will increase more as a result of appropriate public involvement and commitment. It is aimed to reveal that both public players and private investors can enjoy more benefit in the Scenario-2 even if they have to bear more cost for public infrastructure developments.

(3) Player

It is assumed that there are four major players on the project:

1) Central Government (CG) including MOT, MOF, etc.
2) Bangkok Metropolitan Administration (BMA)
3) State-owned Enterprise (SOE) operators, including State Railway of Thailand (SRT) and Electricity Generating Authority of Thailand (EGAT), etc.
4) Private investor

Both CG and BMA obtain tax revenue as a benefit of the project. Instead, they would bear the cost of major infrastructure. SRT obtains land leasehold fee from private investors so that the land value increase is critical for the benefit. There is an option that lease fee revenue refluxes to the capital cost of infrastructure development in the next term. Private investors acquire development right instead of leasehold fee payment. They run their business on tenant marketing and facility operation with taking demand risk.

(4) Zone

According to the development plan, there are 25 sub-zones to be developed sequentially. It is assumed that there are some correction values regarding tenant occupancy, land value, and land lease area, because each sub-zone has variation factors such as the distance from railway station and area portion of profitable facility development, which have impact on land value and occupancy.

(5) Facility

According with the development plan, there are four profitable facility categories: 1) retail, 2) office, 3) residence, and 4) hotel. Based on the result of property marketing survey and market sounding, it is assumed that each type of facilities has different business model.

In the financial analysis, both retail and office apply tenant lease business. The developer builds the facility buildings and seeks tenants to move into the building. The developer covers the operational expense (OPEX) of the building and/or carry them onto the tenant lease fee.

The general business model of residence market is sales of condominiums. Service apartment business is only feasible in the central business district (CBD) area. It is noted that the residence in Bang Sue area must be sold with a condition of fixed-term leasehold because the land itself is constrained by leasehold agreement.

Hotel has a specific type of business model. It is assumed that developer bear the capital expense (CAPEX) for hotel building and sublease it to an operator so that the operator would bear OPEX.

(6) Infrastructure

Basic infrastructure cost would be borne by public players. On the other hand, it should be checked how much private investors could cover the infrastructure cost due to deduction of the public player's cost. The detailed analysis of this cost allocation of infrastructure development is described in Chapter 8.1.2

Based on the concept that OPEX of infrastructure would be covered by the service charge, OPEX for infrastructure is out of scope in the financial analysis.

(7) Revenue from the Development Project

Following figure illustrates share revenue of by business segments and their historical changes (expressed in 2017 fixed price).

As shown in the figure, since business model of residence market is sales of condominiums, revenue from residential will generate relatively early. Other than residential business, the project could expect stage revenue by sub-lease (hotel) and lease (retail and office).

Total revenue generated through out project period is estimated to be THB 2,602 billion, of which 45% is generated from retail business, and followed by office (28%), residential (14%) and hotel (13%).

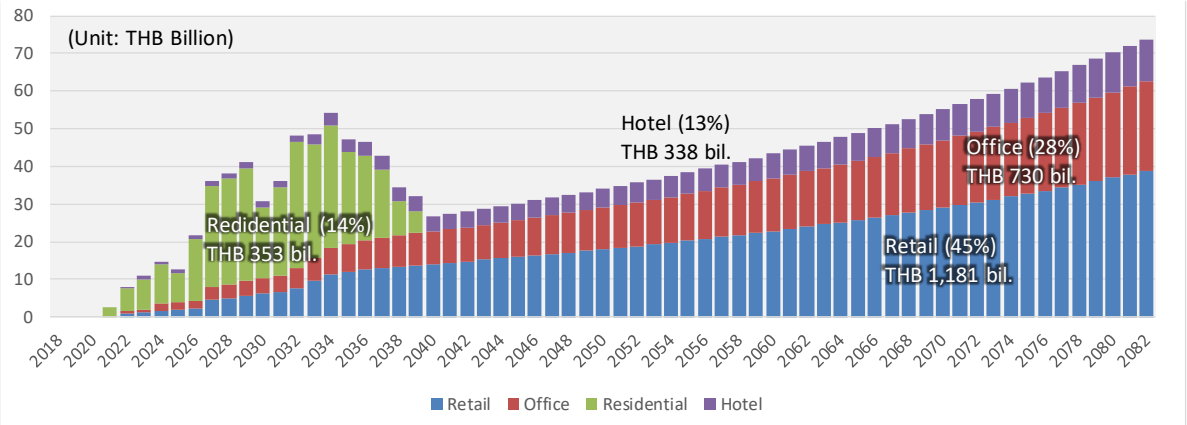
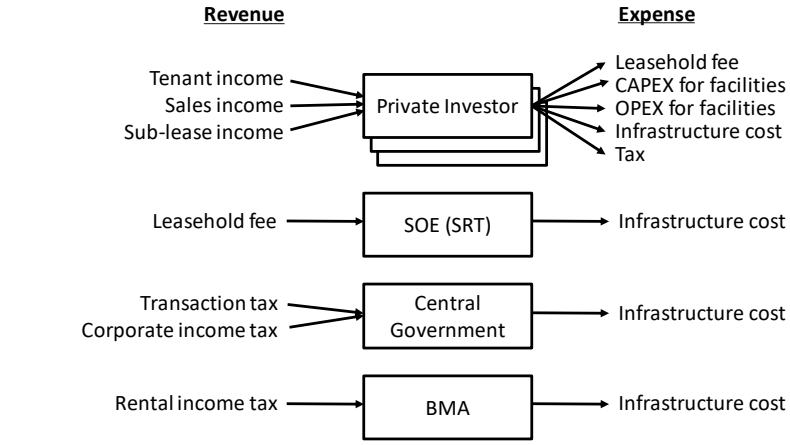


Figure 8.2.1 Share Revenue of the Development Project by Business Segments

8.2.2 Analysis Scheme

The following sketch in Figure 8.2.2 shows the financial analysis scheme:



Source: JST

Figure 8.2.2 Financial Analysis Scheme

Private investors receive tenant income from retail and office tenancy, sales income from residence buyer, and sub-lease income from hotel operator. They have to pay land leasehold fee to SRT and tax to the government bodies, in addition to the CAPEX and OPEX for each facility. It would be required for private investors to bear some infrastructure cost within a reasonable range of amount.

SRT receives land leasehold fee from the private investors while the government bodies do taxes. They all should bear infrastructure development cost in order to achieve integrated development capturing increase in land value.

8.2.3 Precondition and Parameter

Table 8.2.1 shows major parameters of each scenario:

The following are the preconditions:

- In case of Scenario-1, facility grade becomes middle-class or 3-stars
- In case of Scenario-2, facility grade becomes high-class or 4/5 stars
- CAPEX of Scenario-2 becomes larger than the one of Scenario-1.
- OPEX stays the same in each scenario.

- Rentable / saleable floor area ratio is the total rentable / saleable area in a building divided by the area available for use.
- Rental income tax becomes revenue of BMA.
- Both transaction tax and corporate income tax become the revenue of the Central Government.

Table 8.2.1 Major Parameters

Parameter	Unit	Scenario-1	Scenario-2	Resource
Leasehold period	Years	30	50	Assumption by the JICA Study Team with reference of the Property Marketing Survey
Tenant lease price				Property Marketing Survey
Retail	[THB / net m^2 / month]	750	1,500	
Office	[THB / net m^2 / month]	486	623	
Sales price of residence	[THB / net m^2]	41,564	87,627	
Hotel sublease income	[THB / net m^2 / month]	384.0	600.0	
Rentable / saleable floor area ratio				
Retail	%	50%		
Office	%	60%		
Residence	%	70%		
Hotel	%	60%		
CAPEX	[K THB / net m^2]	33	51	Estimation by the JICA Study Team
OPEX				Property Marketing Survey
Retail	[THB / net m^2 / month]	300.0		
Office	[THB / net m^2 / month]	150.0		
Residence	[THB / net m^2 / month]	100.0		
Hotel	[THB / net m^2 / month]	0.0		
Land value increase				
Year 2018-2032	%	4.0%	7.5%	Assumption by the JICA Study Team with reference of the Property Marketing Survey
Year 2033-2082	%	2.5%	5.0%	
Unit land price	[THB / gross m^2]	75.0		The report by TEAM Consulting Engineering and Management Co., Ltd
Lease price percentage	%	43.2%		Interviews
Upfront payment of land lease fee	%	40%		Interviews
Grace period of lease fee payment		3		Interviews
Payment period of lease fee	years	10		Interviews
Inflation	%	2.5%		Property Marketing Survey
Cost of debt		5.0%		Property Marketing Survey
Discount rate		5.0%		Set as same as cost of debt
Equity rate		30%		Property Marketing Survey
Loan grace period	years	3		Property Marketing Survey
Loan pay-back period	years	10		Property Marketing Survey

Parameter	Unit	Scenario-1	Scenario-2	Resource
Rental income tax		12.5%		Property Marketing Survey
Corporate income tax		20%		Property Marketing Survey
Transaction tax		5%		Property Marketing Survey

Source: JST, based on interviews and property marketing survey

The following Table 8.2.2 shows zone-specific preconditions of Scenario-2. Those values refer to the development plan.

It is noted that the Term 1 corresponds to Short Term (Phase 1) , Term 2 does Middle Term (Phase 2), and Term 3 does Long Term (Phase 3).

Table 8.2.2 Precondition of Each Zone Development

Sub-Zone	Term	COD[1] Year	Land area Gross m²	Scenario-1				Scenario-2			
				Retail Gross m²	Office Gross m²	Residence Gross m²	Hotel Gross m²	Retail Gross m²	Office Gross m²	Residence Gross m²	Hotel Gross m²
A	1	2022	27,300	9,817	25,000	2,709	24,542	20,000	80,000	13,800	50,000
E1	1	2022	27,200	83,200	25,000	0	0	83,200	80,000	0	0
E3	1	2022	76,500	0	0	0	0	0	0	344,300	0
F1	1	2022	9,700	9,700	0	0	0	9,700	0	0	0
C	2	2027	39,500	0	0	0	0	30,000	0	493,200	0
D1	2	2023	174,400	0	0	0	0	0	0	45,500	73,000
E2	2	2024	48,300	50,000	62,500	85,480	0	50,000	200,000	213,700	0
F2	2	2027	113,900	55,641	37,375	38,315	25,680	195,000	119,600	335,700	90,000
G1	2	2027	77,200	1,639	0	22,115	0	5,000	0	168,700	0
G2	2	2027	21,900	6,000	20,313	0	0	6,000	65,000	0	0
G3	2	2027	70,900	1,721	0	21,268	0	5,000	0	154,500	0
G4	3	2028	37,300	0	0	0	0	5,000	0	79,000	0
G5	3	2028	113,400	542	0	10,851	0	5,000	0	250,100	0
G6	3	2029	50,100	0	0	0	0	5,000	0	107,700	0
B1	3	2032	100,600	38,410	25,000	98,789	0	40,000	80,000	257,200	0
B2	3	2032	74,800	16,885	12,500	34,761	0	30,000	40,000	154,400	0
B3	3	2033	14,800	44,400	0	0	0	44,400	0	0	0
B4	3	2033	10,800	32,400	0	0	0	32,400	0	0	0
D2-1	3	2033	62,400	31,442	0	22,869	21,748	60,000	0	109,100	41,500
D2-2	3	2034	25,000	20,000	9,375	17,480	0	20,000	30,000	43,700	0
D3	3	2034	78,500	46,930	0	45,334	46,930	60,000	0	144,900	60,000
D4	3	2033	26,500	0	10,938	6,600	0	0	35,000	64,300	0
H1	3	2034	97,600		25,000		0	10,000	80,000	239,400	0
H2	3	2033	55,300	4,810	23,438	13,911	24,051	10,000	75,000	72,300	50,000
I	3	2032	151,300	0	0	0	0	5,000	0	335,400	0

[1]COD: Commercial Operation Date

Source: JST

The following Table 8.2.3 shows infrastructure preconditions, cost in each term, and assumed financial allocation:

Table 8.2.3 Infrastructure Cost and Allocation

Group	Item		Cost [THB in Million]			Allocation			
			Term 1	Term 2	Term 3	Private	SOE	CG.	BMA
Basic Infra	Embankment		41	246	287	0%	100%	0%	0%
	Road	Major road	110	348	318	0%	0%	0%	100%
		Street lighting	5	14	13	0%	0%	0%	100%
	Water	Water plant	306	306	0	0%	100%	0%	0%
		Reservoir	22	22	0	0%	100%	0%	0%
		Water pipe	24	77	71	0%	100%	0%	0%
	Sewer	Concrete pipe	24	77	71	0%	0%	0%	100%
		Manhole	3	10	9	0%	0%	0%	100%
		Sewage treatment plant	245	245	0	0%	0%	0%	100%
	Drain	Drainage	122	386	353	0%	0%	0%	100%
		Pumping station	68	68	0	0%	0%	0%	100%
	Power	Transmission cable	509	0	0	0%	100%	0%	0%
		Substation	339	339	0	0%	100%	0%	0%
		RMU (switch)	7	19	12	0%	100%	0%	0%
		24 kV cable	37	116	106	0%	100%	0%	0%
	Telecom	Cable conduit	4	12	11	0%	100%	0%	0%
		Optic fiber cable	2	6	5	0%	100%	0%	0%
Transport	BRT	Infrastructure/architect	0	538	0	0%	0%	100%	0%
		Vehicle/system	0	289	385	100%	0%	0%	0%
	Underground passage		122	814	1,220	1,220	50%	0%	0%
	Medium/long distance bus		271	6,041	0	0	25%	25%	0%
	Underground parking		339	0	0	0	50%	0%	0%
	Road facility		271	204	0	0	0%	0%	100%
Green	Green/plantation	Park	3	68	136	0%	0%	0%	100%
Smart City	Cogeneration	Gas pipe	6	19	18	0%	0%	100%	0%
		Cooling pipe	6	19	18	100%	0%	0%	0%
		GCS, DC	692	497	972	50%	50%	0%	0%
		Common duct	4	21	8	0%	0%	100%	0%
	CEMS		0	1,155	0	50%	50%	0%	0%
	Solar power generation		0	0	62	0%	0%	0%	100%
Disaster Prevention	Retention pond		3	12	19	0%	0%	0%	100%
	Generator		34	136	170	0%	100%	0%	0%
Grade-up	Underpass		0	305	0	0%	0%	50%	50%
	Pedestrian skybridge		763	0	0	40%	30%	0%	30%
	ITS		0	407	0	0%	0%	100%	0%
	Data center		0	1,289	0	50%	0%	50%	0%
MICE	Arena		0	3,400	0	80%	0%	10%	10%
	Exhibition center		0	850	0	80%	0%	10%	10%

	Education and medical center	0	5,100	0	80%	0%	10%	10%
SRT Office / Civic Center		0	5,100	0	20%	0%	15%	5%

Source: JST, cost allocation is based on interviews

8.2.4 Result

The output of the financial analysis is summarized in category of player, zone, and facility.

(1) Private Investor in Each Term

The following Table 8.2.4 shows the internal rate of return (IRR) of private investor in each zone.

Table 8.2.4 IRR of Private Investor

Zone	Term	COD*	Scenario-1		Scenario-2	
		Year	FIRR	Equity IRR	FIRR	Equity IRR
A	1	2022	3.9%	3.5%	12.8%	15.1%
E1	1	2022	3.8%	3.4%	14.9%	18.0%
E3	1	2022	N/A	N/A	8.8%	19.8%
F1	1	2022	1.6%	0.7%	13.0%	15.1%
C	2	2027	N/A	N/A	10.3%	18.6%
D1	2	2023	N/A	N/A	11.4%	13.8%
E2	2	2024	2.6%	1.5%	12.2%	15.9%
F2	2	2027	2.2%	1.2%	14.0%	18.7%
G1	2	2027	-2.6%	-9.6%	8.5%	15.3%
G2	2	2027	2.6%	1.8%	12.3%	14.4%
G3	2	2027	-3.3%	-9.9%	8.6%	15.4%
G4	3	2028	N/A	N/A	10.8%	20.1%
G5	3	2028	-5.0%	-13.1%	9.4%	19.6%
G6	3	2029	N/A	N/A	11.3%	22.7%
B1	3	2032	1.4%	-0.6%	14.7%	24.4%
B2	3	2032	0.2%	-1.9%	14.6%	24.2%
B3	3	2033	4.6%	4.4%	18.4%	24.1%
B4	3	2033	4.6%	4.4%	18.4%	24.1%
D2-1	3	2033	3.4%	2.7%	17.1%	26.4%
D2-2	3	2034	3.1%	2.3%	16.0%	23.9%
D3	3	2034	4.3%	4.0%	17.6%	28.1%
D4	3	2033	0.1%	-1.6%	13.7%	22.7%
H1	3	2034	0.9%	-0.3%	15.4%	27.9%
H2	3	2033	3.6%	3.0%	14.1%	19.2%
I	3	2032	N/A	N/A	13.7%	30.7%

Source: JST

Not applicable (N/A) means there is no development plan in the zones. There is substantial difference between Scenario-1 and Scenario-2 where equity-IRR in Scenario-1 is less than 5% while

the equity IRR in Scenario-2 is over 15% in most zones.

One of the general suggestions on this result of Scenario-2 is that the latter developed zones of IRR become higher than the earlier ones. The reason behind is that the land value increase is set higher than the cost inflation and the difference between benefit and expense would become larger in later years.

Zones, where residence facility has high portion scores, have higher equity-IRR than zones without residence because the business model of residence is not rental but sales so that the revenue comes upper-front and the leverage becomes stronger.

Table 8.2.5 Facility IRR* in Short Term (Phase 1)

Zone	Retail	Office	Residence	Hotel
A	22.9%	15.1%	10.3%	16.9%
E1	22.9%	15.1%	N/A	N/A
E3	N/A	N/A	17.3%	N/A
F1	19.9%	N/A	N/A	N/A

*Both tax and leasehold fee are excluded in this IRR cashflow.
Source: JST

Table 8.2.5 shows IRR of each facility in Short Term developed zones. Office has the lowest IRR in lease business, which indicates that the office rental business generally gains law profit with relatively low risk.

(2) SOE

The following Table 8.2.6 shows the revenue of SOE:

Table 8.2.6 Revenue of SOE

	Year 2025	Year 2030	Year 2035
Revenue in Scenario-1 (Net Present Value) [THB in million]	422	1,030	528
Revenue in Scenario-2 (Net Present Value) [THB in million]	1,577	2,456	1,380

Source: JST

Land lease fee paid by private investors will be gained during year 2019-2044 under the condition that the grace period is three years and pay-back term is set at ten years. The revenue of SOE would become THB 2.5 billion per year in net present value while maximum infrastructure cost would become THB 1.2 billion per year so that the profit can reflux into the next phase investment.

(3) Central Government and BMA

In Scenario-2, there will be multiple Special Purpose Company (SPC) established within each zone. SPC is established by private developers. They will invest in developing office, hotel, condominium and mall. The following Table 8.2.7 shows the revenue of Central Government and BMA:

Table 8.2.7 Revenue of Central Government and BMA

		Year 2032	Year 2048	Year 2068
Tax Revenue of CG [THB in million]	Scenario-1	619	913	N/A
	Scenario-2	11,853	11,230	30,788
Tax Revenue of BMA [THB in million]	Scenario-1	388	995	N/A
	Scenario-2	2,701	8,719	23,134

Source: JST

Year 2032 is the last year of Long Term (Phase 3), years 2048 and 2068 are the final years of lease hold contract of Short Term (Phase 1) (beginning year is 2019) in each scenario (30 years in Scenario-1 and 50 years in Scenario-2). The tax revenue has substantial impact in Scenario-2.

On the other hand, in Scenario-1, the tax revenue is estimated only at 10% of Scenario-2. This is because the land value would have increased not enough for private investors to gain profit so that the tax revenue based on profitability would not have increased.

8.3 Economic Analysis

8.3.1 Objective and Approach

(1) Objective

Economic analysis aims to reveal the potential economic impact of the project. The impact is quantitatively calculated based on statistical data with some assumption. From economic point of view, important indicators are 1)"flow-based" population of station and surrounding facility users and 2) "stock-based" population (such as new residents or tenants) increase ratio. Also, increase in land price should be monitored. From user's point of view, we should monitor how users perceive the "convenience" and "comfort" level of using station and surrounding facilities.

(2) Approach

Effects of an urban redevelopment project could be measured by 1) increase in consumer spending, 2) economic linkage effects among construction, real estate, retail and service industrties, 3) reduction in transit time, vehicle operating cost, CO2 emission and traffic accident resulting from modal shift, 4) increase in land utilization ratio, 5) rise in land price, 6) increase in public space, 7) employment creation, 8) daytime/ nighttime population increase etc.

Out of these effects, 1), 2), 3) and 5) coud be measured by monetary value.

Taking data availability into consieration, this report estimated "1) increase in consumer spending" as economic benefit.

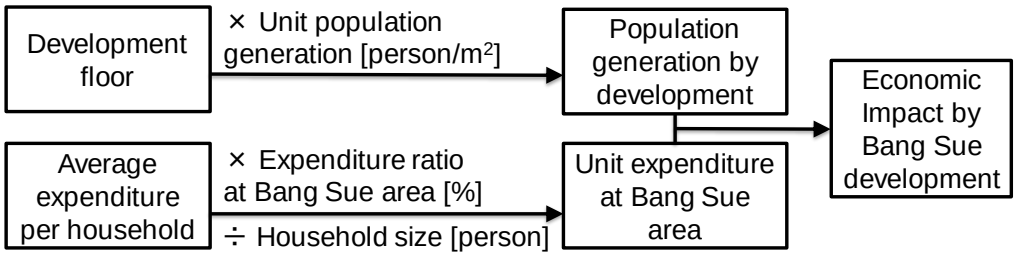
In this economic analysis, economic impact is estimated by the amount of consumer spending. The amount of consumer spending at the Bang Sue area is calculated by people generation and average consumer spending. Specifically, the following formula shows the basic idea of economic impact calculation:

[Economic impact of the project]
= [Number of people generated by the project development] x [Average consumer spending per person]

Following section explains the methodology and preconditions.

8.3.2 Analysis Scheme

The following Figure 8.3.1 shows the economic analysis scheme:



Source: JST

Figure 8.3.1 Economic Analysis Scheme

In order to evaluate the project impact, the number of population generation is calculated based on the difference between Scenario-2 and Scenario-1.

The average consumer spending per person refers to the data published by the Thailand National Statistical Office 2016.

8.3.3 Precondition and Parameter

The following Table 8.3.1 shows the population generation difference between Scenario-2 and Scenario-1.

Table 8.3.1 Population Generation Difference between Scenario-2 and Scenario-1

Zone	Retail [person]	Office [person]	Residence [person]	Hotel [person]
A	4,073	2,750	388	655
E1	0	0	1,593	1,877
E3	0	2,750	0	0
F1	12,000	0	17,262	0
C	0	6,875	4,488	0
D1	0	0	12,051	0
E2	0	0	0	0
F2	55,744	4,111	10,408	1,654
G1	1,345	0	5,130	0
G2	0	2,234	0	0
G3	1,312	0	4,663	0
G4	2,000	0	2,765	0
G5	1,783	0	8,374	0
G6	2,000	0	3,770	0
B1	636	2,750	5,544	0
B2	5,246	1,375	4,187	0
B3	0	0	0	0
B4	0	0	0	0
D2-1	11,423	0	3,018	508
D2-2	0	1,031	918	0
D3	5,228	0	3,485	336
D4	0	1,203	2,020	0
H1	4,000	2,750	8,379	0
H2	2,076	2,578	2,044	667
I	2,000	0	11,739	0

Source: JST

Unit expenditure per person is calculated by the average amount of monthly household expenditure multiplied by expenditure ratio at the Bang Sue area by facilities and divided by household size.

Average amount of monthly household expenditure refers to the National Statistical Office 2016. Household size is set at 3.2 persons/household referring to the National Statistical Office 2010. The expenditure ratio at the Bang Sue area by facilities is assumed by JST based on empirical data as shown in Table 8.3.2.

Table 8.3.2 Average Amount of Monthly Household Expenditure

Expenditure Item	Average Amount of Monthly Household Expenditure*	Retail	Office	Residence	Hotel
Food and beverages	8,498	5%	5%	20%	1%
Alcoholic beverages	177	5%	5%	20%	1%
Tobacco	94	5%	5%	20%	1%
Household operation	7,575	0%	0%	80%	0%
Apparel and footwear	787	5%	0%	10%	1%
Personal care	1,152	5%	5%	10%	1%
Medical and health care	544	5%	5%	10%	1%
Transport	7,092	5%	5%	50%	1%
Education	881	5%	0%	10%	0%
Recreation	482	5%	0%	10%	1%
Special ceremony	42	0%	0%	10%	0%
Total	27,325	985	878	11,749	188

Source: Average amount of monthly household expenditure refers to the National Statistical Office 2016, expenditure ratio is assumed by JST.

8.3.4 Result

The following Table 8.3.3 shows the result of economic impact by year:

Table 8.3.3 Economic Impact

	2022	2027	2032	2022 – 2082 Total
Economic Impact* [THB in Million]	582	2,806	4,473	297,193

* Economic price without inflation

Source: JST

It is estimated that the economic impact of consumer expenditure by the project development would become approximately THB 300 billion in 50 years.

8.4 Project Schedule

8.4.1 Project Implementation (Phased Development)

For the development of Bang Sue Area, the stepwise development that as shown in Chapter 6 is recommendable in terms of the following points of view: (a) inauguration of new urban mass transit railways, which are being constructed or will be constructed, (b) land status (availability, infrastructure

including different types of utility), (c) market demand, and (d) financial arrangements.

Specifically, a three-phase development program will be introduced from the perspective of promoting well-planned, integrated development of the overall area.

In the Short Term (Phase 1), urban infrastructure and residential land will be developed in the surroundings of Bang Sue Grand Station, mainly including the SRT's land, setting 2022 as the target year to coincide with the opening of Bang Sue Central Station. At the same time, development of a skydeck from Bang Sue Central Station to the surrounding district and Jatujak Station will also be planned.

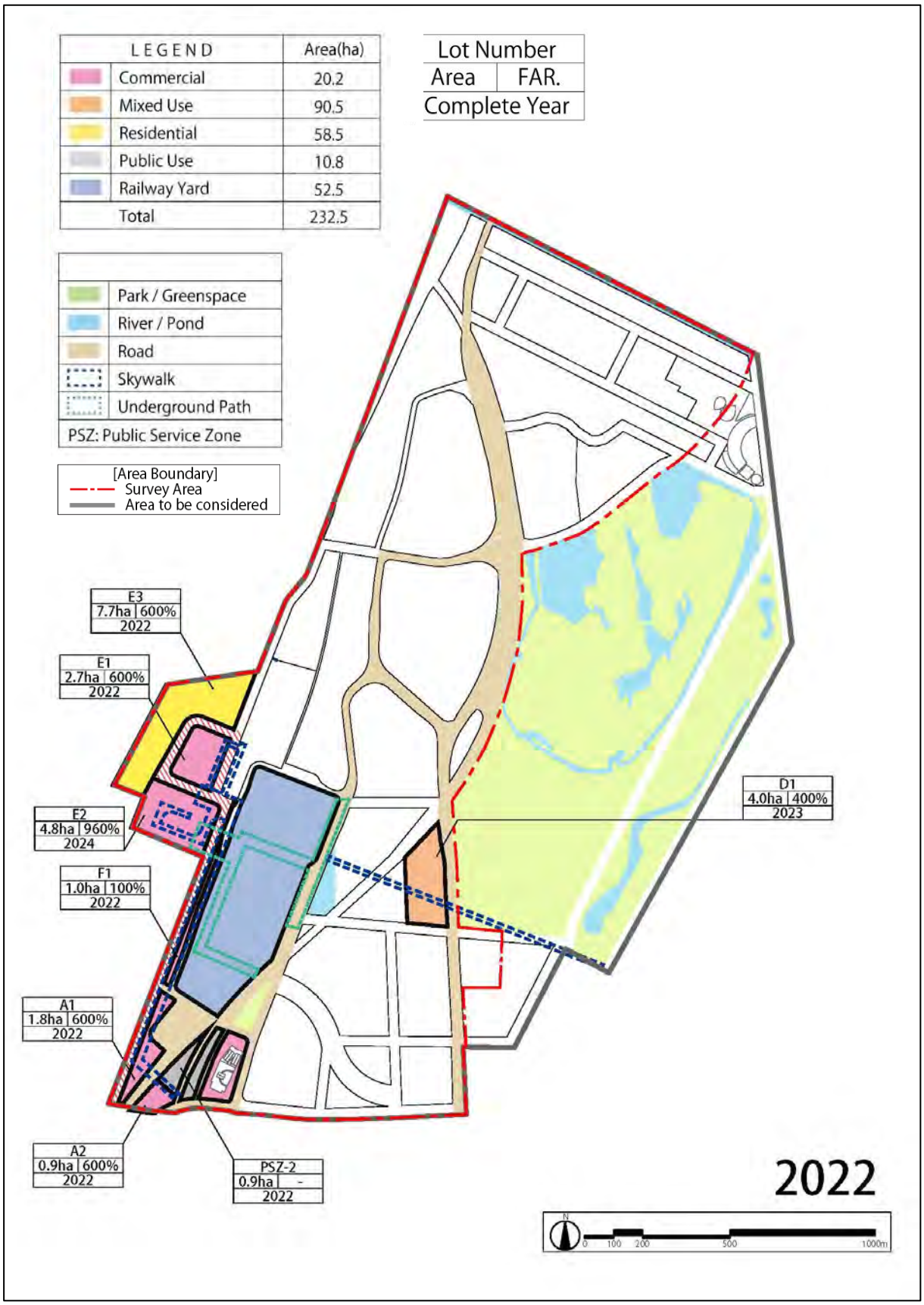
In the Middle Term (Phase 2), re-development and development of relevant infrastructure will be planned in the F2 District north of Bang Sue Central Station, which is currently used as a depot, the C District in the central area, which is currently used as the bus center, and the KM11 District, where the residences of SRT staff are currently located, setting 2032 as the target year.

In Zone F2, as the railway incidental facilities exists, on the occasion of development in this zone, relocation of the facilities is necessary. SRT site near Chiang Rak Noi Station is considered as one of the candidate places. (Figure 8.4.1）

Source: JST

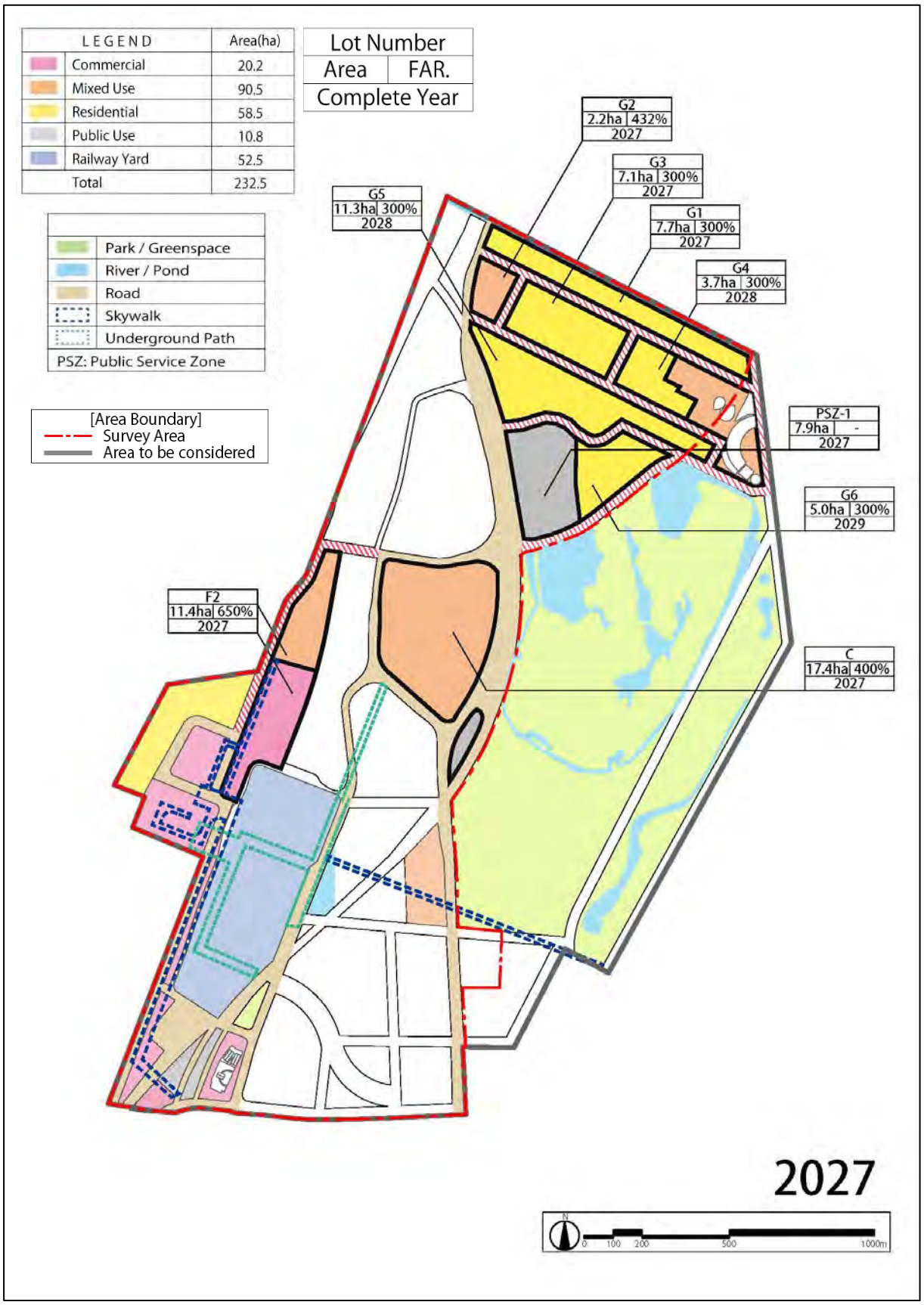
Figure 8.4.1　Relocaion Candidate Site of Railway Incidental Facilities

In the Long Term (Phase 3), development of residential land and underground passageways will be planned mainly in B District in the south of the area, which is currently used as a depot, setting 2037 as the target year.



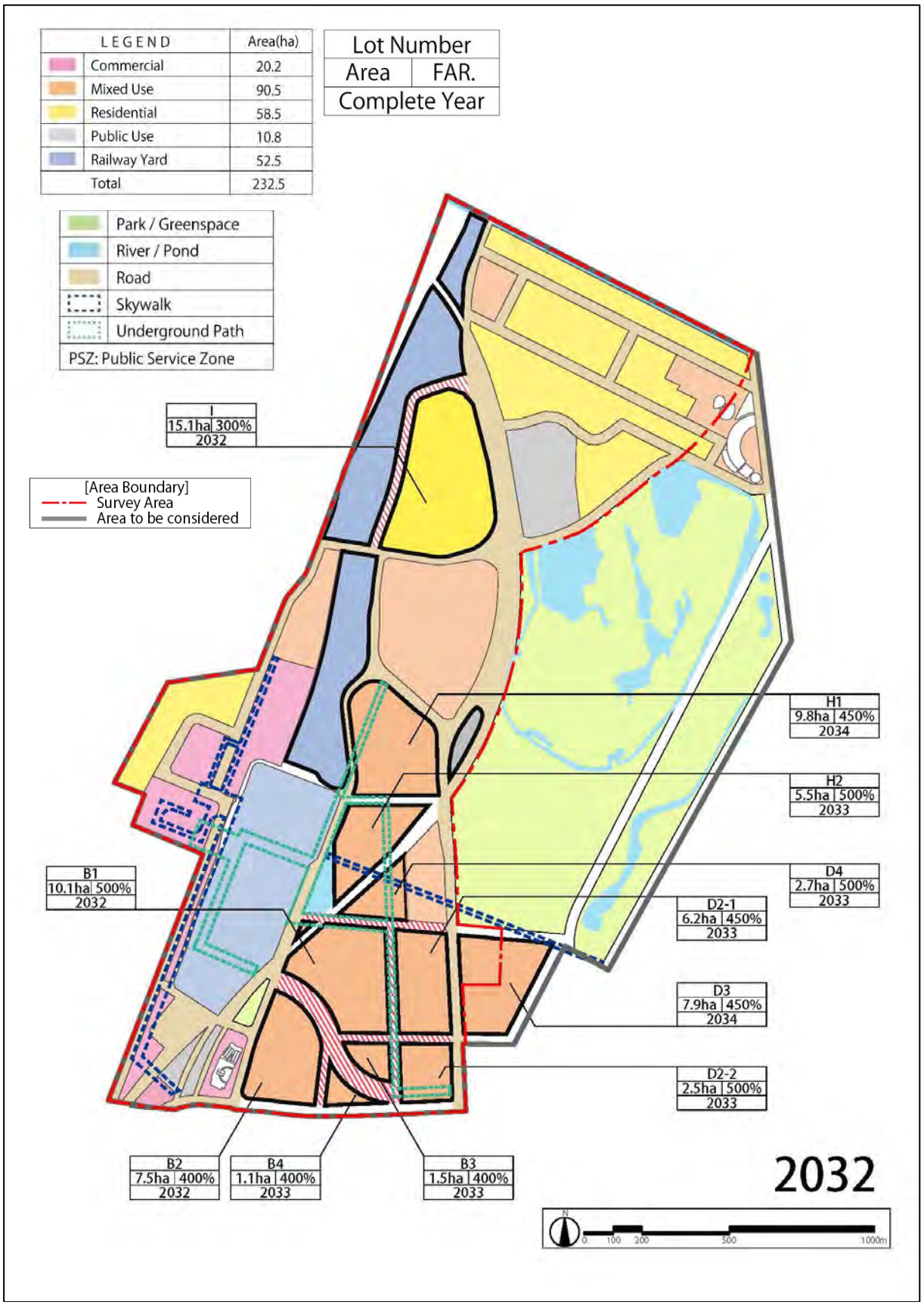
Source: JST

Figure 8.4.2 Project Stepwise Plan［Short Term (Phase 1)］



Source: JST

Figure 8.4.3 Project Stepwise Plan ［Middle Term (Phase 2)］

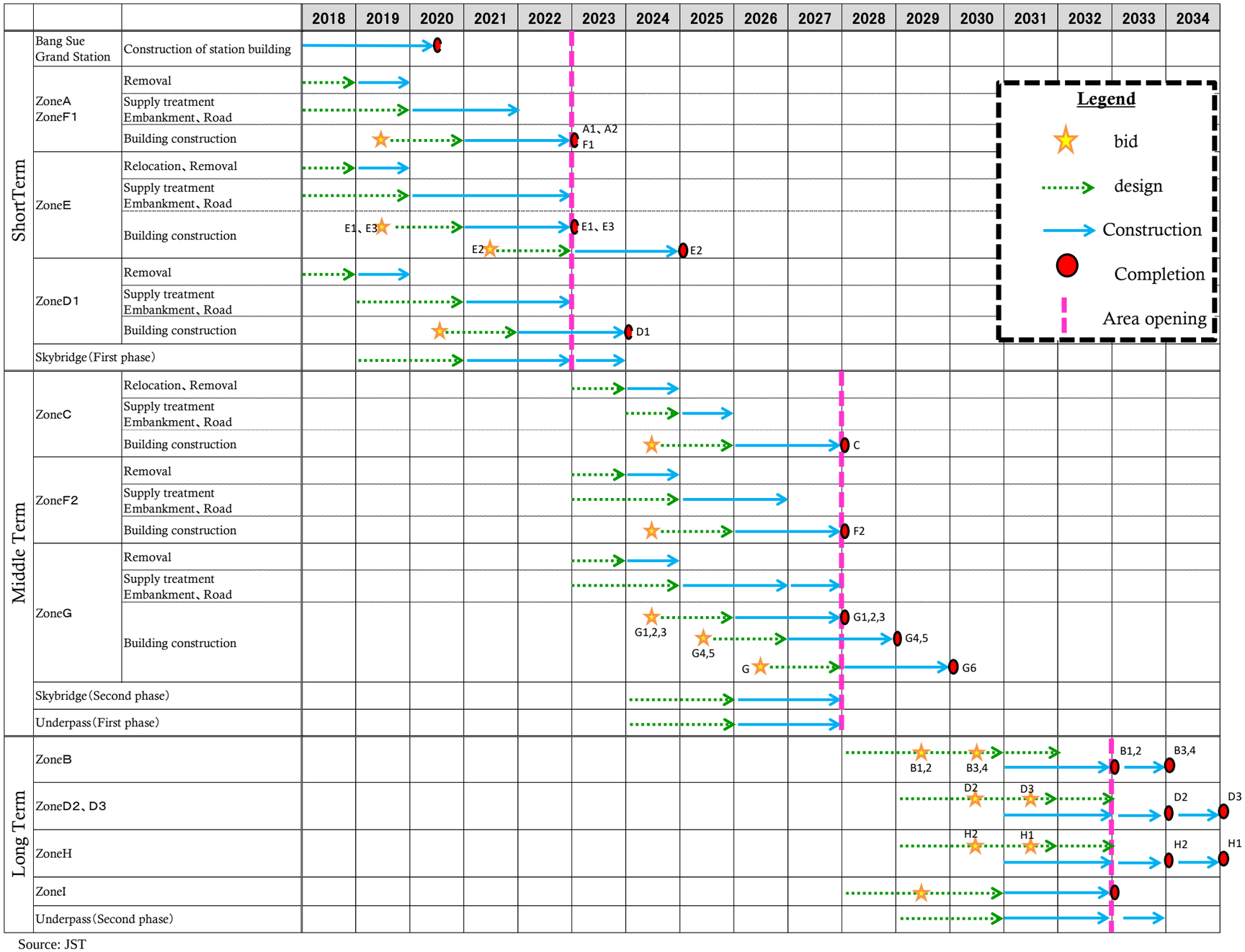


Source: JST

Figure 8.4.4 Project Stepwise Plan［Long Term (Phase 3)］

8.4.2 Project Schedule

Draft project schedule is shown in Figure 8.4.5.



Source: JST

Figure 8.4.5 Project Schedule

Chapter 9 Intention of Japanese Private Sector

9.1 Survey on the Intentions of Japanese Companies to Bang Sue Redevelopment Project

In order to implement Bang Sue Redevelopment Project, arrangement of organization and funding is critical. In this section, project implementation organization and project funding mechanism are proposed.

9.1.1 Briefing Seminar

A questionnaire survey was conducted to understand the intention of Japanese companies to participate into urban development-related business in Thailand and possibility of introducing qualified urban infrastructure. The survey was conducted to 1) the member companies of Japan Conference on Overseas Development of Eco-Cities (J-CODE), and 2) the member companies of division of Engineering Work and Construction, Japanese Chamber of Commerce, Bangkok. J-CODE is an association of private companies which have interest and intention to participate in urban development project in overseas countries especially in Souse east Asia. Briefing seminars were held to introduce the project of Bang Sue Redevelopment Project to member companies of those two organizations. The outline of the briefing seminar is as shown in Table 9.1.1.

Table 9.1.1 Outline of Briefing Seminar

Date	Target Organization	Process and Action
July 14 to 21, 2017	Japan Conference on Overseas Development of Eco-Cities	Briefing session by the JICA Survey Team Distribution of materials Collecting the questionnaire form by e-mail
August 3 to 10, 2017	Division of Engineering Work and Construction, Japanese Chamber of Commerce, Bangkok, Thailand	Briefing session by the Embassy of Japan Distribution of materials Collecting the questionnaire form by email

Source: JST

9.1.2 Questionnaire Survey

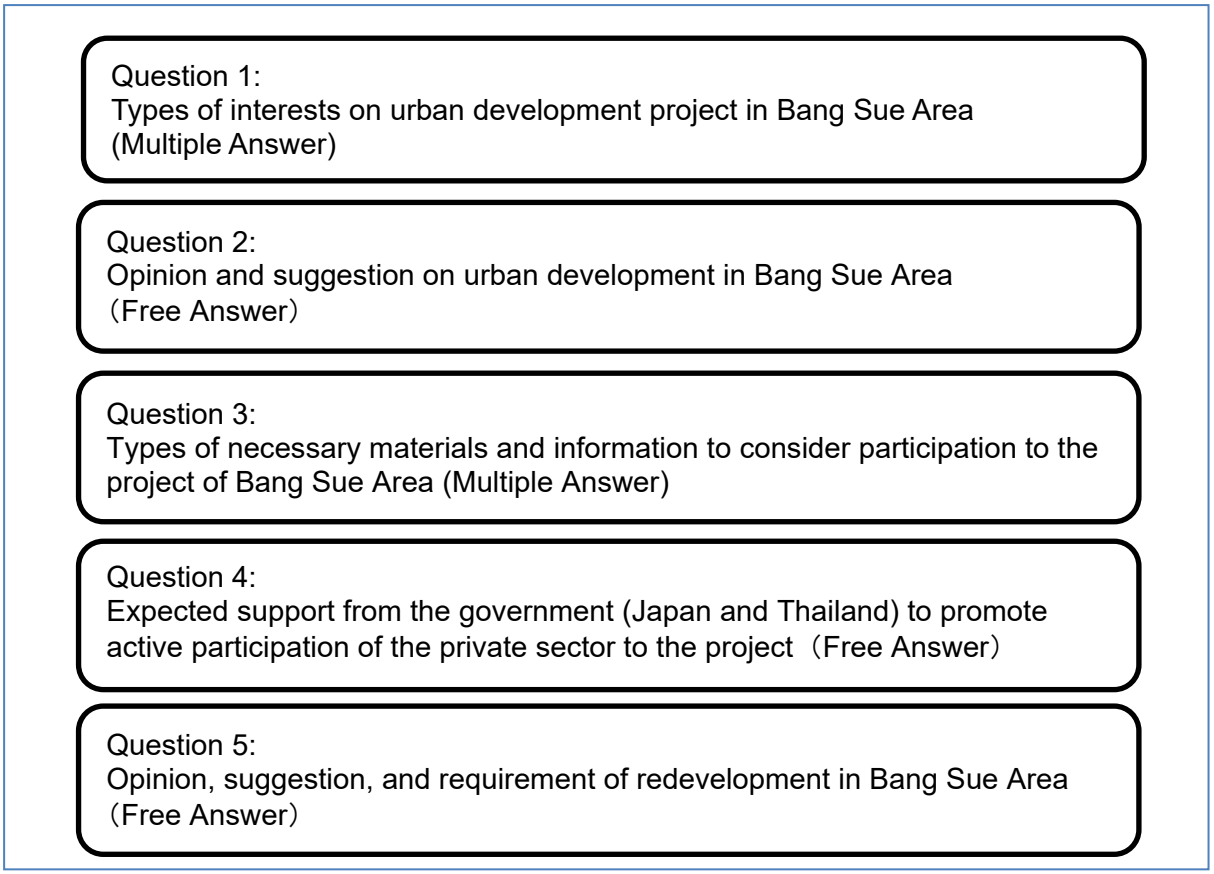
(1) Introducing the Project

Briefing sessions were held to introduce the basic information of the Bang Sue Redevelopment Project to member companies of those two organizations, i.e., the Japan Conference on Overseas Development of Eco-Cities (J-CODE) and the Division of Engineering Work and Construction, Japanese Chamber of Commerce (JCC), Bangkok, Thailand. The seminar for J-CODE was held on July 14, 2017, and the seminar for JCC was held on August 3, 2017.

(2) Questionnaire Survey

A questionnaire survey was conducted to the participants of the two briefing seminars. The purpose of the survey is to collect opinions from Japanese private companies to promote the project.

The outline of the questionnaire is as follows:



Source: JST

Figure9.1.1　Outline of the Questionnaire

(3) Result of the Survey

Result of questionnaire survey is as follows:

1) Number of Answers

In total, 26 companies answered to the questionnaire survey. As a breakdown, there are eight manufacturing companies, five general construction contractors, three developers, two trading firms, two consulting firms, one retailer, and four other companies.

2) Summary of the Results and Analysis

Question 1: Interest of urban development project in Bang Sue Area (Multiple Answer), is as shown in Figure 9.1.2.

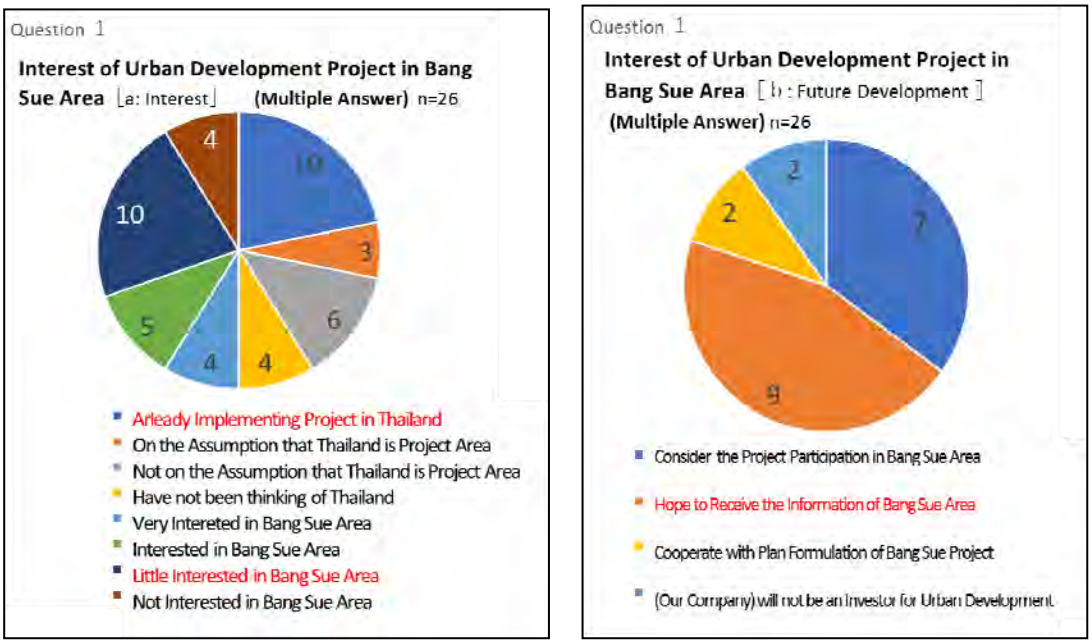
Question 2: Five companies requested further detailed information of the project.

Question 3: In terms of necessary information to consider business participation to the project, the most popular item is “Project schedule (14 companies)”, followed by “Infrastructure plan (10 companies)” and “Current situation of the site (9 companies)”, as shown in Figure 9.1.3.

Question 4: Some companies expect the government for “infrastructure development”, “tax benefits”, and “extension of land lease period (at least 50 years)”, as well as “devising a system to fair project selection”.

Question 5: Some companies expect “basic information on the area”, “information on the development plan”, and “governmental support in order to introduce the technology of Japanese

companies to the area".



Source: JST

Figure 9.1.2 Result of Question 1

Source: JST

Figure 9.1.3 Result of Question 3

9.2 Understanding the Intentions of Japanese Companies through Interview Survey

9.2.1 Interview Survey

In addition to the questionnaire survey, interview survey was conducted in Tokyo, Japan. The survey mainly aims to understand primary impressions and conditions of developers on business participation in the Bang Sue Redevelopment Project.

(1) Interviewees

The interview was conducted to seven Japanese private companies, including developers, trading firms, and house builders. The interviewees are person in-charge of real estate project in overseas especially in the Association of Southeast Asian Nation (ASEAN) region.

(2) Questions

The major points of interview are as follows:

1. Business environment in Thailand for Japanese developers
2. Intention to participate in a business in Thailand
3. Impression of Bang Sue Area
4. Possible businesses in Bang Sue Area
5. Requirements/conditions for business participation in Bang Sue Area
6. Others

(3) Result

The major opinions and intentions of Japanese companies were learned through interviews as follows:

Table 9.2.1 Major Opinions from Japanese Private Companies

Category	Major Opinions
1. Business environment in Thailand for Japanese developers	• Thailand is an attractive market with stronger economy compared with other ASEAN countries. • For a Japanese company, Bangkok can be a regional base for business expansion in Asia, as well as Singapore. • On the other hand, land in good condition or attractive project in urban area is taken by local developers/investors which have strong network, connection, and political power. Japanese developers have small opportunity to participate in real estate business. • It is very difficult to obtain information of attractive projects. • Partnership with local partner is essential for Japanese developers/investors to implement land development business in Thailand. It is difficult for Japanese firms to purchase and develop the land on their own. • Thai firms seem not very active to do joint project with Japanese firm as they have enough financial and political ability to implement the project by themselves. • Japanese know how and technologies for urban development such as TOD are becoming acceptable and applicable as Bangkok develops urban railway system recently.
2. Intention to participate in business in Thailand	• Overall, many of the interviewees have positive attitude on the project. • Some firms have been involved in joint development projects in the city center of Bangkok with local partners (or partners from other Asian countries). • Some firms are conducting or have conducted a market research and survey for commencing business in Bangkok.

Category	Major Opinions
	• All interviewed firms are positive about doing business in Thailand (especially in Bangkok). • On the other hand, for some firms, project formulation is difficult, although they could implement a study for it.
3. Impression of Bang Sue area	• Most of the companies had heard about the area but not specific until the interview. • It is a great advantage of the project that the land is all owned by SRT and it does not need land acquisition and adjustment of ownership. • The area is appropriate for TOD and seems promising. • The area is a little distant from the city center of Bangkok, but it seems to have great potential as a residential area where people commute to the urban area by trains. • Development of the vacant lot will be of largescale, and information about the trends of existing markets in the surroundings is not clear. It makes difficult to look to the future market. Therefore, participating to the project from the first phase may be risky. It is suggested to check at the status of sales and other results from the first phase before making a judgment.
4. Possible businesses in Bang Sue Area	• Luxury serviced apartment targeting expatriates. • Condominiums targeting high-income person • Demand for office space is still unclear. • Commercial use could be promising. • Operation of MICE facilities is not suitable for Japanese firms.
5. Requirements / conditions for business participation in Bang Sue area	• Partnership with reliable local business partner is essential. • Local partner is expected to take care of licensing procedures and other necessary procedures. • It is ideal to have a partnership with local firms which have high interest in working with a Japanese firm and can accept Japanese technologies and experiences. • Land proceeds (rent fee, in this project) must be reasonable for business plan of Japanese firm. • In terms of bidding, design competition is preferable than price competition. • It is preferred that basic infrastructure (such as main roads and utilities) is developed by the government. • A 30-year lease period is too short. It would be a huge risk for private investors even if it could be renewed after 30 years. Fifty to 70-year lease period is an essential condition to participate in the project. • The amount of investment for single project is limited. Participation will be difficult if the size of one project is too large. • Basic information such as overall plan, project schedule, etc., will be necessary for internal discussion in the headquarters. • Clear prospects of support from the Japanese government will be a great help to consider business participation. It is preferred to have a system that allows Japanese firms to join the project without bidding, under special schemes such as Thailand -Japan joint model project.
6. Others	• It would be interesting to apply the concept of smart city, system that can be easily installed such as information technologies would be appropriate. • It is important to understand the expectation of the Government of Thailand, BMA and SRT toward Japanese private firms to avoid mismatch of the plan.

Source: JST

9.3 Promoting Quality Infrastructure

9.3.1 Intention of Japanese Private Sector

Results of the questionnaire and interview have revealed that many Japanese firms are highly interested in business participation to the project, with the advantages in the position of Bang Sue Area

in the superior plans, high traffic convenience, and the land of project area owned by one owner, the State Railway of Thailand (SRT).

On the other hand, regarding business participation to the project, few firms are ready to start consultation. Many firms preferred to start information research because many essential conditions such as lease period and other conditions of land lease and local partner are not clear yet.

Regarding "smart city" and other concepts, some Japanese firms expressed their positive intention to join the project from planning to operation phase. Supposedly that Japanese firms can begin to cooperate or participate from a relatively early phase, in terms of technical matters.

9.3.2 Policy for Promoting Quality Urban Infrastructure

The government of Japan has a policy to actively promote quality urban infrastructure with the aim of supporting Japanese private sector to join urban development projects and urban infrastructure development in overseas. In "Infrastructure Export Strategy", the Government of Japan states that "On the condition of business model and business decision of private sector, the government will fully support private sector and promote introducing quality infrastructure to overseas under public-private cooperation." "Wide-area infrastructure development" is mentioned as an approach. Specifically, it focuses on "Promoting area development project such as combination of transport infrastructure and surrounding area development", "Problem-solving, urban management project including several sub-projects for transport management, urban development etc. to solve urban problems such as traffic congestion and so on", and "Comprehensive urban development including environmental management and transit oriented development"[1].

Ministry of Land, Infrastructure, Transport and Tourism (MLIT) positions ASEAN as the most important area under their policy of international cooperation in infrastructure system. According to their policy for each country in ASEAN, the following contents are listed for Thailand; "Thailand is located at the center of Indochina, and it is a core country of Mekong region. They also consolidate their position as a factory of the world. They play a key role of ASEAN Economic Community (AEC) and for development of Mekong region. Many of Japanese private companies do their business in Thailand. For suitable development of Thailand, development of following sectors is crucial, such as, high value-added industry, development of transport infrastructure especially railways for productivity improvement, human resource development, development of institutions[2]."

Thus, the development of Bang Sue Area is a prospective project as a candidate of the policy of urban infrastructure promotion of the Government of Japan. As Japanese private sectors tend to watch a situation at the early stage of a project, the government should actively disseminate the information of this project. Moreover, it is recommended that the government supports Japanese private sector by market Japanese experience, knowhow and technologies related to urban development more actively.

[1] Infrastructure Export Strategy, http://www.kantei.go.jp/jp/singi/keikyou/dai30/siryou2.pdf
[2] MLIT Action Plan for Infrastructure Development Promotion, http://www.mlit.go.jp/common/001125098.pdf

Chapter 10 Way Forward

10.1 Action Plan

Main actions to be taken at the very initial stage (until 2019) are as shown below.

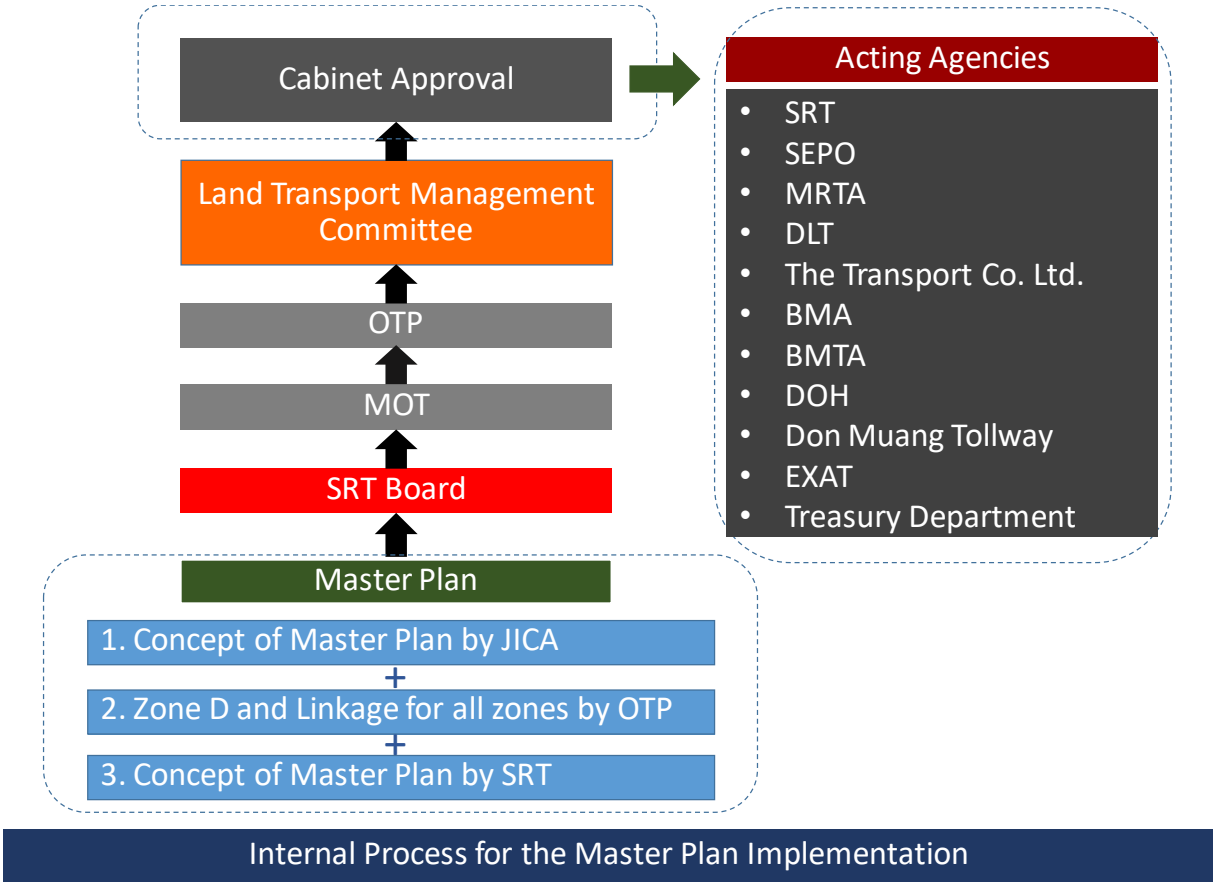
10.1.1 Actions to be Taken by Thai Government

Thai Government should take a series of comprehensive actions for smooth implementation of Bang Sue Area redevelopment as shown in Table 10.1.1. Thai internal process for Master Plan implementation is as shown in Figure 10.1.1.

Table 10.1.1 Actions to be Taken by Thai Government

Category	Action	Organizations in Charge	Related Organizations
1. M/P Finalization	(1) Feedback from stakeholders (It is recommended to make the best use of the movie, which was exclusively made for the present survey.)	OTP/SRT	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
	(2) Cabinet approval	Land Transport Management Committee/ OTP	SRT/ SEPO/ MRTA/ DLT/ BoKoSo/ BMA/ BMTA DOH/ Don Muang Tollway/ EXAT/ Treasury Dept
2. Steering Committee	(1) Members/ Roles	OTP/ SRT	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
	(2) Secretariat	SRT Subsidiary (SRT Property Co. for Asset Management)	SRT
	(3) Sub-committees for the following areas - Smart city - TOD and transport networking - Basic infrastructure - MICE	SRT/ OTP	MOT/ Ministry of Energy/ Ministry of Interior/ Ministry of Digital Economy/ BMA/ EGAT/ MWA/ MEA/ BoKoSo/ BMTA
3. Government Assistance	(1) Approval for a special zone including the followings. - Land lease period - Incentives for investors - One stop window	Land Transport Management Committee/ OTP	SRT/ SEPO/ MRTA/ DLT/ BoKoSo/ BMA/ BMTA DOH/ Don Muang Tollway/ EXAT/ Treasury Dept
	(2) Approval for the establishment of SRT subsidiaries (SRT Property Co. and SRT Bang Sue Development Co.)	OTP/SRT	MOT/ MOF
	(3) Coordination with PPP Committee	SRT/OTP	MOT/ SEPO
	(4) Finance planning	SRT/OTP	MOT/ MOF
	(5) Coordination regarding bus terminal/ depot planning	OTP/SRT	MOT/ BoKoSo/ BMTA

Source: JST



出典：OTP

Figure 10.1.1 Thai Internal Process for Master Plan Implementation

The temporary schedule for actions to be taken by Thai Government is as shown in Figure 10.1.2.

Category	Actions	2017		2018		2019	
1. MP Finalization	(1) Feedback from Stakeholders						
	(2) Cabinet Approval						
2. Steering Committee	(1) Members/ Roles						
	(2) Secretariat						
	(3) Sub-committees						
3. Gov. Assistance	(1) Special Zone						
	(2) SRT Subsidiaries						
	(3) Coordination (PPP Committee)						
	(4) Finance Planning						
	(5) Bus Terminal/ Depot Planning						

Source: JST

Figure 10.1.2 Temporary Schedule for Actions to be Taken by Thai Government

10.1.2 Actions to be Taken by SRT

SRT should take a series of comprehensive actions, hand in hand with Thai Government, for smooth implementation of Bang Sue Area redevelopment as shown in Table 10.1.2.

Table 10.1.2 Actions to be Taken by SRT

Category	Action	Related Organizations
1. Establishment of Subsidiaries	(1) To clarify organizational functions, organizational structure, human resource, and daily work process	
	(2) To elaborate an internal regulation	
	(3) To recruit talent and provide training	
	(4) To coordinate Governmental Steering Committee	
2. Short Term Development (until 2022)	(1) A1/A2: Preparation and implementation ・ Market sounding ・ Tender documents ・ Discussion and coordination with PPP committee ・ Bidding/ Evaluation/ PPP Contract ・ Implementation supervision	PPP committee/ SEPO/ Private sector
	(2) E1/E3: Preparation and implementation ・ RAP (Resettlement Assistance Program) ・ Tender documents ・ Discussion and coordination with PPP committee ・ Bidding/ Evaluation/ PPP Contract ・ Implementation supervision	PPP committee/ SEPO/ Private sector
	(3) Bus terminals/ Depots	OTP/ BoKoSo/ BMTA
	(4) Skywalks/ Underground passages	BMA/ Private sector
3. Middle Term Development (until 2027)	(1) F1/F2: Preparation including the existing depot resettlement	PPP committee/ SEPO/ Private sector
	(2) E2: Preparation	PPP committee/ SEPO/ Private sector
	(3) C: Preparation including the existing bus terminal resettlement and MICE design	OTP/ BoKoSo/ BMTA/ PPP committee/ SEPO/ Private sector
	(4) G: Preparation	PPP committee/ SEPO/ Private sector
4. Smart City-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	Smart City Sub-committee
5. TOD and Transport Networking-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	TOD and Transport Networking Sub-committee
6. Basic Infrastructure-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	Basic Infrastructure Sub-committee
7. MICE-related Planning/ Coordination through Sub-committee	(1) Planning (2) Coordination	MICE Sub-committee

Source: JST

The temporary schedule for actions to be taken by SRT is as shown in Figure 10.1.3.

Category	Actions	2017		2018		2019	
1. Establishment of Subsidiaries	(1) To clarify organizational functions, organizational structure, human resource, and daily work process						
	(2) To elaborate an internal regulation						
	(3) To recruit talent and provide training						
	(4) To coordinate Governmental Steering Committee						
2. Short Term Development	(1) A1/A2: Preparation and Implementation (Market Sounding/ Tender Documents/ PPP Committee/ Bidding-Evaluation-Contract/ Implementation Supervision)						
	(2) E1/E3: Preparation and Implementation (Ditto)						
	(3) Bus Terminals/ Depots (Bokoso/ BMTA)						
	(4) Skywalks/ Underground Passages						
3. Preparation for Middle Term	(1) Zone F (including the existing depot resettlement), Zone E-2, Zone C (including Bus Terminal resettlement), Zone G						
4. Smart City-related Planning/ Coordination, Sub-committee*							
5. TOD/ Transport-related Planning/ Coordination, Sub-committee*							
6. Infrastructure-related Planning/ Coordination, Sub-committee*							
7. MICE-related Planning/ Coordination, Sub-committee*							

Source: JST

Figure 10.1.3 Temporary Schedule for Actions to be Taken by SRT

10.2 Main Considerations in Implementing Bang Sue Area Redevelopment

It is recommended that Thai stakeholders should consider all the points shown in Table 10.2.1 in implementing Bang Sue Area redevelopment, especially at initial stage.

Table 10.2.1 Main Consideration Points at Initial Stage for Thai Stakeholders

No.	Category (Topic)	Challenges	Consideration Points
1	Laws & Regulations (Special Zone)	Bang Sue Area may need a clear and explicit government policy for promoting and realizing a large-scaled integrated development	It is recommended that Thai government should discuss the designation of a special zone to Bang Sue Area by cabinet approval which includes prolongation of land lease period, promoting incentives for investors, and providing one window service. [Reference: Appendix 10-1: Act on Special Measures concerning Urban Regeneration]
2	Laws & Regulations (Land Lease Period)	Private sector prefers freehold to leasehold as for land arrangement. SRT land has its regulatory constraints: The leasehold period of Bang Sue Area is limited to 30 years, which may not attract private investors.	As mentioned above, it is desirable to designate Bang Sue Area as special development zone with benefits such as longer leasehold period (up to 99 years), tax incentives, longer grace period.
3	Laws & Regulations (Underground Space Development)	Few buildings are directly connected to the underground spaces at stations. In other words, convenience and land value have not been maximized yet. In the future, more buildings should be directly connected to underground spaces.	It is recommended to make clear rules regarding structure, maintenance, costs, etc. of joint spaces between underground space owner and the building owners. [Appendix 10-2] Underground Space Development
4	PPP Tender (PPP Tender Conditions)	Initial ramp-up period of Bang Sue Area redevelopment contains various business risks (e.g. tenant demand, interface with public infrastructure). It is required to prepare tender conditions that are attractive enough for private investors.	It is important to set up an interactive PPP tender process between public sector and private sector: 1) To obtain pre-proposals from potential bidders as part of PQ process, 2) To hold interactive opinion sharing sessions with each of short-listed bidders, 3) To refine RFP (Request for Proposal) documents to reflect private sector's opinions.
5	Investment Permits (One Stop Window)	Bang Sue Area redevelopment has multiple layers with many stakeholders. It is necessary to set up a convenient investment process so that potential investors should not annoyed by a complicated process which requires to obtain permits one-by-one from all stakeholders.	It is essential to establish one stop window for accelerated coordination to obtain necessary permits for each layer of redevelopment.
6	Implementation Organization	Bang Sue Area Redevelopment requires technical discussions which may be too detailed for senior level steering committee discussion.	It is needed to establish the following sub-committees. 1) Smart city 2) TOD and transport networking 3) Basic infrastructure

Source: JST