2019 年 8 月 26 日　13 時～16 時
13:00-16:00, August 26, 2019

［C　計画・設計・論文］
[C Planning/Design/Essay]

Ｃ－１　計画・設計
（専攻分野：都市環境工学）
C-1 Planning and Design
(Major Field of Study: Urban Environmental Engineering)

受験番号＿＿＿＿＿＿＿＿＿＿＿＿

Examination I. D.＿＿＿＿＿＿＿＿＿＿

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If your major field of study is “Urban Environmental Engineering,” then answer either C-1 or C-2.

C－1 Planning and Design (Urban Environmental Engineering)

In City A, the combustibles of the municipal solid wastes are incinerated at the waste treatment plant to generate electricity. Biogas gained from the sewage-sludge digestion is used for the power generation. In the city, the following two measures (a) and (b) are considered for the treatment of the kitchen waste in the municipal solid wastes. Answer the following questions from Q.1 to Q.4 about this issue. The basic data about City A are shown in Table 1. Assume necessary data by yourself, if they are not provided.

(a)	Kitchen waste in the municipal solid wastes is separately collected by City A and digested mixing with the sewage sludge.
(b)	Kitchen waste in the municipal solid wastes is separately collected by City A and composted.

Q.1 About the incineration at the waste treatment plant, answer the following questions (1) to (4).

(1) The current data about the municipal solid wastes in City A are shown in Tables 2 to 5. Calculate the amount of combustibles currently incinerated at the waste treatment plant and the water content ratio of the wastes.

(2) When all the kitchen waste in the municipal solid wastes is separately collected, calculate the amount of combustibles incinerated at the waste treatment plant and the water content ratio of the wastes.

(3) Assuming that low heating value H_L is defined as the following equation, calculate the change of total heating values of combustibles incinerated at the waste treatment plant with and without the kitchen-waste separate collections.

$$H_L\ (\mathrm{kJ/kg}) = 190B - 25W$$

B : Combustible content in the waste （%）
W : Water content in the waste （%）

(4) Based on the results of (3), explain the positive and negative environmental impacts that occur at the waste treatment plant, when the kitchen waste is separately collected.

Q.2 Answer the following questions (1) to (5) about the measure (a).

(1) The current data about the sewage treatment in City A are shown in Table 6. Calculate the current sewage-sludge generation on TS basis. The concentration of MLSS in the aeration tank is kept at 2,000 mg/L, and the increased sludge is withdrawn as the excess sludge. Industrial wastewater and groundwater inflows are not considered.

(2) When all the kitchen waste in the municipal solid wastes is separately collected, calculate the total amount of organic matter treated by the digestion mixed with the sewage sludge on VTS basis. The contents of organic matter in the sewage sludge are shown in Table 7. The organic content in the kitchen waste is the same with the combustible content.

(3) The methane content in the biogas generated by the digestion is about 50–60 %. Explain components of the biogas other than methane.

(4) Calculate the amounts of the generated biogas for the cases with and without the measure (a), when the decomposition rate of VTS is 80 % and the methane production rate against the decomposed VTS is 0.6 Nm^3/kgVTS during the digestion. Assume that the methane content in the biogas is 60 %.

(5) Assuming that 2 kWh/Nm^3 is achieved by the biogas power generation, calculate the change of the electricity generated from the biogas with and without the measure (a). In addition, discuss this amount in comparison with the amount of electricity generated at the waste treatment plant.

Q.3 Answer the following questions (1) and (2) about the measure (b).

(1) The data about the compost production are shown in Table 8. Explain what process the composting is, and explain why the energy inputs are needed in the composting process.

(2) Estimate the change in the amount of greenhouse gas emissions from fertilizer substitutes, assuming that the total amount of compost substitutes conventional fertilizers. Assume the conventional fertilizer as ammonium sulfate, and use the emission intensities shown in Table 9. The nitrogen content in the compost is 5 %. Consider only the fertilizer production stage, assuming that there is no change in the greenhouse gas generation during the fertilizer use (fertilization) between the chemical fertilizer and the compost.

Q.4 Comprehensively discuss the effectiveness of the measures (a) and (b) in about 0.5 page, taking into account the results of Q.1, Q.2, and Q.3 and other various aspects.

Table 1. Basic data for City A

Population	120	[ten thousand people]
Population aged 65 and older	30	[%]
Water supply coverage	100	[%]
Rate of commercial water use	0.3	[-]
Household wastewater discharge	250	[L/(day・person)]
Sewage coverage	95	[%]
Sewer system	Separated sewer system	
Sewage treatment process	Conventional activated sludge process	
Areas for cultivation	2,600	[ha]
Paddy field	1,900	[ha]
Farmland	700	[ha]
Utilization rate of cultivation area	70	[%]

Table 2. Data for the municipal solid wastes in City A

Amount of the municipal solid wastes (wet-weight basis)	35	[ten thousand ton/year]
Collection system	Collected at collection stations	
Segregation categories	Combustibles, Incombustibles, Recyclables, Bulk wastes	

Table 3. Composition of the municipal solid wastes (wet-weight basis)

Combustibles	80	[%]
Incombustibles	6	[%]
Recyclables	12	[%]
Bulk wastes	2	[%]

Table 4. Breakdown of combustibles in the municipal solid wastes (wet-weight basis)

Papers	50	[%]
Kitchen waste	30	[%]
Plants（woods, bamboos, straws, etc.）	10	[%]
Plastics, rubber, leather	10	[%]

Table 5. Composition of combustibles in the municipal solid wastes (weight basis)

	Water content [%]	Combustible content [%]	Ash content [%]
Papers	30	65	5
Kitchen waste	80	18	2
Plants（woods, bamboos, straws, etc.）	30	65	5
Plastics, rubber, leather	15	70	15

Table 6. Data for the sewage treatment

SS inflow at the primary settling tank	200	[mg/L]
Removal ratio of the primary settling tank	50	[%]
Dissolved BOD inflow at the aeration tank	80	[mg/L]
Conversion ratio of dissolved BOD into sludge	0.5	[mgMLSS/mgBOD]
Conversion ratio of inflow SS into sludge	0.9	[mgMLSS/mgSS]
MLSS in the aeration tank	2,000	[mgMLSS/L]
Self-degradation coefficient of the sludge	0.04	[1/day]
Hydraulic retention time of the aeration tank	8.0	[hour]

Table 7. Organic matter contents

Primary sludge	0.70	[VTS/TS]*
Excess sludge	0.80	[VTS/TS]

* VTS: volatile total solids, TS: total solids

Table 8. Data for compost production

Material	Input	Kitchen waste	1,000	[kg]
	Output	Compost	300	[kg]
		Treatment residues	200	[kg]
Energy	Input	Electricity	95	[kWh]
		Kerosene	1.2	[L]
		Light oil	4.5	[L]
		Heavy oil	0.8	[L]

Table 9. Greenhouse-gas emission from each material

	Unit amount	Greenhouse gas emission [kg CO_2]
Ammonium sulfate	1 kg	0.5
Kerosene	1 L	2.64
Light oil	1 L	2.80
Heavy oil	1 L	2.95
Electricity	1 kWh	0.45

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[C Planning/Design/Essay]

Ｃ－２　論文
（専攻分野：都市環境工学）
C-2 Essay
(Major Field of Study: Urban Environmental Engineering)

受験番号＿＿＿＿＿＿＿＿＿＿＿＿
Examination I. D.＿＿＿＿＿＿＿＿＿＿

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If your major field of study is “Urban Environmental Engineering,” then answer either C-1 or C-2.

C－2　Essay (Urban Environmental Engineering)

Answer the following questions.

Q.1　Measures for climate change mitigation and energy policy are closely related. Explain the future of energy policy within one page of the answer sheet, referring to an international agreement that has a major impact on energy policy.

Q.2　In recent years, adaptation strategies and adaptation plans for climate change have been developed in various countries. Explain the way of promoting climate change adaptation, within one page of the answer sheet, referring to the roles of stakeholders.

Q.3　Climate change is considered not only to increase the risk of meteorological disasters, but also to adversely affect the water environment and water resources. Explain the negative impacts on the water environment and water resources and their adaptation measures within one page of the answer sheet.

Q.4　Explain concerns about the impacts of microplastics on marine ecosystems within a half-page of the answer sheet.

Q.5　Explain what countermeasures are being discussed against the marine pollution by plastic wastes, and then describe your opinions on the expected effects of the countermeasures within one page of the answer sheet.

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［C　計画・設計・論文］
[C Planning/Design/Essay]

Ｃ－３　計画・設計
（専攻分野：都市計画）
C-3 Planning and Design
(Major Field of Study: Urban Planning)

受験番号
Examination I. D.

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If your major field of study is “Urban Planning,” then answer either C-3 or C-4.

C－３　Planning and Design (Urban Planning)

Propose a development concept for Site X and a development plan for Block B and Block C after reading the following sentences and maps of Answer Sheet 1 and 2.

1. About the Site X and the surroundings

-There is a railway station northwest from Site X and it takes approximately one hour to Tokyo from this station. There is no inconvenience in the shopping environment with a full shopping street and a supermarket between Site X and the station in addition to some convenience stores opposite across the west road of Site X. There are public elementary schools and a public junior high school nearby. The climate is mild and there is no worry about snow.
-Site X is composed of three blocks as Block A, Block B and Block C from the north.
-The current condition of surrounding roads and streets are as follows.
  >north side of Block A: one side one lane bidirectional, no sidewalk, about 8m width
  >west side of Site X: one side one lane bidirectional, with sidewalk, about 12-14m width
  >east side of Site X: the approach to a shrine, pedestrian street, about 15m width
  >between Block A and B: service line for parking lots in Block A and B, one side one lane bidirectional, no sidewalk, about 6m width
  >between Block B and C: service line for parking lots in Block B and C, one side one lane bidirectional, no sidewalk, about 8m width
  >south side of Block C: main road in wide area, one side two lanes bidirectional, with sidewalk, about 25-30m width
-In particular, the approach road to the shrine on the east side has rich street trees, mainly zelkova, deciduous trees. Local residents cooperatively clean the fallen leaves and live there with attachment.
-The east side of the approach to the shrine is basically a detached residential area.
-Site X and the detached residential area on the east should accommodate residential-oriented developments with the maximum floor area ratio of 200% and building coverage ratio of 60%. The north side and the west side of Site X belong to commercial zone with the maximum floor area ratio of 400% and building coverage ratio of 80%.
-Block A was owned by a private owner who managed a vocational school. Because of decreasing number of students, the school was closed. Block B and Block C were municipal lands with a city hall branch, a library and a nursery school. All those public buildings were too aged and needed to be rebuilt. So the municipality bought Block A and would move those

public facilities in Block B and C to Block A. Block A would be a new civic zone with green spaces. The municipality would sell Block B and Block C to a housing developer.

2. Development concept for Site X

<Planning requirements>

-In Block A, a city hall branch (the total floor area of approximately 5,000m^2 and its parking lots for about thirty cars), a library (the total floor area of approximately 5,000m^2 and its parking lots for about thirty cars), a nursery school (the total floor area of approximately 1,000m^2 in addition to the playground of 1,000m^2 and its parking lots for about five cars), and park green space which may be divided or assembled, should be included.
-Regarding the requirements on usage and volume for Block B and Block C, see 3. below.
-The width of the surrounding roads can be changed through this development but neighboring blocks should not be changed. The shapes of Block B and Block C can be modified and can be assembled together.
-Bus stops for community bus and bicycle parking lots should be allocated.
-Parking lots can be planned on the first floor of each building but cannot be underground.

<Required planning documents>

By using 「解答用紙 1：地区 X の開発構想（図面）(Answer Sheet 1: Development Concept for Site X (Map)) 」, propose a development concept for Site X composed of Block A, B and C, which includes following items, with a map and texts. If necessary, you may add original items and/or illustrate diagrams and sketches.

(1) Development concept
(2) Land use planning policies (use, building form, building volume and building arrangement, arrangement of various facilities, location of entrances and relationships with surroundings, etc.)
(3) Transportation planning policies (flows of pedestrians, bicycles, automobiles and community buses, etc.)
(4) Development policies for parks, green and open spaces

3. Development plans for Block B and Block C

<Planning requirements>

-To create a new residential area providing diverse lifestyles for the future, the municipality imposed the following conditions to the housing developer which develops both Block B and

Block C.

a) Collective housing with services for single aged people for them to be able to continue their living in the community. No parking lots.

b) Collective housing for elderly couples, who worry about keeping their detached houses or have too much spaces after their children left. No parking lots and some shared cars.

c) Collective housing for young families to live for a long time. The parking lot rate is 70% of the residential households.

d) Collective housing for people living while working with extra spaces for offices, ateliers and so on. The parking lot rate is 100% of the residential households.

The number of units for each type a)-d) can be set freely but the total floor area should be from 45,000m^2 to 55,000m^2.

-Several meeting places should be allocated.

-Appropriate green and open spaces should be provided.

-Appropriate bicycle parking lots and garbage dumps should be allocated.

-Bus stops for a community bus should be placed.

<Required planning documents>

Using 「解答用紙 2 : 街区 B・街区 C の開発計画（図面）(Answer Sheet 2: Development Plan for Block B and Block C (Map))」 and「解答用紙 3 : 街区 B・街区 C の開発計画（文章）(Answer Sheet 3: Development Plan for Block B and Block C (Texts))」, propose a development plan for Block B and Block C, which includes the following items, with 1/1000 map and texts. If necessary, you may add original items and/or illustrate diagrams and sketches.

(1) Collective housing for each type a), b), c) and d) (form of housing buildings, location of entrances, number of floors, number of units for each housing type)

(2) Car parking lots

(3) Necessary spaces for collective housing including meeting places, bus stops, bicycle parking, garbage collection and other facilities

(4) Green and open space plan

(5) Circulation plan (pedestrian, bicycle and automobiles)

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解答用紙 1: 地区 X の開発構想（図面） Answer Sheet 1: Development Concept for Site X (Map)

受験番号 Examination I.D.

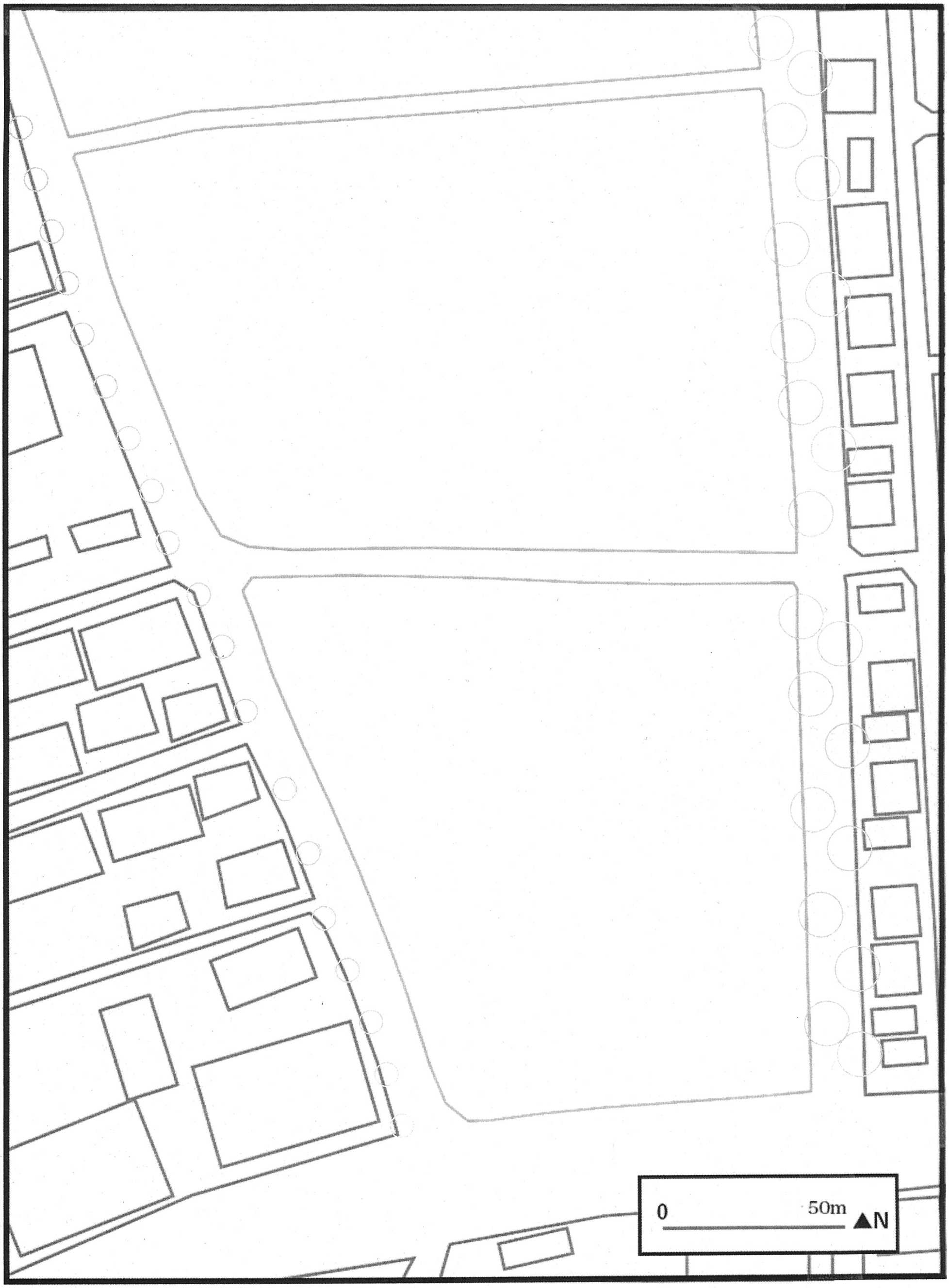
地区 X は街区 A、B、C より構成される。Site X is composed of Block A, B and C.

この地図は、さいたま市発行の地形図（1/2,500）を使用したものです。

解答用紙 2: 街区 B・街区 C の開発計画（図面）

Answer Sheet 2: Development Plan for Block B and Block C (Map)

受験番号 Examination I.D.



解答用紙 3: 街区 B・街区 C の開発計画（文章）　Answer Sheet 3: Development Plan for Block B and Block C (Texts)

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[C Planning/Design/Essay]

Ｃ－４　論文
（専攻分野：都市計画）
C-4 Essay
(Major Field of Study: Urban Planning)

受験番号＿＿＿＿＿＿＿＿＿＿＿＿
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If your major field of study is “Urban Planning,” then answer either C-3 or C-4.

C－4　Essay (Urban Planning)

Figures 1 to 4 are taken from a book named “The Little House”, whose first edition appeared in the USA in 1942.　Answer the following three questions by referring to Figures 1 to 4.

(1) What seems to have happened to The Little House from urban development point of view?　Suppose that this book was published based on a real story happened in an American city during 1900 to 1940, examine Figures 1 to 4, and state your thoughts.

(2) In Figure 4, it seems that The Little House finally became vacant.　What kind of uses can be applied to this property without consolidating land and redeveloping it as surrounding areas but by maintaining its original structure/land as far as possible?　Suppose that the House is in a contemporary Japanese city, and propose two possible uses when the House is maintained, and another two when the House is demolished but the land is maintained.

(3) What kind of institutions and/or systems should be developed and applied to encourage four uses you answered in Question (2)?　Propose institutions/systems for each of four uses, along with the discussions on the reasons why you think they are effective.　Suppose that the House/land is maintained as a private property in a contemporary Japanese city.　You may refer to both existing and hypothetical institutions/systems.　The same proposal may be repeated if it is thought to be effective for different uses.

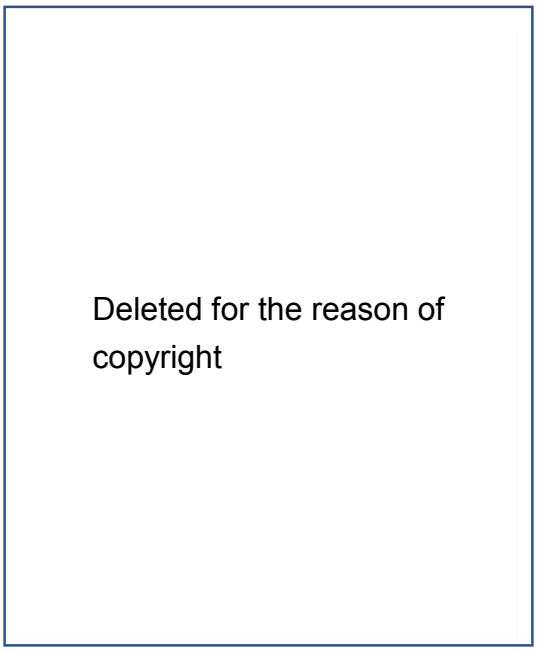

Figure 1

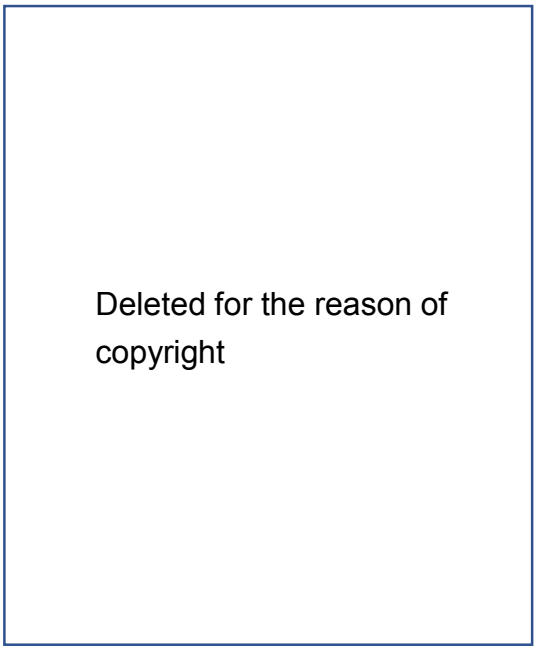

Figure 2

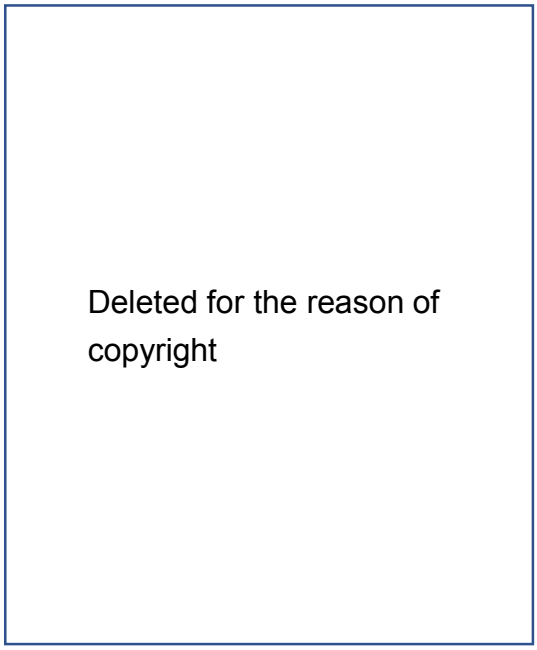

Figure 3

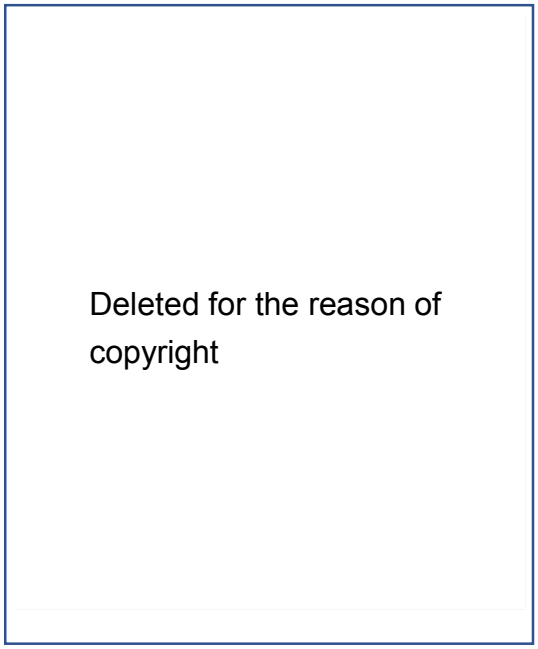

Figure 4