



# **Cross-ministerial Strategic Innovation Promotion Program (SIP) Second Phase/Automated Driving for Universal Services/Development, Pre-verification, Maintenance, and Management of Infrastructure Related to Tokyo Waterfront Area Demonstration Experiment**

## **FY2019 Annual Report**

**Summary**  
**Pacific Consultants Co., Ltd.**  
**Nippo Corporation**

**March 2020**

# 1.1 Project Purpose

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## **[SIP Second Phase: Purpose of R&D Planning of Automated Driving]**

- Put automated driving into practice and expand its spread in order to contribute to solving social issues, such as **reducing traffic accidents, mitigating traffic congestion**, ensuring mobility of transportation-handicapped people, and improving driver shortages and reducing costs in logistics and mobility services, aiming to realize a society where everyone can live a high quality life.
- Establish **the technologies in cooperative areas that are necessary for the realization of automated driving** by 2023, **confirm their effectiveness by conducting demonstration experiment** involving various businesses and local governments while enhancing the prospect of social implementation by **creating multiple cases of practical application**.



## **[Purpose]**

As a part of “Automated Driving for Universal Services” in the second phase of SIP, this project is intended to establish a mechanism for utilizing traffic environment information, such as traffic signal information and merging support information, provided by the traffic infrastructure, and **put the infrastructure-coordinated advanced automated driving into practice at an early stage**.

## 1.2 Project Outline: Detailed Development Items of This Study

### Project outline

#### **Development, pre-verification, maintenance, and management of the infrastructure in the Haneda Airport area (ordinary roads)**

In the area subject to the demonstration experiment in the Haneda area, design and develop the infrastructure (place magnetic markers, color the dedicated lane, build temporary bus stops, pave Zone 1, and so on) required for the next-generation public transportation systems (such as buses and small group transportation vehicles) and conduct pre-verification to ensure that there is no problem with the implementation of the demonstration experiment.

The infrastructure developed will be maintained and managed until the end of the demonstration experiment.

After the end of the demonstration experiment, the infrastructure will be withdrawn to restore the original state.

### Detailed development items (1) to (6) of this study

- (1) Overall management (conducted in FY2019)  
[By Pacific Consultants Co., Ltd.]
- (2) Development of infrastructure necessary for next-generation public transportation systems (conducted in FY2019)  
[By Nippo Corporation]
- (3) Pre-verification (partly conducted in FY2019)  
[By Nippo Corporation]
- (4) Maintenance and management of infrastructure (partly conducted in FY2019)  
[By Nippo Corporation]
- (5) Withdrawal of infrastructure developed (not conducted in FY2019)  
[By Nippo Corporation]
- (6) Coordination with stakeholders (conducted in FY2019)  
[By Pacific Consultants Co., Ltd.]



## 1.3 Study Method

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- Develop the infrastructure (place magnetic markers, color the dedicated lane, build temporary bus stops, pave Zone 1, and so on) necessary for the experiment to be conducted in the Haneda Airport area as a part of the Tokyo waterfront area demonstration experiment.
- Maintain and manage the infrastructure until the end of the demonstration experiment, and restore the original state after the end of the experiment.
- In developing the infrastructure, the specifications of each infrastructure are determined after consultation with the road administrator, traffic administrator, and experiment participants.
- Also how to construct each infrastructure and how to restore the original state are determined after consultation with the parties concerned.



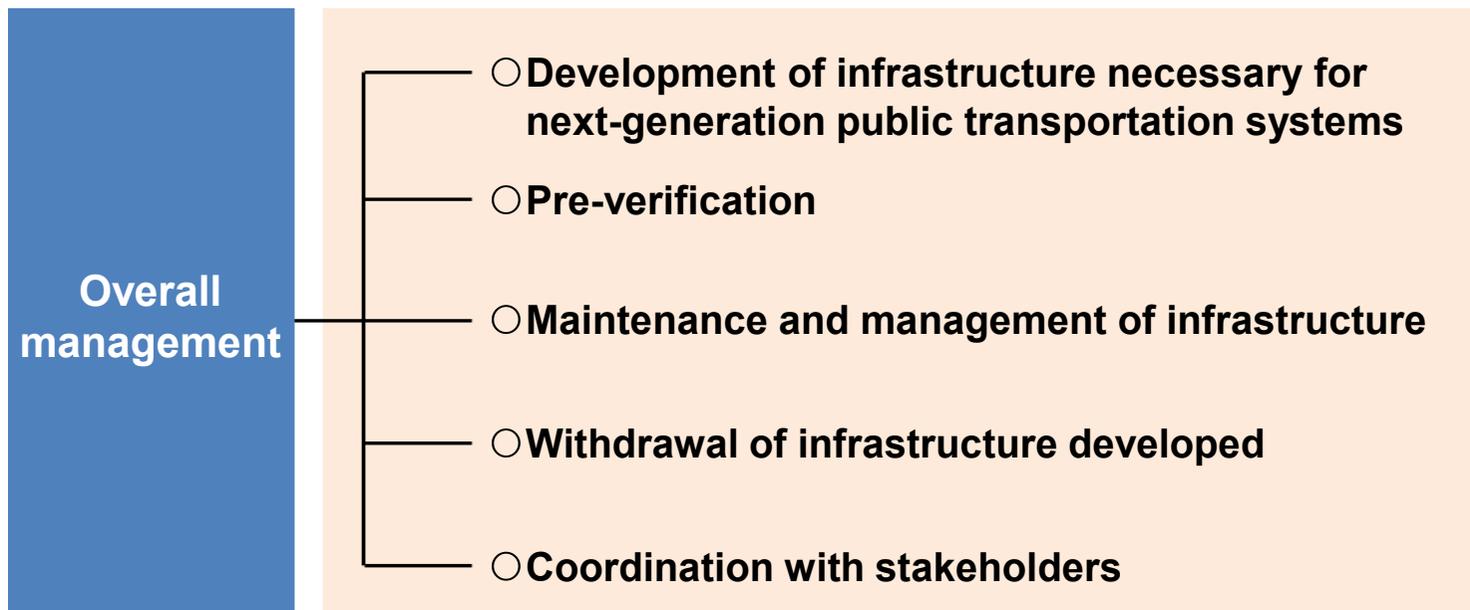
Report the progress of the infrastructure development at the **“Tokyo Waterfront Area Demonstration Experiment Task Force”** and **“Tokyo Waterfront Demonstration Experiment Haneda Airport Area SWG.”**

## 2. Overall Management

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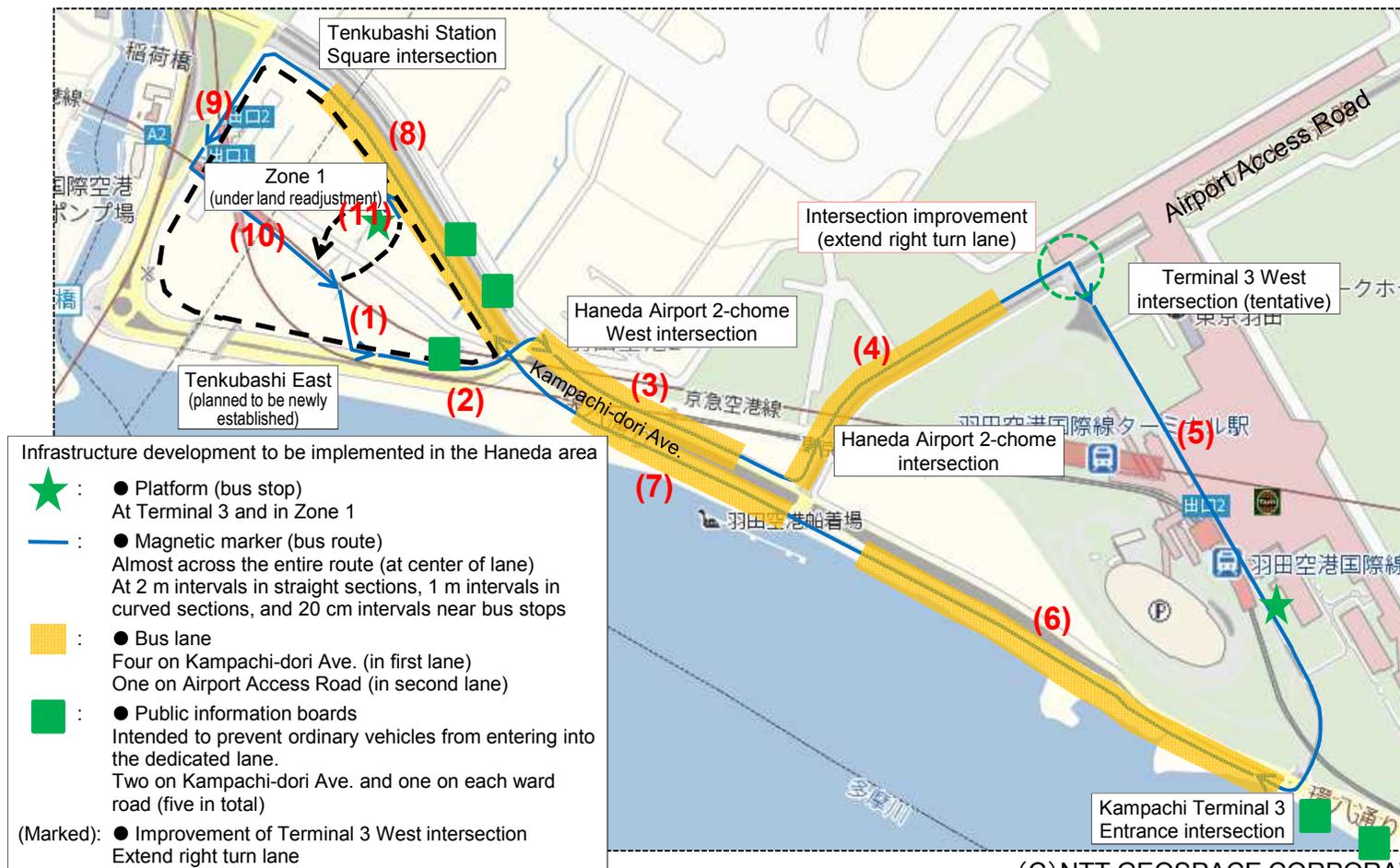
In preparation to design and develop the infrastructure (place magnetic markers, color the dedicated lane, build temporary bus stops, pave Zone 1, and so on) required for the next-generation public transportation systems (such as buses and small group transportation vehicles), pre-verify, maintain, and manage the infrastructure, and finally withdraw it to restore the original state, the overall research and development management and schedule adjustment were carried out.

The progress of the infrastructure development was reported to the relevant ministries, agencies, and organizations as well as the experiment participants at the “Tokyo Waterfront Area Demonstration Experiment Task Force” and “Tokyo Waterfront Demonstration Experiment Haneda Airport Area SWG.”



### 3. Development of Infrastructure Necessary for Next-generation Public Transportation Systems

- Design, develop, maintain, and manage the infrastructure for building an automated driving system using magnetic markers. The infrastructure will be withdrawn to restore the original state after the end of the demonstration experiment.
- Place magnetic markers, color the dedicated lane, build temporary bus stops, and pave Zone 1, as the infrastructures.



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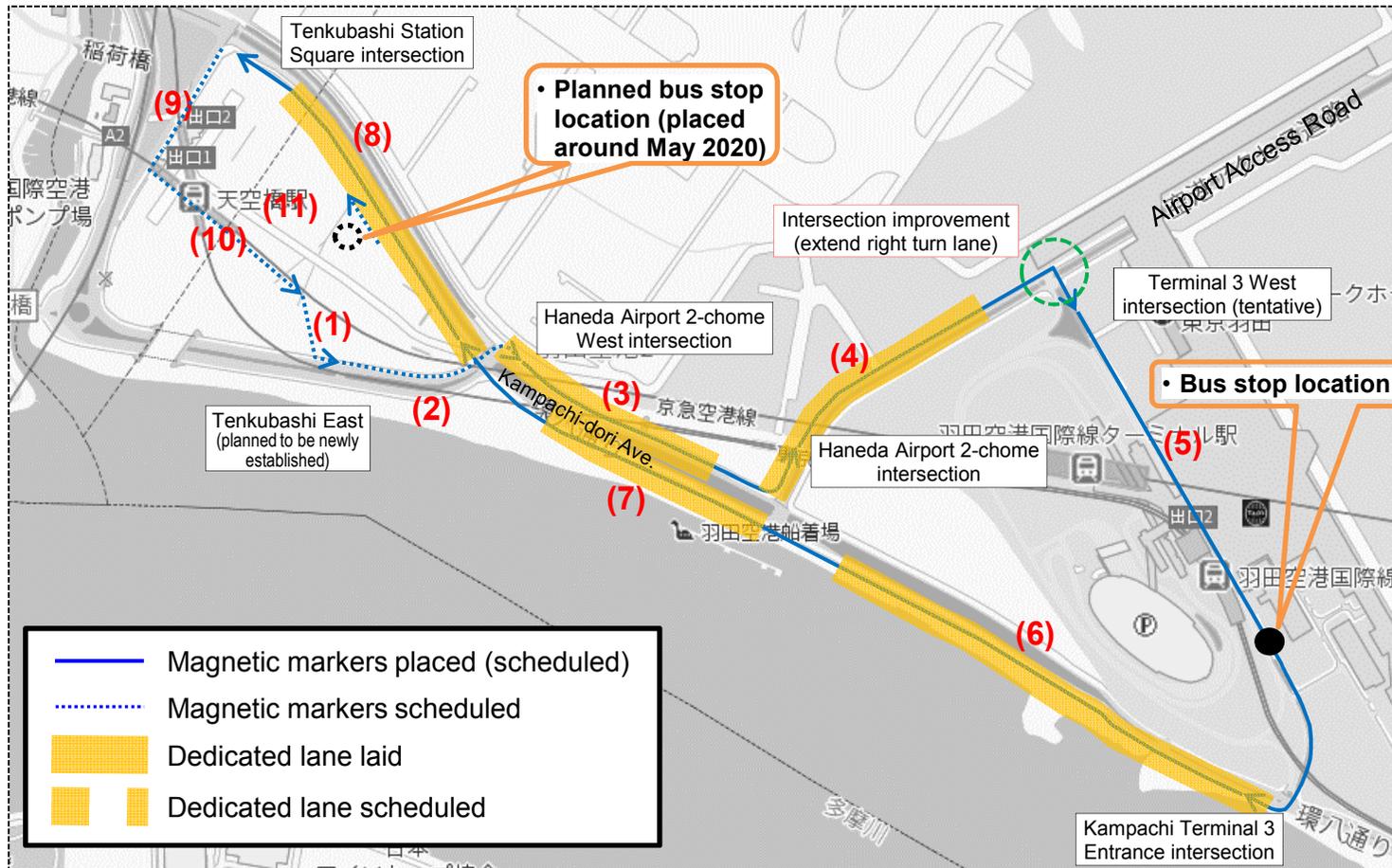
## 3.1 Placement of Magnetic Markers

- Bury magnetic markers in the pavement to improve the reliability of automated driving.
- The placement specifications were determined as follows after consultation with the parties concerned.

Item	Specification	Reason for determination
(1) Placement interval	In straight sections: 2 m	Because the experimental sections in this demonstration experiment are longer than ever before.
	In curved sections: 1 m	Placement intervals were decreased because there are many sharp-angled intersections that may hinder the automated driving of buses in the experimental sections in the Haneda Airport area.
	Near bus stops: 20 cm	Placement intervals were decreased in order to make it easier to control automated buses as they need to turn more sharply when stopping at the temporary bus stops than at ordinary ones.  * The intervals were readjusted from 20 cm to 1 m during the actual construction.
(2) Placement method	Food red method	The method of running a bus on site and marking the placement positions with a red food coloring agent is called "Food red method."  Whereas the method of marking the vehicle track and marker positions on a map and placing the actual markers according to the map is called "Reverse marking method."  The food red method was adopted because the reverse marking method (1) has no actual results, (2) requires a longer construction period, and (3) may cost more.
(3) Type of marker	Burial type	Since this demonstration experiment takes a long time, a burial type marker was adopted placing emphasis on durability.

# 3.1 Placement of Magnetic Markers

- In FY2019, magnetic markers were placed as follows:



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## 3.1 Placement of Magnetic Markers

- In placing magnetic markers, the sections and locations of placing them were determined after consultation with the parties concerned. The locations to place the markers are listed below for each section.

Section	Location(s)
(1)	At the center of the lane.
(2)	The location of placement is on the former Kampachi-dori Ave. which is currently managed by the Aviation Bureau (as four lanes) and scheduled to be an Ota Ward Road (as two lanes) in the future. At the center of the lane.
(3)	Placed at the center of the first lane, assuming a left turn at the next intersection.
(4)	Placed at the center of the second lane (or the right turn lane in front of intersections), assuming a right turn at the next intersection.
(5)	In front of bus stops, placed in the third lane in front of the terminal on routes that require no lane change. Beyond bus stops, placed at the center of each of the first and second lanes at the point where the bus changes lanes from the first to the second lane. Beyond that, placed at the center of the second lane.
(6)	At the center of the first lane.
(7)	At the center of the first lane.
(8)	At the center of the first lane. Placed in the left turn lane in front of intersections, assuming a left turn at the next intersection.
(9)	At the center of the lane.
(10)	At the center of the lane. Connected to section (1).

## 3.2 Coloring Dedicated Lane

- The dedicated lane was colored in order to increase visibility for ordinary drivers.
- Along with laying the dedicated lane, information boards were designed and placed to inform drivers of the existence of the lane.
- Also, the right turn lane at the International Terminal West intersection, which needs to be extended, was designed and discussed in detail.

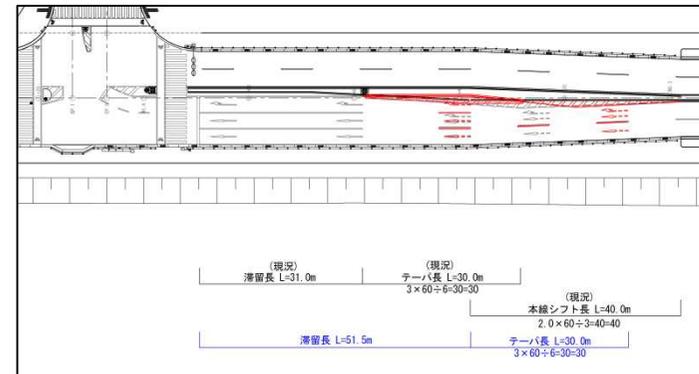
Image of colored bus lane



Image of public  
information board



Outline of improvement of International  
Terminal West intersection



## 3.2.1 Color Paving of Dedicated Lane

- The specifications for color paving of the dedicated lane were determined as follows after consultation with the parties concerned.

Item	Specification	Reason for determination
(1) Coloring width	30 cm at both ends of lane	Comparing the full lane coloring and lane end coloring, the former was found to be good in visibility but cost more. Considering that, lane end coloring of 30 cm width was adopted (see the figures below for visibility).
(2) Coloring method (paving material)	Product A	Based on the fact that the demonstration experiment will be continued only until FY2020, placing emphasis on economic efficiency while ensuring the minimum necessary functionality, Product A, which is originally used for pedestrian crossings, was adopted.



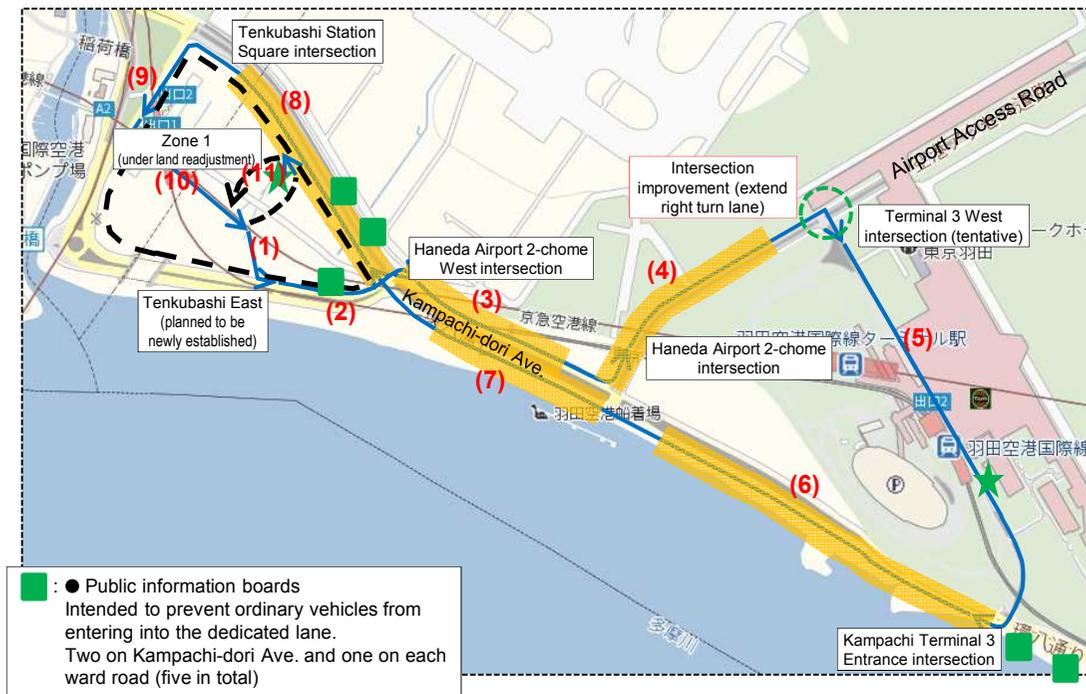
## 3.2.1 Color Paving of Dedicated Lane

- The following are the photos of the actual colored lane.

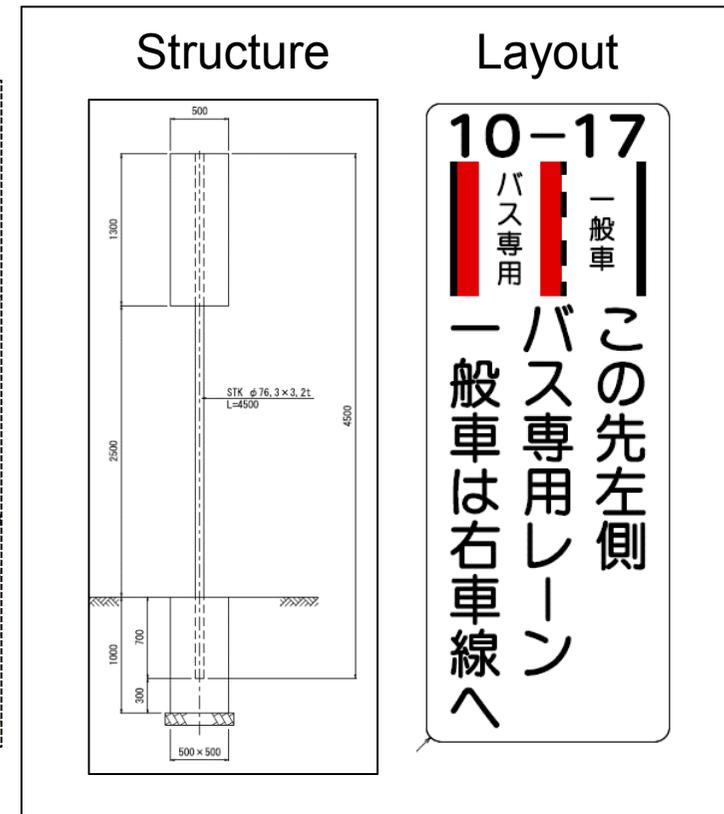


## 3.2.2 Public Information Boards

- In consultation with the parties concerned, public information boards were decided to be placed at the five locations shown in the left figure below (where drivers need to be informed that there is a bus lane ahead).
- In FY2019, public information boards were placed at four locations on the Kampachi-dori Ave. On the former Kampachi-dori Ave. in section (2), information boards are scheduled to be placed in FY2020.



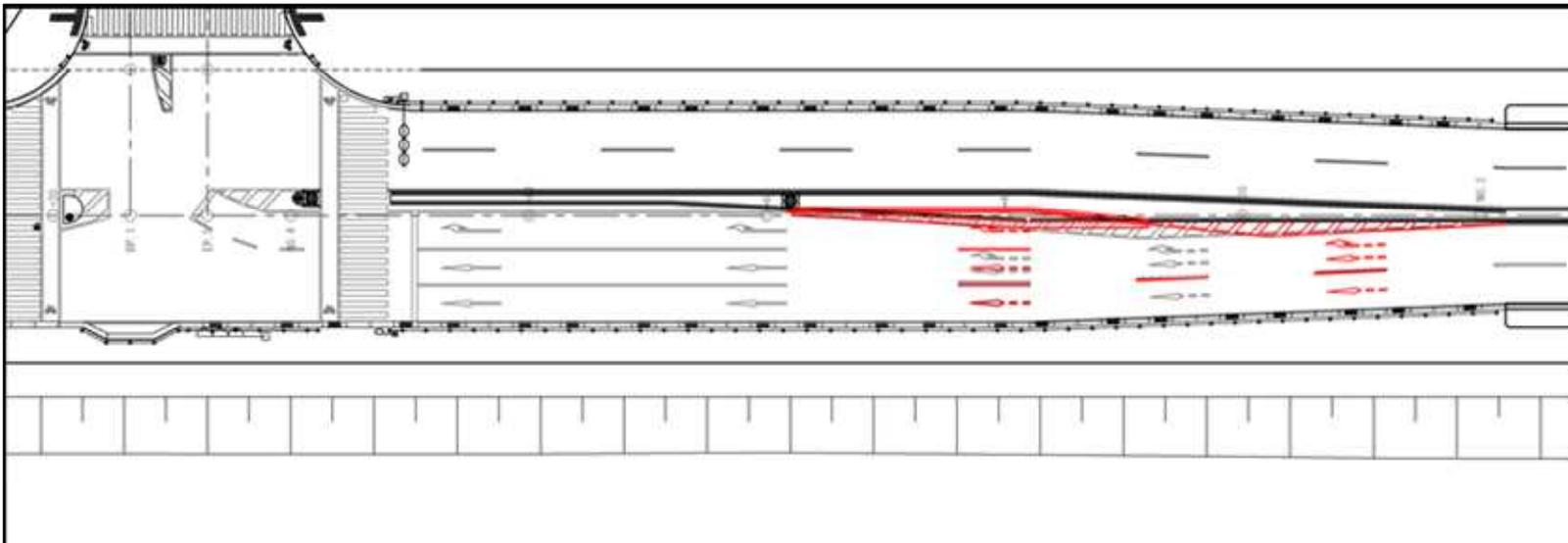
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### 3.2.3 Extension of Right Turn Lane at International Terminal West Intersection

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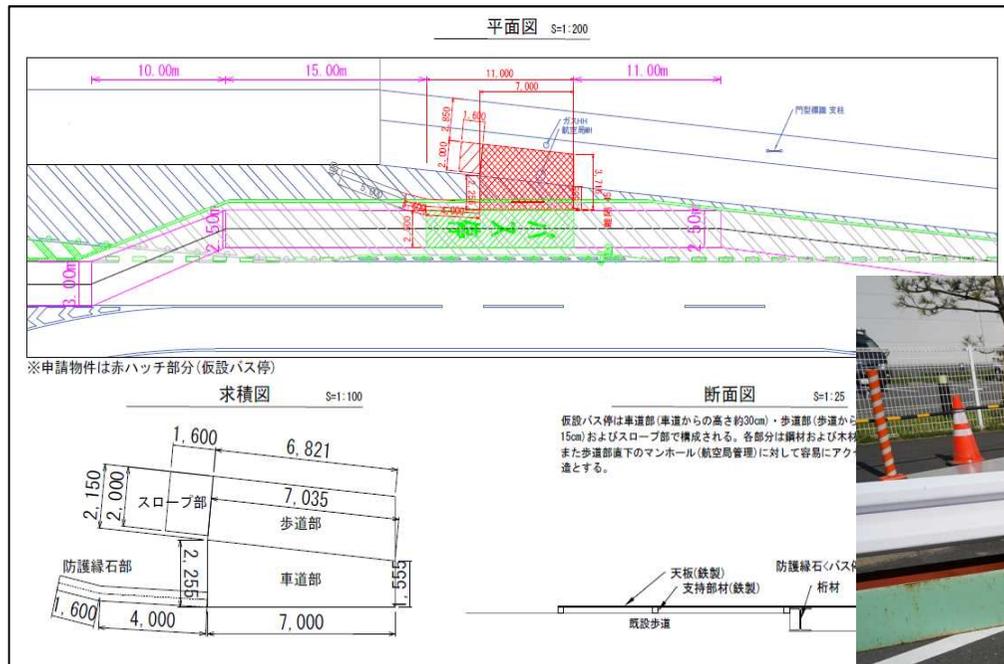
- Extend the right turn lane to ease traffic congestion.
- Extend the right turn retention length from the current approx. 30 m to approx. 50 m.
- \* This project only offers design, and the actual construction work will be carried out by the Aviation Bureau.
- \* This design is not based on any surveys. The precise locations of features shall be confirmed on site at the time of actual construction work.



### 3.3 Building Temporary Bus Stops

- Build temporary bus stops in order to conduct demonstration experiments of the stopping behavior of automated buses. Also, if necessary, modify the white lines and zebra patterns in front and behind bus stops.
- The Terminal 3 bus stop was built in March 2020.
- The following are the design drawing and a photograph of the Terminal 3 bus stop.

Design drawing of Terminal 3 bus stop



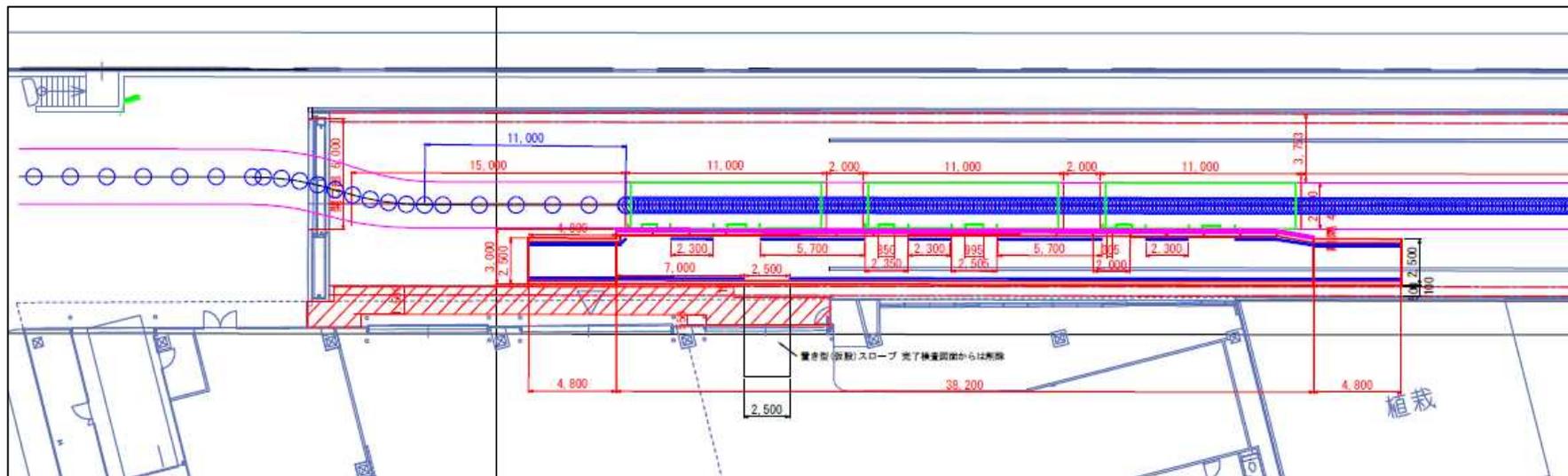
Appearance of Terminal 3 bus stop



### 3.3 Building Temporary Bus Stops

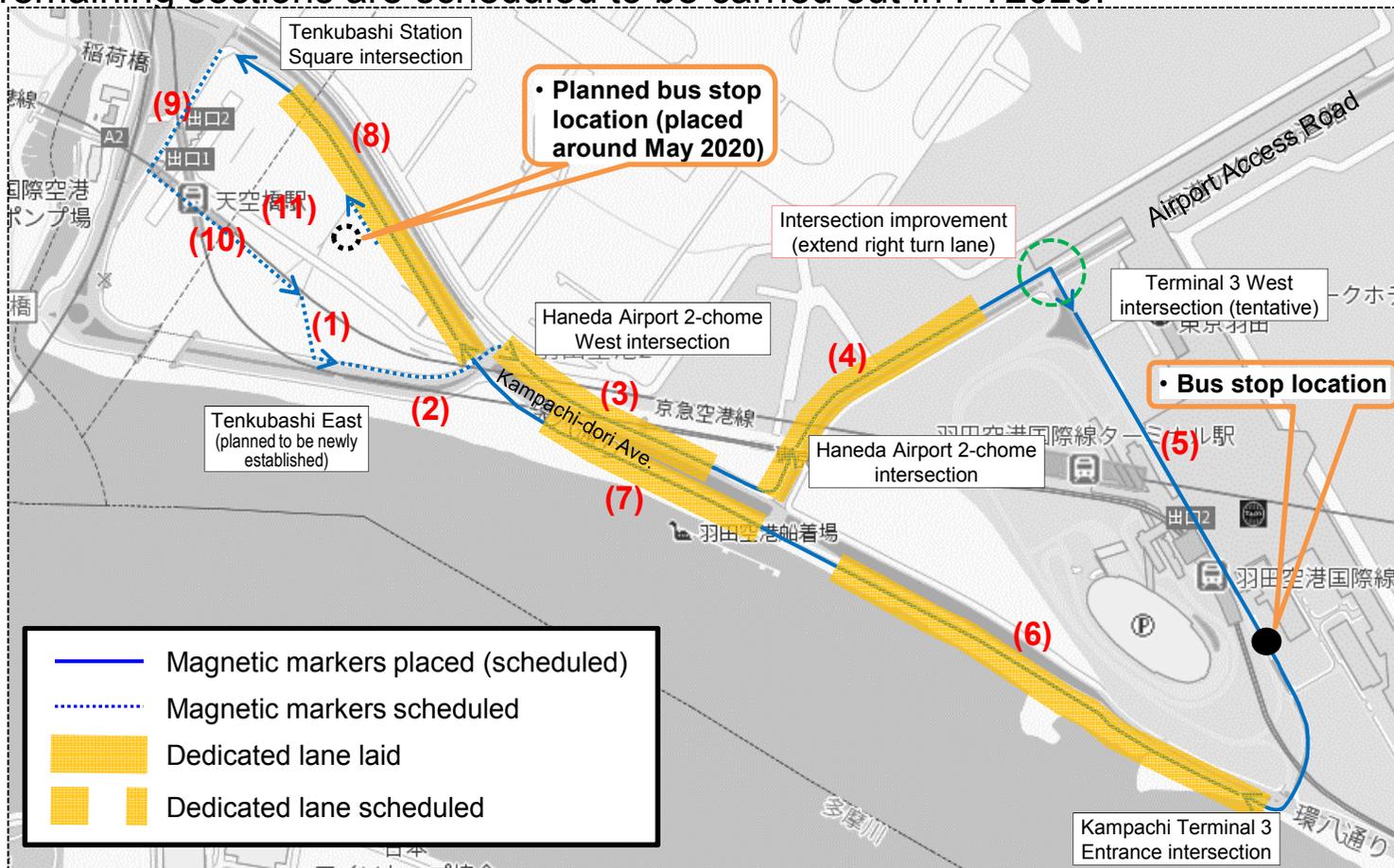
- The Zone 1 bus stop is scheduled to be built in FY2020.
- The following is the design drawing of the Zone 1 bus stop.

Design drawing of Zone 1 bus stop



# 4. Pre-verification

- In order to verify in advance whether there are any problems in conducting the demonstration experiment, obtain accurate position information (latitude and longitude data) on the buried magnetic markers and reflect it in the detailed design drawing.
- In FY2019, the magnetic markers were placed and coordinate surveys were completed in sections (3), (4), (5), (6), (7), and (8) as shown below. The coordinate surveys of the remaining sections are scheduled to be carried out in FY2020.



# 5. Maintenance and Management of Infrastructure

- Regularly maintain and manage the infrastructure developed.
- The maintenance and management were carried out according to the plan below.

**Maintenance and Management of  
Infrastructure for Next-generation Public  
Transportation Systems**

**Plan (Draft)**

 **NIPPO**

November 2019

Nippo Corporation

1. Outline of Survey

1.1 Purpose of Survey

This project maintains and manages the infrastructure (magnetic markers, a colored dedicated lane, and temporary bus stops) required for the next-generation public transportation systems (such as buses and small group transportation vehicles) until the end of the demonstration experiment in the demonstration experiment area in the Haneda Airport area (ordinary roads).

1.2 Survey Content

Survey name: Maintenance and management of infrastructure for next-generation public transportation systems  
Survey location: Roads around Tokyo International Airport (see Figure 1)

Contents:

- (1) Maintenance and management of magnetic markers  
Visually check the magnetic markers (once every three months). If necessary, make simple repairs after consultation with the road administrator and others. Receive information on whether the magnetic markers maintain their performance from the vehicles supplier (Advanced Smart Mobility) participating in the experiment. If there are any markers that need to be replaced, discuss how to deal with them with the parties concerned.
- (2) Maintenance and management of dedicated lane  
As the dedicated lane is colored, check the pavement of the lane for any deterioration in color (once every three months). If necessary, make simple repairs after consultation with the implementing entity of the experiment, road administrator, and others.
- (3) Maintenance and management of temporary bus stops  
Visually check the temporary bus stops (once every three months). If necessary, make simple repairs after consultation with the implementing entity of the experiment, road administrator, and others.

2. Survey Report

The survey results will be reported using the attached report sheets (Forms I-1, I-2, I-3, and I-4).

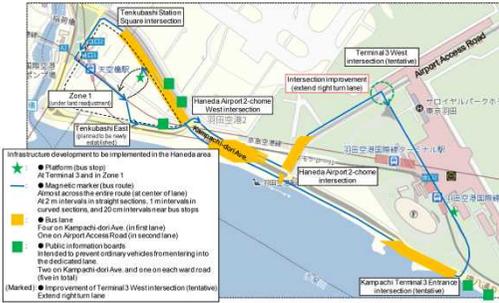


Figure-1 Survey guide map

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## **5.1 Maintenance and Management of Magnetic Markers**

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- Visually check the magnetic markers (once every three months).
- Receive information on whether the markers maintain their performance from the vehicle supplier participating in the experiment. If there are any markers that need to be replaced, discuss how to deal with it with the parties concerned.
- At present, no abnormality is found with the markers that are already placed.

## **5.2 Maintenance and Management of Dedicated Lane**

- As the dedicated lane is colored, check the pavement of the lane for any deterioration in color (once every three months).
- Since the color paving of the dedicated lane was completed in March, visual inspection is scheduled to be carried out in FY2020.

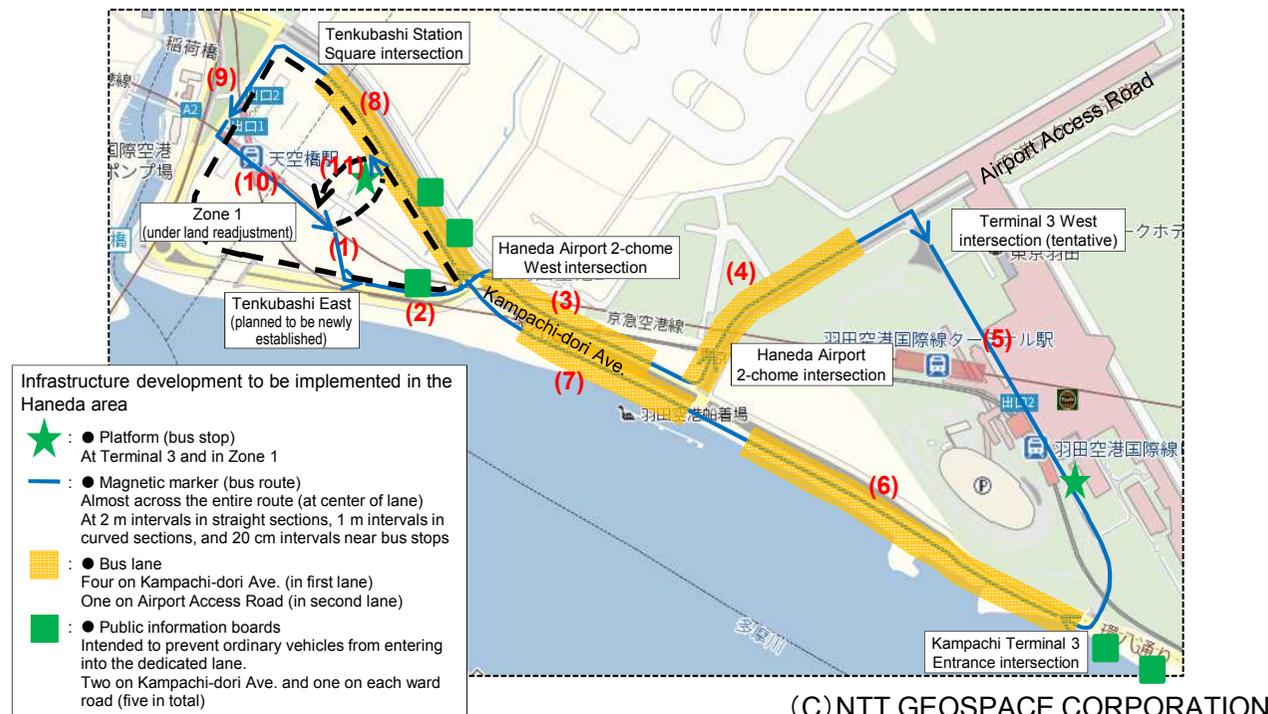
## **5.3 Maintenance and Management of Temporary Bus Stops**

- Visually check the temporary bus stops (once every three months). Since the temporary bus stops were completed in March, visual inspection is scheduled to be carried out in FY2020.

## 6. Withdrawal of Infrastructure Developed

- After the end of the demonstration experiment, the infrastructure developed will be withdrawn to restore the original state.
- The withdrawal is scheduled to be carried out in FY2020 after the end of the Tokyo waterfront area demonstration experiments.

Infrastructure to be withdrawn in FY2020



## 7. Coordination with Stakeholders

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- In preparation to the above-mentioned research and development, coordinate with the traffic administrator, road administrator, and other stakeholders.
- In FY2019, the following matters were coordinated with the stakeholders regarding the infrastructure development.

Item	Matters coordinated
3. 1 Placement of magnetic markers	<ul style="list-style-type: none"> <li>• Detailed design (with experiment participants, road administrator, and traffic administrator)</li> <li>• Construction method (with road administrator, traffic administrator, and Zone 1 developer)</li> </ul>
3. 2 Paving the dedicated lane	<ul style="list-style-type: none"> <li>• Detailed design (with road and traffic administrators)</li> <li>• Detailed design of public information boards (with traffic administrator)</li> <li>• Extension of right turn lane at International Terminal West intersection (with road and traffic administrators)</li> <li>• Construction method (with road and traffic administrators)</li> </ul>
3. 3 Building temporary bus stops	<ul style="list-style-type: none"> <li>• Detailed design (with experiment participants, road administrator, traffic administrator, and Zone 1 developer)</li> <li>• Construction method (with road administrator, traffic administrator, and Zone 1 developer)</li> </ul>