Figure D.1: Subway General Information

The **Makati Subway Project** launched in 2017, is a first of its kind project in the country by a local government.

The subway is an 11-kilometer (6.8 mi) under-construction underground rapid transit line to be located in Makati City, that will link establishments across the city's business district. The project is under a joint venture between the City Government of Makati and a private consortium, led by Philippine Infradev Holdings.

The preparatory work for the subway officially began on December 12, 2018, following a ceremonial drilling ceremony at the front of the Makati City Hall, which is near the site of the proposed Station 5 of the subway. The signing of the memorandum of understanding between the Makati city government and a consortium consisting of Philippine Infradev and Chinese firms Greenland Holdings Group, Jiangsu Provincial Construction Group Co. Ltd., Holdings Ltd. and China Harbour Engineering Company Ltd was also held on the same day. Preparatory work included soil testing and feasibility studies of the proposed locations for the subway line's stations.

On July 2019, soil testing related to the subway was completed as the Philippine Infradev and Makati LGU has signed a joint venture agreement for the project.

Photo: Ceremonial Drilling Ceremony / December 12, 2018

The Makati Subway a 6-car train is assumed to have 225 passengers per car (based on 4 passengers standing/sqm) capacity and is proposed to have the following features:

- Design Capacity of 27,000 pphpd and ultimate capacity of about 40,500 pphpd (passenger per hour per direction) for this subway system
- Design Speed = 80kph
- Rolling stock is assumed to adopt “China Type A” metro
- Direct Current (DC) power supply with acceleration/deceleration of 1m/s2
- Trains are right hand running
- Preferable minimum radius = 300m
- Absolute minimum radius = 250m
- Very difficult situation radius = 225m

Reasons for building a Local Subway

Figure D.2: Mayor Binay showing the Makati Subway Scale Model with JV Partners, Philippine Infradev Holdings, Inc.

Makati as the financial center of the Philippines have a very dense daytime population estimated at 3.2 to 4.2 million, a stark contrast to its 600,000 night time population. In order to upgrade the mobility in the city it is vital that a modern and efficient mass transportation system is in place. In addition, the Makati subway will also:

- Ease existing traffic congestion
- Reduce travel time - Metro Manila commuters and motorists alike spend more than an hour, on average, in traffic every day, placing it the 3rd worst in traffic in Southeast Asia.
- Provide alternative transport mode for public commuters - Due to limited alternative for mass transport system, more and more Filipinos opt to use private cars, which lead to worsening of traffic condition of Metro Manila
- Provide comfortable, convenient and reliable public transport - Generally, public transportation is way behind the private transport in terms of comfort and convenience
- Reduce Air Pollution – According to World Health Organization (WHO) Report in 2018, about 45.3 of 100,000 Filipinos die due to air pollution (the country had the 3rd highest number of deaths due to air pollution) and vehicle emission

contributes 69% to the country's air pollution. By 2048, the subway is expected to reduce 2.3 million tons of carbon dioxide each year

- Boost Economy - the subway's importance to the city begins with a single, durable economic principle: Cities create density, and density creates growth. Economists call the phenomenon agglomeration.

Features of the Proposed Makati Subway

The proposed Makati Subway will be integrated with the Existing MRT Line 3 (Station 1 - Ayala EDSA and Station 6 - Guadalupe Stations) and the proposed Metro Manila Mega Subway (Station 7 - UMak Station) and will is also within distance from the Philippine National Railway Station (PNR) Station 3 - through Makati Fire Station.

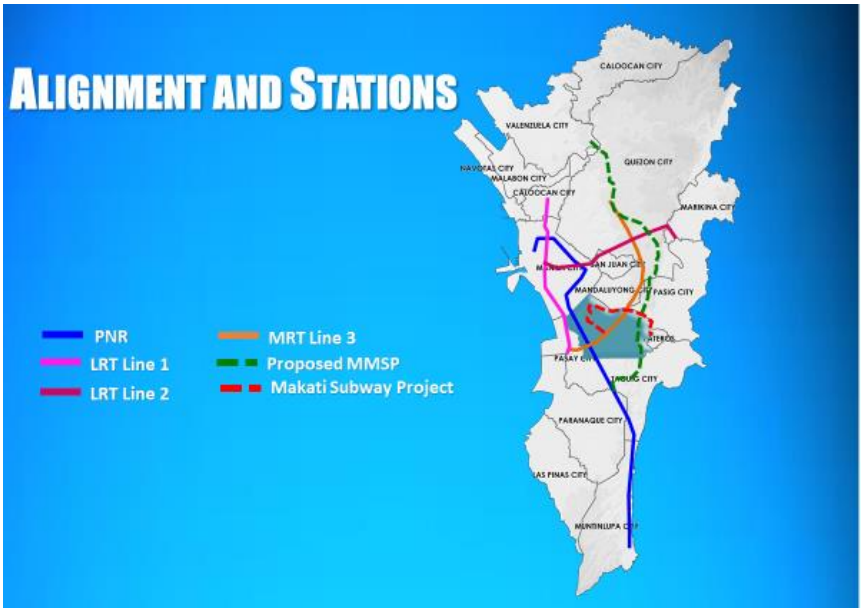

Figure D.3: Proposed Alignment

As of June 2019, 8 out of the 9 proposed stations have been finalized. These are: Station 1: Ayala EDSA; Station 2: Ayala Paseo; Station 3: Makati Fire Station; Station 4: Circuit; Station 5: Makati City Hall; Station 6: Guadalupe; Station 7: University of Makati; Station 8: Buting and Station 9: Comembo.

Figure D.4: Proposed Stations

The two proposed stations along Ayala Avenue are yet to be finalized due to right of way issues. The proponents have stated that they may divert the subway towards the Philippine National Railways Buendia station or the Mile Long property in Legazpi Village instead. In the interim, the first station would be in the current location of the Makati Central Fire Station, which will be demolished, then towards a Lucio Tan owned property near Circuit Makati, and Makati City Hall. The remaining stations would be located near Century City, Makati Bliss Housing in the Guadalupe, BGC-Ortigas Bridge, University of Makati and the final station in the vicinity of Ospital ng Makati.

The Construction

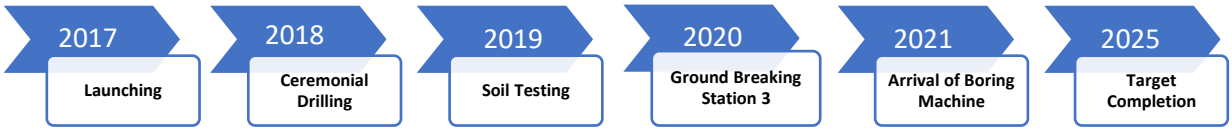

Figure D.5: Subway Timeline

Figure D.6: Mayor Binay with JV Partners, Philippine Infradev Holdings, Inc.

Philippine Infradev Holdings, Inc. received an Environmental Compliance Certificate (ECC) from the Department of Environment and Natural Resources (DENR) and is looking to commence works before the year 2020. If pushed through, the subway may be completed in 2024, a year ahead of schedule.

Despite the pandemic, the year 2020 is significant in the development of the Makati Subway. It is on July 20, 2020 that the Engineering, Procurement, and Construction (EPC) contract was signed and awarded to China Construction Second Engineering Bureau Ltd. (CCSEB) and Shanghai Electric Automation Group for the subway line's construction. Further, on July 23, 2020, the Right-of-Way acquisition has commenced for the project, of which 55 landowners received a total of ₱1,000,000 (US$20,270) as compensation. The affected landowners will receive a total compensation of ₱1.18 billion (US$23.9 million).

On August 18, 2020, groundbreaking for the transit-oriented development of Station 3 took place, where former parking lots used to stand. To recall, Philippine Infradev executed an agreement with China Construction First Group Corp. Ltd. (CCFG) to build the transit-oriented development of Station 3.

Acquisition of properties is also underway in the vicinity of Makati City Hall, as several homes and structures were closed and demolished. The vicinity, also known as Station 5, has been identified as the project's main construction site, where the tunnel boring machine will be assembled and lowered. On October 21, 2020, City Ordinance No.2020-204 was enacted to approve and hasten the Right-of-Way acquisition.

On May 14, 2021, the first of five-tunnel boring machine was received by the Philippine Infradev Chairman Ren Jinhua in Shanghai, China from its manufacturer in a simple ceremony. It will arrive in the country once the Station 5 construction site was demolished and cleared up.

The proposed stations will be designed in a customer-friendly manner and will be modern and simple structures offering an open and bright travelling environment conducive to easy and direct accessibility. The full-height platform screen doors will be installed at the station platforms in respect of passengers' safety and to provide a full air-conditioned environment at the platform. There will be a system of information and direction signage should be well-planned and installed in public areas of the stations. The stations will also be equipped with provisions including station control room, customer service center, real time CCTV, centralized public announcement system, etc.

Fares and Ticketing

The upcoming line will use a distance-based fare structure and will be charged 20% to 25% higher than the fares of Line 1 and Line 3. A 25 percent premium will bring the subway's rate to about ₱38 (75 U.S. cents) for 9 stops.

Fare collection system will be convenient and user-friendly. Ticket gates will be provided to separate the paid and unpaid areas at the Station concourse level.

Both contactless smart card and single-ride magnetic/contactless ticket for multiple and single journeys will be used as the medium to travel. There will be sufficient number of Card Validators, Automatic Ticket Vending Machines.

Proposed Expansion

In the aftermath of the 2019 elections, Antonio Tiu, President of Philippine Infradev has stated that he is open to initiate and enter a similar partnership deal with Makati's neighboring cities for the expansion of the subway system. The cities of Manila, Mandaluyong, San Juan, Pasay, and Pasig were specifically mentioned by Tiu.

With the finalized move of the terminus to the Mile Long property, a 2-hectare complex along Amorsolo street, Tiu has started negotiations with the Calixto siblings, Mayor Emi and Congressman Tony, of Pasay to extend the line up to the Ninoy Aquino International Airport, which is only three kilometers away from Mile Long and is slated for redevelopment

Challenges and Possible Solutions

What will happen to the affected properties?	• The majority of the subway alignment is proposed to run under the corridor of public roads to minimize impacts to the private lands. • The planned subway avoids running underneath the high-rise buildings. • Affected properties will be properly notified. Processes and procedures for the acquisition of affected properties will be in accordance with the law.
How to mitigate the impact to traffic condition of the city?	• TBM Tunelling Method will be employed. The TBM moves forward as it excavates the tunnel by extending the pushing jacks at the back. • For areas affected by the construction of stations, possible rerouting will be done.
Where to get the funds?	• This project is a Joint Venture Project between the City Government of Makati and the IRC Properties Inc. • City Government Roles is to provide the government-owned lots and help facilitate the acquisition of affected private lots, and to provide technical and administrative assistance during the plan and implementation stage.

	• The IRC Properties Inc. will build and operate and maintain the subway
How To Mitigate Hazard?	Included in the technical studies and design of the subway are features that will mitigate various hazards such as flooding and earthquake. For Flooding: The cases of New York City, London and Taiwan were considered • Installation of Water Pumps, • Construction of Flex-Gate, • Resilient Tunnel Plug, • Thames Barrier – a kind of closable river gate that spans 520 metres across the River Thames and protects 125km² of central London tidal surges. It was designed to protect against all but the kind of floods that would likely occur only once in 1,000 years. • Raising entrances and openings; installing flood gates and flood control structures - the goal is to protect against floods that reach 50cm higher than those likely to occur once in 200 years Earthquake The case of Japan and California, India, San Francisco, CA, and Hong Kong were considered • Early earthquake warning system (EEW) • Measures to Shorten Stop Distances • “Seismic Isolation” Technologies • L-Shaped Car Guides • Measures to Prevent Rail Breakage of Glued Insulated Joints • Retrofitting existing facilities for seismic safety • Fluid Viscous Dampers - bridge vibration control. The damping fluid is silicone oil, which is inert, non-flammable, non-toxic, and stable for extremely long periods of time. The fluid viscous damper for structures is similar in action to the shock absorber on an automobile, but operates at a much higher force level. • 10 second warnings enabling the control center to automatically stop all trains travelling at 30mph or less and trains moving faster to slow. (This safety system comes from the 12 earthquake sensors BART has installed as part of the ‘ShakeAlert’ system)

	In light of public concerns regarding the safety of China-made locomotives, the MTRC added that there will be staff “stationed full-time at the factory to quality-assure the manufacturing and assembly processes.” It added that rigorous testing will be conducted, and that trains must be certified by the Electrical and Mechanical Services Department before they enter service. MTRC subsequently conducted tests on its C-trains, and verified that asbestos materials were not used in the Hong Kong builds.