# 12. Study on Downstream River Channel

## 1) Route 1 (Lower Bicutan - South Parañaque River)

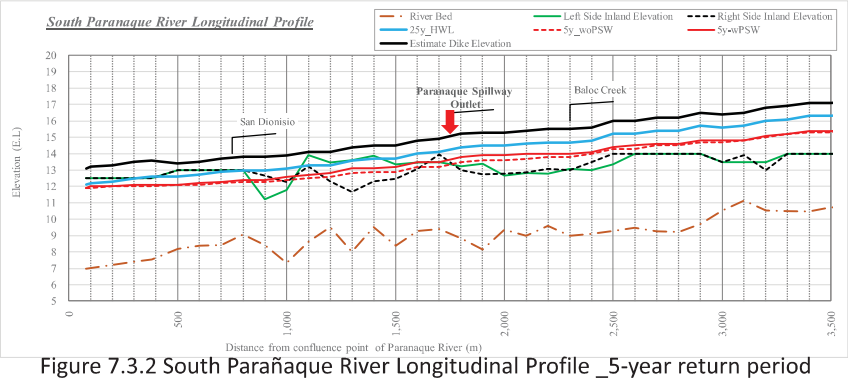



Figure 7.3.2 South Parañaque River Longitudinal Profile _5-year return period

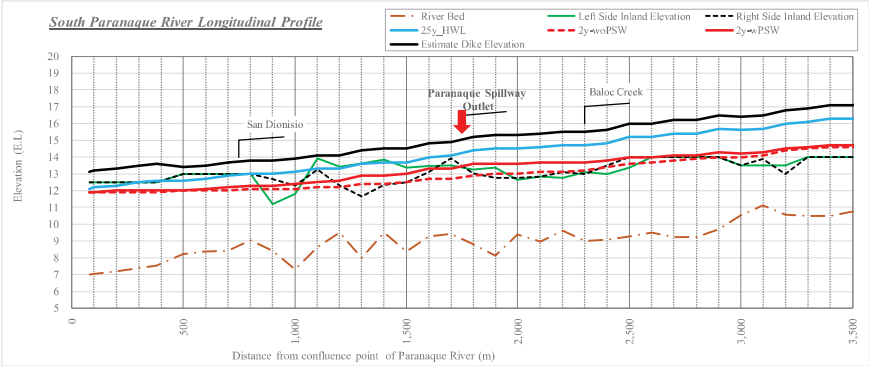
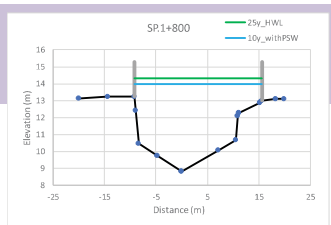



Figure 7.3.3 South Parañaque River Longitudinal Profile _2-year return period

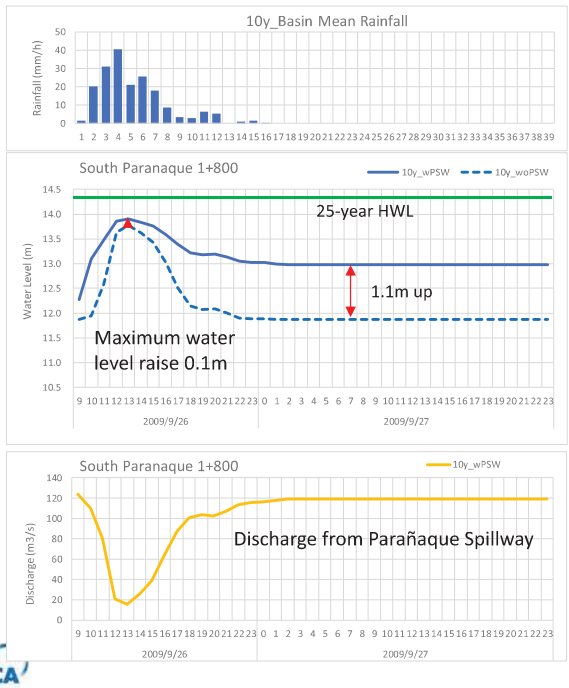


# 12. Study on Downstream River Channel

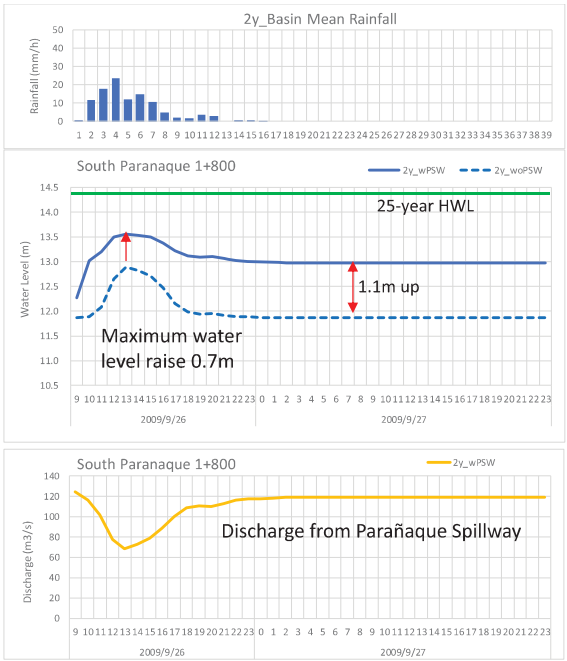



## 1) Route 1 (Lower Bicutan - South Parañaque River)

10-year Return Period




2-year Return Period



# 12. Study on Downstream River Channel

## 2) Route 3 (Sucat - Zapote River)

- The river water level will raise up 0.1 – 0.2 m in each return period. The design scale of Zapote River Basin is 50-year for flood control measures and High Water Level (HWL) of 50-year is 12.1m. The river water level is higher than 50-year HWL more than 25-year return period.
- In more than 25-year return period, there is a section that is over 50-year HWL (maximum 20 cm) due to drainage of Parañaque Spillway but lower than the assumed dike top height (HWL + free-board).

Figure 7.3.4 Drain Facility Location of Route 3 in Zapote River

[Calculation Condition]
Laguna Lake Water Level :14.0m
Tide Level : 11.87m

ZA. 0+100

| Return Period | without Parañaque Spillway | | **with** Parañaque Spillway | | | | Difference WL ①- WL ② |
|---|---|---|---|---|---|---|---|
| | WL① | River Q | WL② | River Q | Outlet Q* Max | Outlet Q* Min | |
| | (m) | ($m^3$/S) | (m) | ($m^3$/S) | ($m^3$/S) | ($m^3$/S) | (m) |
| 100 | 12.2 | 677.6 | 12.3 | 827.8 | 176.1 | 155.1 | 0.1 |
| **50** | 12.1 | 586.0 | 12.3 | 739.8 | 176.1 | 159.0 | 0.2 |
| 25 | 12.0 | 501.8 | 12.2 | 659.2 | 176.2 | 162.8 | 0.2 |
| 15 | 12.0 | 442.5 | 12.1 | 602.5 | 176.2 | 165.3 | 0.1 |
| 10 | 12.0 | 396.4 | 12.1 | 558.4 | 176.2 | 167.1 | 0.1 |
| 5 | 11.9 | 319.0 | 12.0 | 483.8 | 176.2 | 169.9 | 0.1 |
| 2 | 11.9 | 216.1 | 12.0 | 383.7 | 176.2 | 172.8 | 0.1 |

* Drainage discharge of Parañaque Spillway (Outlet Q) was estimated at the level of water level in the case without Parañaque Spillway (present condition). The calculation method of drainage discharge is calculated based on the calculation of (6) in the crossing (section) plan as shown in 4.3.3.



# 12. Study on Downstream River Channel

## 2) Route 3 (Sucat - Zapote River)

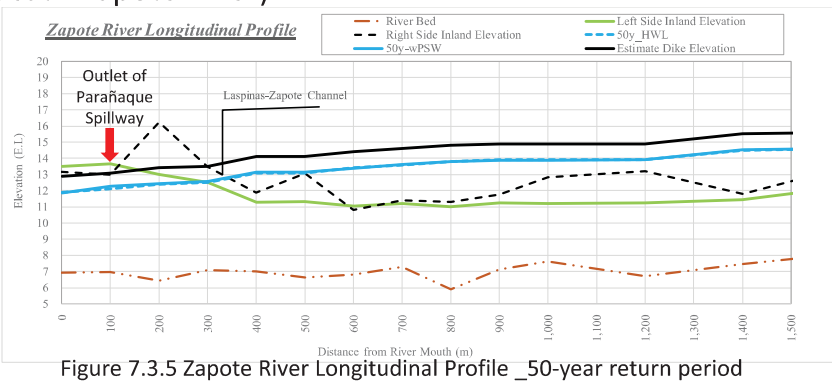



Figure 7.3.5 Zapote River Longitudinal Profile _50-year return period

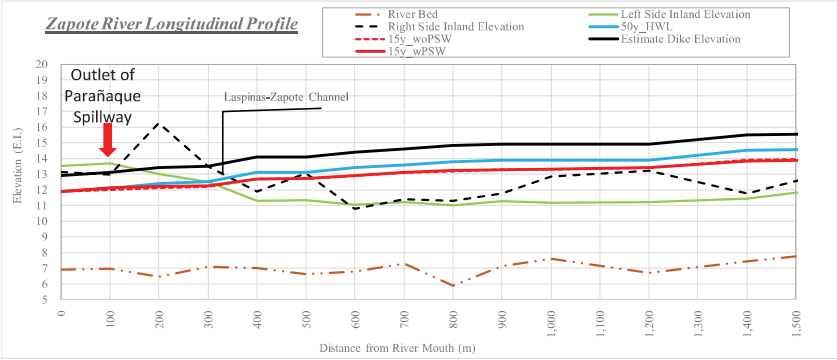
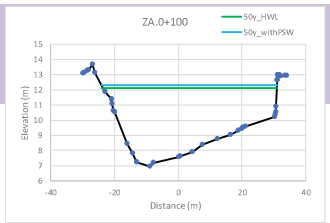


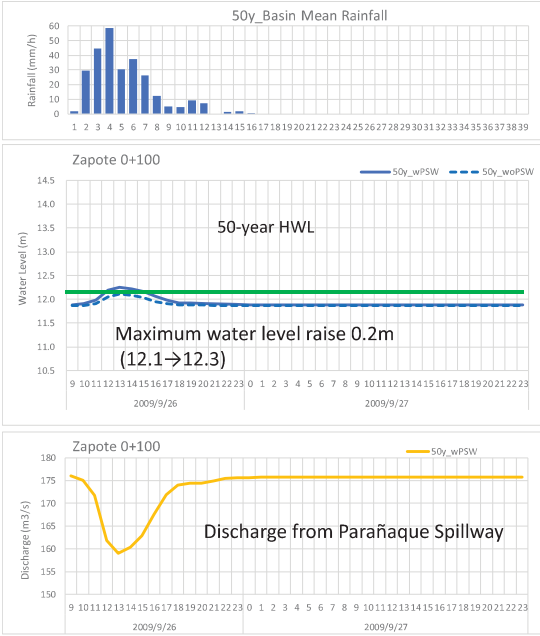

Figure 7.3.6 Zapote River Longitudinal Profile _15-year return period

# 12. Study on Downstream River Channel

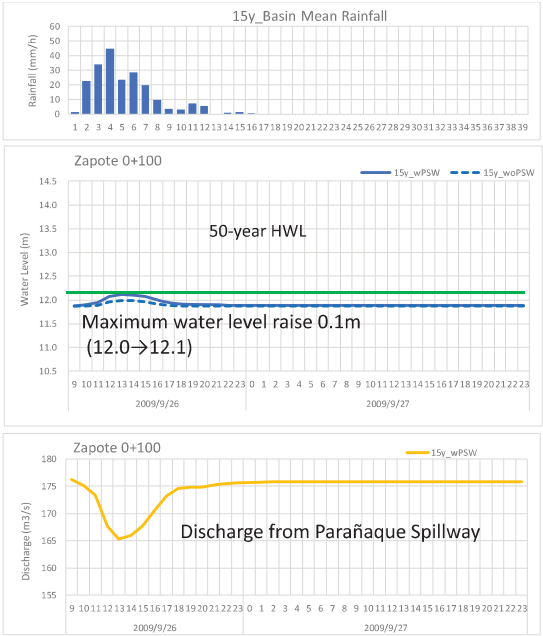



## 2) Route 3 (Sucat - Zapote River)

50-year Return Period




15-year Return Period



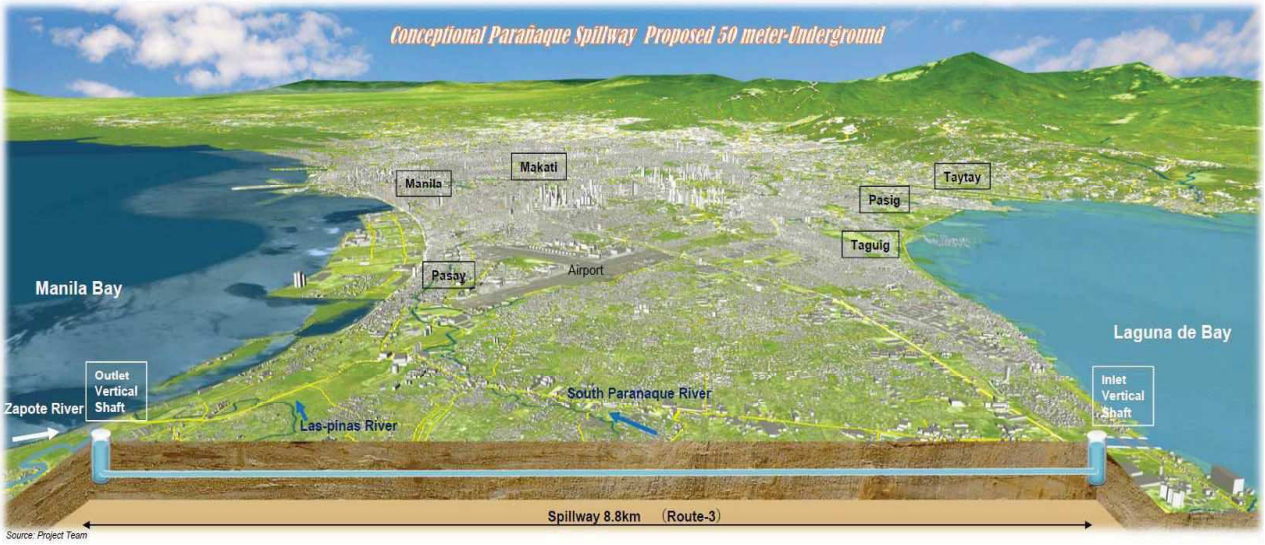



# 12. Study on Downstream River Channel

## 3) Evaluation on the influence on downstream river channel (summary)

| Route | Location of Drainage facilities | Influence of Downstream River Channel |
|---|---|---|
| 1 (Lower Bicutan - South Parañaque River) | South Parañaque River (SP. 1+800) | ● If probable scale exceeds 10 year, the water level at South Parañaque River, which is the drainage destination, exceeds design lake level (14.0 m), so there is a time when it can not drain from Parañaque Spillway.<br>● Design scale of South Parañaque is 25 years based on basin area. If river improvement (embankment) becomes possible, influence due to drainage of Parañaque Spillway is little in the cross section after river improvement.<br>● However, since the section where river water level rises greatly affects the upstream and downstream of outlet point due to Parañaque Spillway, river improvement including not only South Parañaque river but also the upstream tributaries is essential. |
| 3 (Sucat - Zapote River) | Zapote River (ZA. 0+100) | ● At the time of flood, river water level of Zapote River will not exceed design lake level (14.0 m), there is no time when drainage from Parañaque Spillway can not be done.<br>● In more than 25-year return period, there is a section that is over 50-year HWL (maximum 20 cm) due to drainage of Parañaque Spillway but lower than the assumed dike top height (HWL + free-board).<br>● Influence of Parañaque Spillway drainage is not limited to Zapote River. It also affects surrounding rivers / channel because Zapote River is connected to Las Piñas River near estuary via channel and Las Piñas River is also connected to South Parañaque River by San Dionisio River. |

# Thank you so much for your Attention !!



Republic of the Philippines
Department of Public Works and Highways
Manila

**Title/Description: FOURTH STEERING COMMITTEE MEETING FOR THE DATA COLLECTION SURVEY ON PARAÑAQUE SPILLWAY IN METRO MANILA**

**Minutes of Meeting**

| **Date:** | **Started** | **Adjourned** | **Venue** |
|---|---|---|---|
| April 4, 2018 | 1:30 P.M. | 4:00 P.M. | Operations Room, 2nd floor, DPWH Central Office, Port Area, Manila |

| **Attendees:** | **Topics:** |
|---|---|
| Please see attached marked "**ANNEX 1**" | 1. Schedule<br>2. Results of Pre-Feasibility Study |

| Topic | Session Highlights and Discussion | Person Responsible |
|---|---|---|
| | The Meeting was chaired by Director Patrick Gatan of UPMO Operations, DPWH. The results of the study were explained by Mr. Takahiro Mishina, Leader of the JICA Survey and discussions were made. The principal items discussed and/or concluded in the Meeting are summarized below: | |
| 1. Call to Order | • Director Gatan called the meeting into order at 1:50 P.M and acknowledged the presence of the members/representatives of the Steering Committee.<br>• After the acknowledgement, Director Gatan requested the JICA Consultant to present the updates/status of the Survey.<br>• Mr. Mishina presented the results of the Pre-Feasibility Study for the Parañaque Spillway. | |
| 2. Results of the Pre-Feasibility Study | • Dir. Gatan opened the floor for any clarification on the results of the Pre-Feasibility Study, started by asking Mr. Mishina on the duration for a 14m water level at Laguna de Bay to lower with the construction of the Parañaque Spillway. | JICA Study Team |

| | | |
|---|---|---|
| | • Mr. Mishina replied that in the brochure prepared for the meeting, the number of days for the water level to reach to its normal elevation will be reduced by half based on the recorded level on the 2009 data, as reference.<br>• He stated that during typhoon Ondoy, it took 105 days for flood water to subside, however, with the Parañaque Spillway, their calculation is it will take 45 days for flood water to recede. | |
| 3. Operation and Maintenance | • Ms. Lennie Santos of LLDA and Dir. Gatan inquired about the rule curve to be followed at the inlet and outlet. Her concern is that complaints from the residents triggered when water level reaches the 12.5 m, she further asked the operation of the spillway at elevation 13 m and 12 m.<br>• Mr. Mishina replied that rule curve of the spillway is 12 m, however, it can be operated even before the water level reaches 12 m depending on the conditions observed by the spillway operators.<br>• Ms. Santos suggested that the Study Team should recommend the agency with specific mandates to be responsible for the operation of the spillway, as it is the first tunneling project of the country.<br>• Mr. Mishina recommended that it should be the Department of Public Works and Highways (DPWH). | JICA Study Team, Ms. Lennie Santos |
| 4. Environmental Issues | • PM Hipolito clarified three issues/concerns:<br>o The water quality parameters used in the simulation for the Pre-Feasibility Study as the existing water quality data are for period of non-disasters. She noted that during typhoons and flooding, the water quality is worst given the run-offs of flood water contains different kinds of pollutants. She recommended that further study should done to determine the water quality during typhoons and flooding.<br>o For the sediments to be removed after every operation of the spillway, PM Hipolito further asked if the study team used the Japanese standard as there are more wastes than sediments in flood water in Metro Manila including the cost of management of solid | PM Dolores M. Hipolito, Ms. Lennie Santos and Engr. Alexander Mohammad |

| | | |
|---|---|---|
| | wastes in the O&M costs and design of the spillway pump station.<br>o PM Hipolito asked the opinion of Mr. Mishina on the recommendation of pursuing the project given that the EIRR of the Parañaque Spillway is less than the minimum of 10.<br>• Mr. Mishina confirmed that they did considered all parameters since there are more solid wastes in flood water and this is the reason why the cost of the project is quite high.<br>• Mr. Mishina explained that Parañaque Spillway should not be considered as a stand alone project but as the third and last component of improving the flood management system for the whole Metro Manila as was the objective of the 1975 Comprehensive Master Plan. The River Improvement Project of DPWH which includes the Pasig-Marikina and Marikina Dam needs the Parañaque Spillway to complete the system of managing flood waters.<br>• Ms Santos recommended that water quality monitoring equipment should be included/installed at the outlet of the spillway in order to ensure that pollutants will not affect the protected area particularly in the LLAPCHEA.<br>• Engr. Alexander Mohammad, MMDA representative inquired if the spillway will be different from the drainage pipes as this might cause possible leaks.<br>• Ms. Hipolito clarified that it is separate and will not be in anyway be contaminated by drainage and septic wastes. | |

| **Review and Confirmation:** | | |
|---|---|---|
| Prepared by: | Approved by: | Noted: |
| 三嶋孝浄<br>**TAKAHIRO MISHINA** | **PATRICK B. GATAN, CESO III** | **EMIL K. SADAIN, CESO I** |
| Project Team Leader<br>JICA Survey Team | Project Director<br>UPMO – FCMC | Undersecretary<br>for UPMO Operations and<br>Technical Services |
| Position | Position | Position |

**ANNEX 1 ATTENDANCE SHEET**

| Date: | Started: | Adjourned: | Venue: |
|---|---|---|---|
| April 4,2018 | 1:30 PM | 4:00 PM | 2nd Floor Operations Room, Office of the Secretary, DPWH Head Office, Bonifacio Drive ,Port Area Manila |

**ATTENDANCE SHEET**

| Name | Office | Contact Number | Signature |
|---|---|---|---|
| 1.Dir. Patrick B. Gatan | Chairperson – UPMO -FCMC | | |
| 2.Joseph I Acebuche | LGU – Las Piñas | | |
| 3.Michael Aguilar | LGU- Las Piñas | | |
| 4.Donna Marie A. Manansala | LGU- Parañaque | | |
| 5.Bernardo Amurao | LGU- Parañaque | | |
| 6.Shello B. De Leon | LGU- Parañaque | | |
| 7. Detherina M. Basilio | DILG-NCR | | |
| 8.Maria Lourdes L. Agustin | DILG-NCR | | |
| 9. Jocelyn G. Sta. Ana | LLDA | | |
| 10.Joceilyn F. Siapao | LLDA | | |
| 11.Lennie Santos Borjz | LLDA | | |
| 12.Yolando D. Fiel | MMDA | | |
| 13.Alexander Mohammad | MMDA-FCSMO | | |
| 14.Jonathan T. Gomez | MMDA-EFCOS | | |
| 15.Jan Edmond Sabater | MMDA-EFCOS | | |
| 16.Angeline Agunno | NEDA | | |
| 17.Lara Hidalgo | NEDA | | |
| 18.Rhommel Grutas | PHILVOCS | | |

| | | | |
|---|---|---|---|
| 19.Cathy Palanca | JICA | | |
| 20.Kimiko Hayashi | JICA | | |
| 21.Ayummi Oshima | JICA | | |
| 22.Jonathan Bacor | DPWH-R IV-A | | |
| 23.Tiburcio L. Canlas | DPWH-NCR | | |
| 24.Arie Peñaranda | DPWH-PPD | | |
| 25.Yvette Kirsten Rivera | DPWH-PPD | | |
| 26.Dolores M.Hipolito | DPWH-FCMC | | |
| 27.Leonila R. Mercado | DPWH-FCMC-UPMO | | |
| 28.Jesse C. Felizardo | DPWH-FCMC-UPMO | | |
| 29.Michael T. Alpasan | DPWH-FCMC-UPMO | | |
| 30.Mark Zaplan | DPWH-FCMC-UPMO | | |
| 31.Cathirine Kay Roque | DPWH-BOD | | |
| 32.Mark Gerson P. Baril | DPWH-BOD | | |
| 33.Takahiro Mishina | JICA Survey Team/Team Leader | | |
| 34.Geraldine Santos | JICA Survey Team | | |
| 35.Riza S. Nanas | JICA Survey Team | | |
| 36.Eliazar Rupido | JICA Survey Team | | |
| 37.Leonida Prudente | JICA Survey Team | | |
| 38. | | | |
| 39. | | | |
| 40. | | | |
| 41. | | | |

# APPENDIX 2

Compensation Coast for Land Acquisition and Affected Buildings

Table 2-1 Calculation Result of Compensation Cost Necessary for Land Acquisition and Affected Buildings for Dike Construction

| Location | | a. Phase / Priority | b. Length of Lakeshore Dike (m) | c. Areas by land use within lakeside of Lakeshore Dike (ha) | | | | | d. Zonal Value (Php./m2) | | e. Cost for Land Acquisition (million Php.) | | | f. No. of Buildings/ Unit Area (No./ha) | | | | | g. No. of Buildings (Nos.) | h. Unit Cost of Residential Building (Php.) | i. Replacement Cost for Residential Buildings (million Php.) | j. Total (e4+i) (million Php.) | k. Project Affected People (PAPs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Province | City / Municipality | | | c1. Built-up | c2. Agricultural | c3. Fishpond | c4. Others | c5. Total | d1. RR | d2. A | e1. Residential Area | e2. Agricultural Area | e4. Total | f1. (No./ 2,500 m2) | f2. (No./ 2,500 m2) | f3. (No./ 2,500 m2) | f4. Ave. (No./ 2,500m2) | f5. Ave. (No./ha) | | | | | k1. Average Family Size | k2. PAPs (Nos.) |
| Rizal | Angono | I | 3,310 | 0.8 | 3.8 | 0.0 | 320.6 | 325.2 | 901 | 358 | 7 | 14 | 21 | 35 | 19 | 36 | 30.0 | 120 | 92 | 156,344 | 14 | 35 | 4.5 | 415 |
| Rizal | Taytay | I | 1,350 | 0.0 | 31.9 | 0.0 | 51.9 | 83.9 | 1,011 | 150 | 0 | 48 | 48 | 35 | 19 | 36 | 30.0 | 120 | 0 | 156,344 | 0 | 48 | 4.3 | 0 |
| NCR | Taguig | I | 2,490 | 0.0 | 0.0 | 0.0 | 27.0 | 27.0 | 6,790 | 3,500 | 0 | 0 | 0 | 9 | 49 | 47 | 35.0 | 140 | 0 | 436,735 | 0 | 0 | 4.1 | 0 |
| NCR | Muntinlupa | I | 9,870 | 0.5 | 0.0 | 0.0 | 27.0 | 27.5 | 11,221 | | 60 | 0 | 60 | 9 | 49 | 47 | 35.0 | 140 | 75 | 436,735 | 33 | 93 | 4.1 | 309 |
| Sub-total | | | 17,020 | 1.3 | 35.7 | 0.0 | 426.5 | 463.6 | | | 67 | 61 | 129 | | | | | | 168 | | 47 | 176 | | 725 |
| Laguna | San Pedro | II | 4,080 | 0.2 | 0.0 | 0.0 | 26.6 | 26.8 | 1,792 | 600 | 3 | 0 | 3 | 25 | 51 | 37 | 37.7 | 151 | 25 | 216,573 | 5 | 8 | 4.5 | 112 |
| Laguna | Binan | II | 4,660 | 1.6 | 1.2 | 0.0 | 37.9 | 40.8 | 1,459 | 270 | 24 | 3 | 27 | 25 | 51 | 37 | 37.7 | 151 | 249 | 216,573 | 54 | 81 | 3.8 | 944 |
| Laguna | Santa Rosa | II | 5,780 | 1.7 | 0.0 | 0.0 | 26.4 | 28.0 | 2,793 | 545 | 47 | 0 | 47 | 25 | 51 | 37 | 37.7 | 151 | 254 | 216,573 | 55 | 102 | 3.5 | 889 |
| Laguna | Cabuyao | II | 8,390 | 1.1 | 0.0 | 0.0 | 84.0 | 85.1 | 1838 | 159 | 19 | 0 | 19 | 43 | 29 | 25 | 32.3 | 129 | 137 | 216,573 | 30 | 49 | 3.8 | 520 |
| Laguna | Calamba | II | 9,920 | 1.4 | 10.8 | 0.0 | 36.6 | 48.8 | 2,285 | 416 | 32 | 45 | 77 | 43 | 29 | 25 | 32.3 | 129 | 180 | 216,573 | 39 | 116 | 3.7 | 667 |
| Sub-total | | | 32,830 | 6.0 | 12.0 | 0.0 | 211.5 | 229.5 | | | 125 | 48 | 174 | | | | | | 845 | | 183 | 357 | | 3,134 |
| Laguna | Los Banos | III | 8,240 | 3.3 | 2.8 | 0.0 | 11.1 | 17.2 | 1,809 | 340 | 60 | 10 | 69 | 43 | 29 | 25 | 32.3 | 129 | 426 | 216,573 | 92 | 162 | 3.9 | 1,661 |
| Laguna | Bay | III | 3,780 | 1.9 | 17.8 | 0.0 | 9.0 | 28.6 | 808 | 223 | 15 | 40 | 55 | 28 | 17 | 13 | 19.3 | 77 | 144 | 216,573 | 31 | 86 | 4.1 | 592 |
| Laguna | Calauan | III | 840 | 0.0 | 15.0 | 0.0 | 1.8 | 16.8 | 535 | 35 | 0 | 5 | 5 | 28 | 17 | 13 | 19.3 | 77 | 0 | 216,573 | 0 | 5 | 4.6 | 0 |
| Laguna | Victoria | III | 6,470 | 0.4 | 33.2 | 0.0 | 28.4 | 61.9 | 839 | 304 | 3 | 101 | 104 | 28 | 17 | 13 | 19.3 | 77 | 29 | 216,573 | 6 | 110 | 3.6 | 104 |
| Laguna | Pila | III | 4,750 | 0.7 | 24.7 | 0.0 | 31.6 | 56.9 | 682 | 213 | 5 | 52 | 57 | 28 | 17 | 13 | 19.3 | 77 | 53 | 216,573 | 11 | 68 | 4.4 | 232 |
| Laguna | Santa Cruz | III | 8,820 | 2.2 | 124.5 | 0.0 | 96.8 | 223.5 | 2,169 | 383 | 47 | 477 | 524 | 28 | 17 | 13 | 19.3 | 77 | 167 | 216,573 | 36 | 561 | 4.2 | 703 |
| Sub-total | | | 32,900 | 8.4 | 217.9 | 0.0 | 178.6 | 405.0 | | | 129 | 685 | 815 | | | | | | 819 | | 177 | 992 | | 3,293 |
| Total for Priority Area (I+II+III) | | | 82,750 | 15.6 | 265.7 | 0.0 | 816.7 | 1,098.0 | | | 322 | 795 | 1,117 | | | | | | 1,832 | | 408 | 1,525 | | 7,151 |
| Laguna | Pagsanjan | | 1,160 | 0.0 | 13.8 | 0.0 | 0.0 | 13.8 | 382 | 251 | 0 | 35 | 35 | 18 | 18 | 21 | 19.0 | 76 | 0 | 216,573 | 0 | 35 | 4.3 | 0 |
| Laguna | Lumban | | 8,900 | 0.1 | 523.9 | 0.0 | 402.4 | 926.4 | 699 | 35 | 1 | 185 | 185 | 18 | 18 | 21 | 19.0 | 76 | 8 | 216,573 | 2 | 187 | 4.2 | 33 |
| Laguna | Kalayaan | | 3,840 | 0.4 | 56.3 | 0.0 | 9.1 | 65.8 | 647 | 33 | 3 | 19 | 21 | 18 | 18 | 21 | 19.0 | 76 | 33 | 216,573 | 7 | 29 | 4.5 | 150 |
| Laguna | Paete | | 2,730 | 0.0 | 49.9 | 0.0 | 11.2 | 61.0 | 375 | 68 | 0 | 34 | 34 | 18 | 18 | 21 | 19.0 | 76 | 0 | 216,573 | 0 | 34 | 4.5 | 0 |
| Laguna | Pakil | | 6,300 | 0.5 | 91.0 | 0.0 | 21.1 | 112.6 | 245 | 18 | 1 | 17 | 18 | 18 | 18 | 21 | 19.0 | 76 | 35 | 216,573 | 8 | 25 | 4.5 | 158 |
| Laguna | Pangil | | 4,260 | 0.5 | 135.0 | 0.0 | 14.2 | 149.7 | 252 | 48 | 1 | 65 | 67 | 18 | 18 | 21 | 19.0 | 76 | 42 | 216,573 | 9 | 76 | 4.4 | 183 |
| Laguna | Siniloan | | 1,590 | 0.0 | 55.2 | 0.0 | 7.2 | 62.3 | 495 | 0 | 0 | 0 | 0 | 18 | 18 | 21 | 19.0 | 76 | 0 | 216,573 | 0 | 0 | 4.5 | 0 |
| Laguna | Famy | | 600 | 0.0 | 20.6 | 0.0 | 6.6 | 27.3 | 240 | 10 | 0 | 2 | 2 | 18 | 18 | 21 | 19.0 | 76 | 0 | 216,573 | 0 | 2 | 4.0 | 0 |
| Laguna | Mabitac | | 4,960 | 0.1 | 163.4 | 0.0 | 7.8 | 171.3 | 217 | 26 | 0 | 42 | 43 | 18 | 18 | 21 | 19.0 | 76 | 6 | 216,573 | 1 | 44 | 4.5 | 28 |
| Rizal | Jala-jala | | 23,310 | 2.8 | 29.1 | 0.2 | 91.0 | 123.1 | 505 | 123 | 14 | 36 | 50 | 18 | 18 | 21 | 19.0 | 76 | 215 | 216,573 | 46 | 97 | 4.7 | 1,009 |
| Rizal | Pililla | | 17,320 | 4.2 | 131.3 | 0.0 | 15.0 | 150.5 | 852 | 132 | 36 | 173 | 209 | 18 | 18 | 21 | 19.0 | 76 | 321 | 156,344 | 50 | 259 | 4.4 | 1,412 |
| Rizal | Tanay | | 4,530 | 1.2 | 41.3 | 0.0 | 28.5 | 71.1 | 1,644 | 125 | 20 | 52 | 72 | 18 | 18 | 21 | 19.0 | 76 | 94 | 156,344 | 15 | 87 | 4.6 | 433 |
| Rizal | Baras | | 3,290 | 0.2 | 115.6 | 0.0 | 13.1 | 129.0 | 866 | 163 | 2 | 188 | 190 | 18 | 18 | 21 | 19.0 | 76 | 19 | 156,344 | 3 | 193 | 4.1 | 76 |
| Rizal | Morong | | 5,670 | 0.2 | 245.1 | 0.0 | 35.0 | 280.4 | 1,394 | 135 | 3 | 331 | 334 | 18 | 18 | 21 | 19.0 | 76 | 16 | 156,344 | 3 | 337 | 4.4 | 73 |
| Rizal | Cardona | | 13,110 | 1.4 | 1.9 | 0.0 | 112.0 | 115.2 | 649 | 113 | 9 | 2 | 11 | 18 | 18 | 21 | 19.0 | 76 | 103 | 156,344 | 16 | 27 | 4.0 | 413 |
| Rizal | Binangonan | | 19,110 | 16.9 | 49.8 | 0.0 | 361.4 | 428.1 | 1,386 | 226 | 234 | 112 | 346 | 35 | 19 | 36 | 30.0 | 120 | 2,024 | 156,344 | 316 | 663 | 4.0 | 8,096 |
| Sub-total | | | 120,680 | 28.6 | 1723.2 | 0.2 | 1135.5 | 2,887.5 | | | 325 | 1,292 | 1,617 | | | | | | 2,916 | | 476 | 2,093 | | 12,064 |
| **Grand Total** | | | **203,430** | **44.3** | **1988.9** | **0.2** | **1952.2** | **3,985.5** | | | **647** | **2,087** | **2,734** | | | | | | **4,748** | | **884** | **3,618** | | **19,216** |

Note)
a. Development Phase proposed by JICA Survey Team.
b. Length of the Proposed Lakeshore Dike delineated on Google Earth.
c. Area calculated on GIS. Classification of land use compiled by Department of Agriculture is used with adjustment. c4. others (non-productive land use) includes grass land, bush, forests, etc.
d. Calculation of land price by land use in each LGU based on the Zonal Value provided by BIR (Bureau of Internal Revenue)
e. Calculation is done as follows: e1=c1 x d1, e2=(c2+c3) x d2, e4=e1+e2
f. Estimation is done as follows: 1) Set a square with a size of 50m by 50m (unit area) on representative location (3 sites in each area). 2) Calculate the no. of buildings in each square. 3) Average the three sets of data and convert it to no./ha as an average value.
g. Number of affected buildings located within the lakeside area of the proposed Lakeshore Dike. g=c1 x f4
h. Use the data of average cost (median) for construction of residential building (house) listed in a statistical book.
i. Replacement cost for affected buildings. i=g x h
j. j=e4+i
k. Calculation of Project Affected Persons (PAPs), k1 is average family size based on a statistical book. K2=g x k1.

Table 2-2 Calculation Result of Compensation Cost Necessary for River Channel Improvement

| Location | | River Name | a. Phase / Priority | b. Improvement Length | c. Width of River Improvement (m) | | | d. Area of Land Acquisition (ha) | e. Average Zonal Value (Php./m2) | f. Cost for Land Acquisition (million Php.) | g. Household Density by LGU | | | h. No. of Buildings in Land Acquisition Area (No.) | i. Unit Cost of Residential Building (Php.) | j. Replacement Cost for Residential Buildings (million Php.) | k. Total (f +j) (million Php.) | l. Project Affected People (PAPs) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Province | City / Municipality | | | upto 15.0m | c1. average improvement width | c2. existing river width | c3. c1 - c2 | | | | g1. No. of Households (No.) | g2. Area of LGUs (ha) | g3. Household Density (No./ha) | | | | | l1. Average Family Size | ls. PAPs (No.) |
| Rizal | Angono | Angono River | I | 1,170 | 36 | 13 | 23 | 2.69 | 1,146 | 31 | 25,325 | 2,622 | 9.7 | 26 | 156,344 | 4 | 35 | 4.5 | 117 |
| Rizal | Taytay | | I | 0 | | | | | | | | | | | | | 0 | | 0 |
| NCR | Taguig | Magdaong River | I | 390 | 23 | 10 | 13 | 0.51 | 73,731 | 374 | 198,256 | 4,521 | 43.9 | 22 | 436,735 | 10 | 384 | 4.1 | 91 |
| NCR | Muntinlupa | Alabang River | I | 1,630 | 32 | 17 | 15 | 2.45 | 32,206 | 787 | 122,286 | 3,975 | 30.8 | 75 | 436,735 | 33 | 820 | 4.1 | 308 |
| | | Bayanan Creek | I | 690 | 30 | 10 | 20 | 1.38 | 32,206 | 444 | 122,286 | 3,975 | 30.8 | 42 | 436,735 | 19 | 463 | 4.1 | 174 |
| | | Poblacion River | I | 400 | 30 | 10 | 20 | 0.80 | 32,206 | 258 | 122,286 | 3,975 | 30.8 | 25 | 436,735 | 11 | 268 | 4.1 | 101 |
| | | Magdaong River | I | 630 | 27 | 12 | 15 | 0.95 | 32,206 | 304 | 122,286 | 3,975 | 30.8 | 29 | 436,735 | 13 | 317 | 4.1 | 119 |
| | | SB-23-5 | I | 850 | 30 | 20 | 10 | 0.85 | 32,206 | 274 | 122,286 | 3,975 | 30.8 | 26 | 436,735 | 11 | 285 | 4.1 | 107 |
| | | SB-23-6 | I | 520 | 25 | 15 | 10 | 0.52 | 32,206 | 167 | 122,286 | 3,975 | 30.8 | 16 | 436,735 | 7 | 174 | 4.1 | 66 |
| Sub-total | | | | 6,280 | | | | 10.14 | | 2,640 | | | | 262 | | 107 | 2,747 | | 1,083 |
| Laguna | San Pedro | San Isidro River | II | 1,340 | 41 | 16 | 25 | 3.35 | 1,706 | 57 | 73,030 | 2,405 | 30.4 | 102 | 216,573 | 22 | 79 | 4.5 | 458 |
| | | Tunasan River | II | 790 | 32 | 10 | 22 | 1.74 | 1,706 | 30 | 73,030 | 2,405 | 30.4 | 53 | 216,573 | 11 | 41 | 4.5 | 237 |
| Laguna | Binan | SB-20-4 | II | 770 | 39 | 15 | 24 | 1.85 | 2,452 | 45 | 86,752 | 4,350 | 19.9 | 37 | 216,573 | 8 | 53 | 3.8 | 140 |
| | | Binan River | II | 2,890 | 52 | 30 | 22 | 6.36 | 2,452 | 156 | 86,752 | 4,350 | 19.9 | 127 | 216,573 | 27 | 183 | 3.8 | 482 |
| Laguna | Santa Rosa | Sta. Rosa River | II | 810 | 50 | 18 | 32 | 2.59 | 3,153 | 82 | 101,385 | 5,484 | 18.5 | 48 | 216,573 | 10 | 92 | 3.5 | 168 |
| | | SB-20-2 | II | 1,240 | 41 | 26 | 15 | 1.86 | 3,153 | 59 | 101,385 | 5,484 | 18.5 | 34 | 216,573 | 7 | 66 | 3.5 | 120 |
| | | SB-20-3 | II | 1,010 | 51 | 30 | 21 | 2.12 | 3,153 | 67 | 101,385 | 5,484 | 18.5 | 39 | 216,573 | 8 | 75 | 3.5 | 137 |
| Laguna | Cabuyao | | II | 0 | | | | | | | | | | | | | 0 | | 0 |
| Laguna | Calamba | San Juan River | II | 1,500 | 82 | 60 | 22 | 3.30 | 3,165 | 104 | 123,071 | 14,950 | 8.2 | 27 | 216,573 | 6 | 110 | 3.7 | 101 |
| | | San Cristobal River | II | 1,450 | 71 | 50 | 21 | 3.05 | 3,165 | 96 | 123,071 | 14,950 | 8.2 | 25 | 216,573 | 5 | 102 | 3.7 | 93 |
| | | SB-17-6 | II | 710 | 27 | 13 | 14 | 0.99 | 3,165 | 31 | 123,071 | 14,950 | 8.2 | 8 | 216,573 | 2 | 33 | 3.7 | 30 |
| | | SB-17-7 | II | 750 | 37 | 15 | 22 | 1.65 | 3,165 | 52 | 123,071 | 14,950 | 8.2 | 14 | 216,573 | 3 | 55 | 3.7 | 50 |
| | | SB-17-8 | II | 1,410 | 47 | 15 | 32 | 4.51 | 3,165 | 143 | 123,071 | 14,950 | 8.2 | 37 | 216,573 | 8 | 151 | 3.7 | 137 |
| Sub-total | | | | 14,670 | | | | 33.37 | | 923 | | | | 551 | | 119 | 1,042 | | 2,154 |
| Laguna | Los Banos | Los Banos River | III | 2,100 | 51 | 20 | 31 | 6.51 | 2,171 | 141 | 29,020 | 5,422 | 5.4 | 35 | 216,573 | 8 | 149 | 3.9 | 136 |
| | | SB-17-3 | III | 450 | 24 | 10 | 14 | 0.63 | 2,171 | 14 | 29,020 | 5,422 | 5.4 | 3 | 216,573 | 1 | 14 | 3.9 | 13 |
| | | SB-17-4 | III | 430 | 33 | 10 | 23 | 0.99 | 2,171 | 21 | 29,020 | 5,422 | 5.4 | 5 | 216,573 | 1 | 23 | 3.9 | 21 |
| | | SB-17-5 | III | 1,550 | 33 | 20 | 13 | 2.02 | 2,171 | 44 | 29,020 | 5,422 | 5.4 | 11 | 216,573 | 2 | 46 | 3.9 | 42 |
| Laguna | Bay | Colo River | III | 1,070 | 32 | 25 | 7 | 0.75 | 859 | 6 | 15,149 | 4,266 | 3.6 | 3 | 216,573 | 1 | 7 | 4.1 | 11 |
| Laguna | Calauan | Calauan | III | 1,970 | 61 | 23 | 38 | 7.49 | 373 | 28 | 17,669 | 6,540 | 2.7 | 20 | 216,573 | 4 | 32 | 4.6 | 93 |
| | | SB-16-2 | III | 5,270 | 65 | 10 | 55 | 28.99 | 373 | 108 | 17,669 | 6,540 | 2.7 | 78 | 216,573 | 17 | 125 | 4.6 | 360 |
| Laguna | Victoria | Pila | III | 2,410 | 51 | 14 | 37 | 8.92 | 858 | 77 | 10,822 | 2,235 | 4.8 | 43 | 216,573 | 9 | 86 | 3.6 | 155 |
| Laguna | Pila | SB-15-2 | III | 4,790 | 50 | 20 | 30 | 14.37 | 769 | 111 | 11,447 | 3,120 | 3.7 | 53 | 216,573 | 11 | 122 | 4.4 | 232 |
| Laguna | Santa Cruz | Sta. Cruz River | III | 2,650 | 69 | 60 | 9 | 2.39 | 3,178 | 76 | 27,982 | 3,859 | 7.3 | 17 | 216,573 | 4 | 80 | 4.2 | 73 |
| Sub-total | | | | 22,690 | | | | 73.04 | | 626 | | | | 269 | | 58 | 684 | | 1,136 |
| **Grand Total** | | | | **43,640** | | | | **116.54** | | **4,188** | | | | **1,081** | | **284** | **4,472** | | **4,373** |

Note)
a. Development Phase proposed by JICA Survey Team.
b. Longitudinal length of river improvement section measured on AutoCAD
c. Width of river improvement section given by JICA Survey Team.
d. Calculation by d=b x c3
e. Average Zonal Value calculated by city/municipality.
f. Calculation by f=d x e
g. Household density is estimated from number of households listed in statistical book in each LGU.
h. Approximation by h=d x g3.
i. Use the data of average cost (median) for construction of residential building (house) listed in a statistical book.
j. Calculation by j=h x i
k. Calculation by k=f+j

Table 2-3 Calculation Result of Compensation Cost Necessary for Land Acquisition and Affected Buildings for Development of Paranaque Spillway

| Case (Route) | Facility | Location | | a. Area | | | b. Zonal Value | c. Market Value | d. Cost for land acquisition | | e. Number of buildings | f. Unit cost of residential building | g. Replacement cost for residential buildings | h. Total cost for compensation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | City | Barangay | a1. Length | a2. Width | a3. Area | | | in case of ZV | in case of MV | | | | in case of ZV | in case of MV |
| | | | | (m) | (m) | (m2) | (PhP./m2) | (PhP./m2) | (million PhP.) | (million PhP.) | No. | (PhP.) | (million PhP.) | (million PhP.) | (million PhP.) |
| 1. Lower Bicutan - Parañaque River | Open Channel | Taguig | Lower Bicutan | 1,200 | 83 | 99,346 | 7,829 | 9,395 | 778 | 933 | 280 | 776,862 | 218 | 1,027 | 1,188 |
| | Shaft (Departing) | Taguig | Lower Bicutan | 80 | 50 | 4,000 | 7,829 | 9,395 | 31 | 38 | | | | | |
| | Drainage Facility (Arrival Shaft) | Parañaque | San Dionisio | - | - | 1,000 | 7,110 | 8,532 | 7 | 9 | 0 | 776,862 | 0 | 7 | 9 |
| | Total | - | - | - | - | 104,346 | - | - | **816** | **979** | 280 | - | **218** | **1,034** | **1,197** |
| 2. Sucat - Zapote River | Open Channel | Muntinlupa | Sucat | 600 | 83 | 49,673 | 14,524 | 17,429 | 721 | 866 | 290 | 776,862 | 225 | 1,005 | 1,161 |
| | Shaft (Departing) | Muntinlupa | Sucat | 80 | 50 | 4,000 | 14,524 | 17,429 | 58 | 70 | | | | | |
| | Drainage Facility (Arrival Shaft) | Las Piñas | Pulang Lupa Uno | - | - | 1,000 | 3,270 | 3,924 | 3 | 4 | 0 | 776,862 | 0 | 3 | 4 |
| | Total | - | - | - | - | 54,673 | - | - | **783** | **939** | 290 | - | **225** | **1,008** | **1,165** |

Note)

a1. Width of land acquisition is the width of channel plus additional 12m necessary for acquisition of marginal areas of residential lot.

b. Zonal Value (ZV) provided by BIR (Bureau of Internal Revenue) , specifically average value of ZV at residential area in the barangay in question.

c. Market Value (MV) is calculated as 1.2 times as large as ZV for consistency with the case of Master Plan of this Project.

d. Cost for land acquisition = a3 x b, or a3 x c

f. Average cost of residential buildings (houses) in respective LGUs listed in a statistical book.

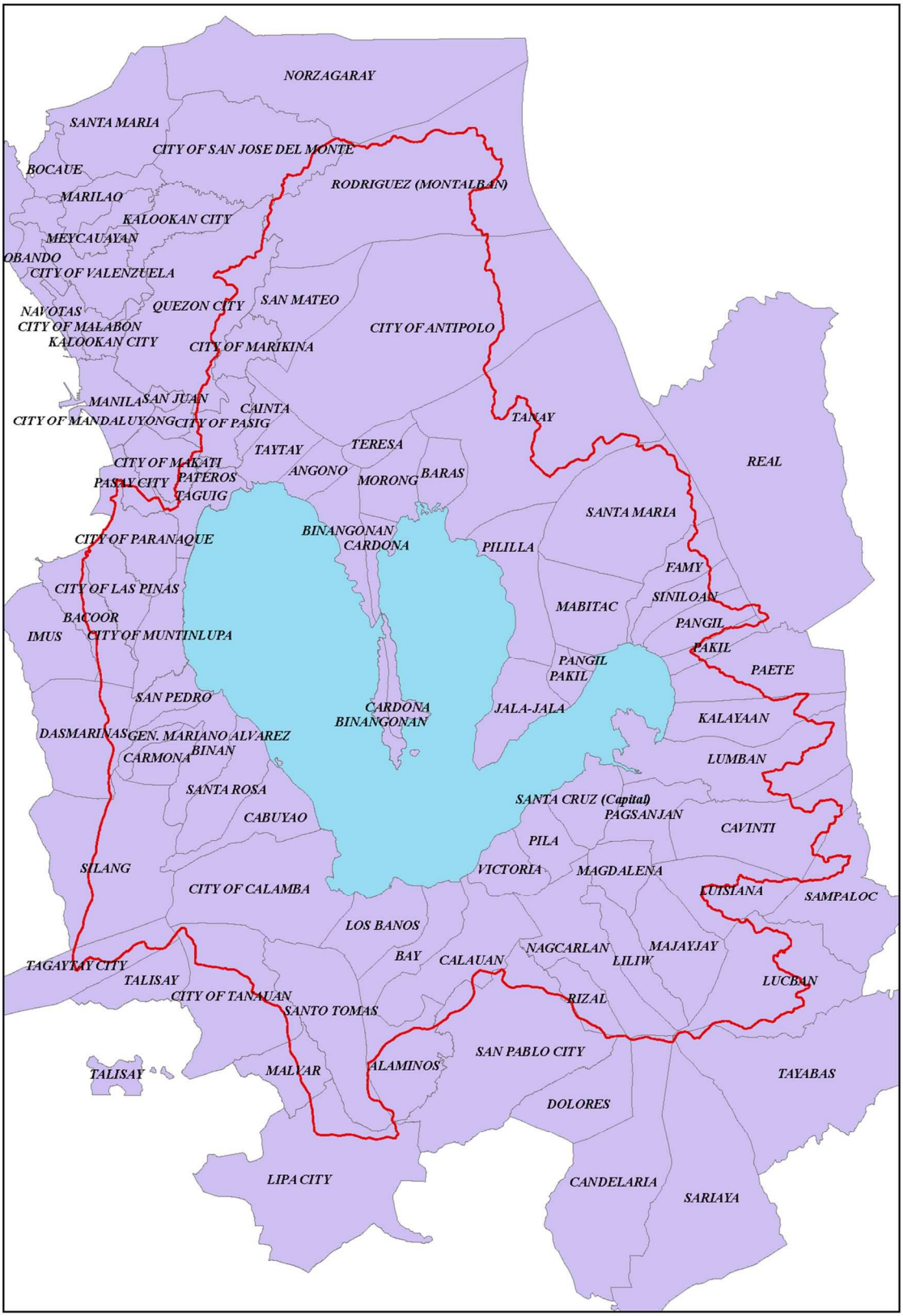
h. Total cost for compensation = d + g

# APPENDIX 3

Materials Related to Economic Analysis

Appendix 3-1 List of LGUs Subject to Flood Damage Analysis

| ID | Province | Name of LGU | Population (2015 census) | Increase Rate (2015-20) | Population in 2017 |
|---|---|---|---|---|---|
| 1 | NCR | CITY OF MUNTINLUPA | 504,509 | 0.98% | 514,446 |
| 2 | NCR | TAGUIG | 804,915 | 0.98% | 820,769 |
| 3 | LAGUNA | BAY | 62,143 | 1.85% | 64,464 |
| 4 | LAGUNA | BINAN | 333,028 | 1.85% | 345,464 |
| 5 | LAGUNA | CABUYAO | 308,745 | 1.85% | 320,274 |
| 6 | LAGUNA | CALAUAN | 80,453 | 1.85% | 83,457 |
| 7 | LAGUNA | CITY OF CALAMBA | 454,486 | 1.85% | 471,458 |
| 8 | LAGUNA | FAMY | 16,587 | 1.85% | 17,206 |
| 9 | LAGUNA | KALAYAAN | 23,269 | 1.85% | 24,138 |
| 10 | LAGUNA | LOS BANOS | 112,008 | 1.85% | 116,191 |
| 11 | LAGUNA | LUMBAN | 30,652 | 1.85% | 31,797 |
| 12 | LAGUNA | MABITAC | 20,530 | 1.85% | 21,297 |
| 13 | LAGUNA | PAETE | 25,096 | 1.85% | 26,033 |
| 14 | LAGUNA | PAGSANJAN | 42,164 | 1.85% | 43,738 |
| 15 | LAGUNA | PAKIL | 20,659 | 1.85% | 21,430 |
| 16 | LAGUNA | PANGIL | 24,274 | 1.85% | 25,180 |
| 17 | LAGUNA | PILA | 50,289 | 1.85% | 52,167 |
| 18 | LAGUNA | SAN PEDRO | 325,809 | 1.85% | 337,975 |
| 19 | LAGUNA | SANTA CRUZ (Capital) | 117,605 | 1.85% | 121,997 |
| 20 | LAGUNA | SANTA ROSA | 353,767 | 1.85% | 366,977 |
| 21 | LAGUNA | SINILOAN | 38,067 | 1.85% | 39,489 |
| 22 | LAGUNA | VICTORIA | 39,321 | 1.85% | 40,789 |
| 23 | RIZAL | ANGONO | 113,283 | 2.08% | 118,045 |
| 24 | RIZAL | BARAS | 69,300 | 2.08% | 72,213 |
| 25 | RIZAL | JALA-JALA | 32,254 | 2.08% | 33,610 |
| 26 | RIZAL | MORONG | 58,118 | 2.08% | 60,561 |
| 27 | RIZAL | PILILLA | 64,812 | 2.08% | 67,536 |
| 28 | RIZAL | TANAY | 117,830 | 2.08% | 122,783 |
| 29 | RIZAL | TAYTAY | 319,104 | 2.08% | 332,517 |
| 30 | RIZAL | CARDONA | 49,034 | 2.08% | 51,095 |
| 31 | RIZAL | BINANGONAN | 282,474 | 2.08% | 294,347 |
| | | **Total** | **4,894,585** | | **5,059,443** |


NORZAGARAY
SANTA MARIA
CITY OF SAN JOSE DEL MONTE
BOCAUE
RODRIGUEZ (MONTALBAN)
MARILAO
KALOOKAN CITY
MEYCAUAYAN
OBANDO
CITY OF VALENZUELA
NAVOTAS
QUEZON CITY
SAN MATEO
CITY OF MALABON
KALOOKAN CITY
CITY OF ANTIPOLO
CITY OF MARIKINA
MANILA
SAN JUAN
CAINTA
CITY OF MANDALUYONG
CITY OF PASIG
TANAY
TAYTAY
TERESA
CITY OF MAKATI
PATEROS
ANGONO
MORONG
BARAS
REAL
PASAY CITY
TAGUIG
SANTA MARIA
BINANGONAN
CITY OF PARANAQUE
CARDONA
PILILLA
FAMY
CITY OF LAS PINAS
SINILOAN
MABITAC
BACOOR
PANGIL
IMUS
CITY OF MUNTINLUPA
PAKIL
PANGIL
PAKIL
PAETE
SAN PEDRO
CARDONA
BINANGONAN
JALA-JALA
KALAYAAN
DASMARINAS
GEN. MARIANO ALVAREZ
BINAN
CARMONA
LUMBAN
SANTA ROSA
SANTA CRUZ (Capital)
PAGSANJAN
CABUYAO
CAVINTI
PILA
SILANG
VICTORIA
MAGDALENA
CITY OF CALAMBA
LUISIANA
SAMPALOC
LOS BANOS
NAGCARLAN
MAJAYJAY
BAY
CALAUAN
LILIW
TAGAYTAY CITY
TALISAY
LUCBAN
CITY OF TANAUAN
RIZAL
SANTO TOMAS
SAN PABLO CITY
TALISAY
MALVAR
ALAMINOS
TAYABAS
DOLORES
LIPA CITY
CANDELARIA
SARIAYA

# Appendix 3-2 Damage to House and Household Goods by Height (PHP)

| Economic Damage of Household Building and Assets (inc. indirect) | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elevation Range** | **Total** | **Metro Manila** | **Laguna** | **Rizal** | Metro Manila | Metro Manila | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna |
| | | | | | Taguig City | Muntinlupa City | San Pedro | Binan | Santa Rosa | Cabuyao | City of Calamba | Los Banos | Bay | Calauan | Victoria | Pila | Santa Cruz |
| <= 12.5 | **0** | **0** | **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <= 12.6 | **160,728,133** | **16,362,179** | **103,505,689** | **40,860,264** | 8,919,819 | 7,442,360 | 2,565,733 | 36,699,990 | 5,297,391 | 9,053,007 | 3,471,232 | 5,078,484 | 6,642,266 | 0 | 6,144,998 | 1,481,839 | 19,827,393 |
| <= 12.7 | **351,179,417** | **74,175,367** | **202,119,546** | **74,884,504** | 48,487,219 | 25,688,147 | 8,001,383 | 64,646,461 | 15,766,516 | 21,445,509 | 9,078,097 | 5,554,592 | 14,356,292 | 0 | 14,651,422 | 4,419,056 | 29,390,572 |
| <= 12.8 | **948,714,527** | **139,481,290** | **593,272,125** | **215,961,112** | 90,450,735 | 49,030,555 | 19,842,697 | 196,284,158 | 40,929,618 | 55,775,046 | 21,305,931 | 22,000,653 | 36,757,470 | 205,641 | 38,686,837 | 8,596,522 | 102,612,388 |
| <= 12.9 | **1,637,105,848** | **322,340,426** | **971,664,042** | **343,101,380** | 208,420,964 | 113,919,462 | 38,630,209 | 306,043,839 | 81,909,537 | 102,468,113 | 44,765,536 | 28,988,368 | 62,818,067 | 238,809 | 64,329,713 | 18,802,752 | 143,105,401 |
| <= 13.0 | **2,375,537,370** | **437,793,591** | **1,441,351,851** | **496,391,928** | 285,600,058 | 152,193,533 | 63,299,029 | 432,519,986 | 122,239,056 | 166,966,680 | 60,336,973 | 39,888,383 | 83,682,496 | 939,804 | 92,179,374 | 25,324,731 | 214,099,146 |
| <= 13.1 | **3,482,934,395** | **601,230,882** | **2,136,024,366** | **745,679,147** | 366,008,010 | 235,222,872 | 99,276,798 | 641,087,644 | 182,258,226 | 241,538,344 | 105,689,618 | 70,341,660 | 120,309,618 | 1,176,551 | 122,141,764 | 39,251,622 | 317,589,598 |
| <= 13.2 | **4,845,460,735** | **956,262,135** | **2,861,610,995** | **1,027,587,604** | 587,662,397 | 368,599,738 | 163,295,560 | 811,996,017 | 236,782,137 | 382,532,849 | 142,802,372 | 79,685,605 | 156,395,299 | 1,631,099 | 160,543,775 | 62,456,676 | 386,430,730 |
| <= 13.3 | **6,120,532,507** | **1,139,714,805** | **3,662,996,315** | **1,317,821,387** | 685,590,803 | 454,124,003 | 241,548,195 | 1,003,789,433 | 301,070,381 | 469,833,493 | 207,088,323 | 109,522,891 | 185,442,577 | 2,454,823 | 201,326,450 | 77,919,814 | 498,849,496 |
| <= 13.4 | **7,610,502,658** | **1,508,118,468** | **4,468,242,084** | **1,634,142,106** | 923,112,548 | 585,005,920 | 340,528,698 | 1,198,067,068 | 354,533,547 | 590,481,881 | 260,561,519 | 136,262,782 | 206,466,822 | 2,525,229 | 226,076,972 | 97,860,511 | 587,830,843 |
| <= 13.5 | **9,065,074,193** | **1,805,690,769** | **5,287,299,921** | **1,972,083,503** | 1,062,148,138 | 743,542,631 | 432,733,053 | 1,364,623,919 | 409,030,624 | 739,689,645 | 340,098,810 | 170,992,777 | 229,342,316 | 2,905,422 | 256,847,487 | 128,285,472 | 655,045,113 |
| <= 13.6 | **11,428,438,810** | **2,178,186,243** | **6,691,883,424** | **2,558,369,144** | 1,242,957,496 | 935,228,747 | 571,081,747 | 1,694,978,328 | 504,173,320 | 918,797,418 | 444,005,209 | 224,962,927 | 281,882,587 | 3,229,290 | 322,499,938 | 169,357,784 | 851,669,162 |
| <= 13.7 | **14,042,960,015** | **2,951,447,356** | **8,016,064,676** | **3,075,447,983** | 1,729,132,696 | 1,222,314,660 | 702,303,680 | 2,037,879,295 | 616,597,777 | 1,101,735,850 | 540,079,097 | 254,027,815 | 338,464,456 | 3,229,290 | 385,335,987 | 215,570,036 | 963,886,534 |
| <= 13.8 | **16,590,727,945** | **3,374,195,281** | **9,602,468,171** | **3,614,064,493** | 1,931,916,594 | 1,442,278,686 | 848,663,184 | 2,405,034,972 | 756,953,100 | 1,292,859,900 | 657,260,508 | 309,198,060 | 380,920,689 | 4,311,724 | 454,533,486 | 264,303,065 | 1,160,994,857 |
| <= 13.9 | **19,270,701,073** | **3,932,236,967** | **11,124,025,459** | **4,214,438,647** | 2,191,013,080 | 1,741,223,887 | 993,878,792 | 2,743,608,860 | 926,371,504 | 1,487,932,224 | 795,221,765 | 360,751,051 | 425,788,545 | 4,798,088 | 507,374,957 | 321,322,111 | 1,305,406,665 |
| <= 14.0 | **22,285,099,848** | **4,615,355,115** | **12,807,158,220** | **4,862,586,512** | 2,540,688,542 | 2,074,666,574 | 1,170,851,480 | 3,040,339,988 | 1,078,294,963 | 1,784,894,736 | 908,279,562 | 412,006,838 | 484,850,236 | 6,317,975 | 552,708,054 | 400,745,959 | 1,444,861,911 |
| <= 14.1 | **25,364,992,025** | **5,195,732,091** | **14,593,043,858** | **5,576,216,075** | 2,765,941,431 | 2,429,790,660 | 1,376,527,278 | 3,364,683,978 | 1,280,203,920 | 1,994,083,378 | 1,103,776,431 | 456,579,262 | 539,032,780 | 8,283,801 | 614,338,080 | 468,887,089 | 1,618,635,212 |
| <= 14.2 | **28,610,155,144** | **6,088,221,762** | **16,307,503,186** | **6,214,430,197** | 3,278,726,200 | 2,809,495,562 | 1,616,623,473 | 3,723,978,866 | 1,465,761,923 | 2,216,383,821 | 1,264,440,658 | 498,576,222 | 575,123,176 | 10,564,385 | 662,379,085 | 523,262,514 | 1,757,467,196 |
| <= 14.3 | **31,607,569,250** | **6,627,877,947** | **18,052,360,929** | **6,927,330,374** | 3,502,000,241 | 3,125,877,706 | 1,859,987,367 | 3,962,647,679 | 1,648,851,495 | 2,402,813,602 | 1,492,582,383 | 580,977,572 | 612,593,495 | 12,110,806 | 706,188,345 | 597,783,004 | 1,899,205,339 |
| <= 14.4 | **34,738,296,094** | **7,316,605,686** | **19,730,977,208** | **7,690,713,201** | 3,836,472,240 | 3,480,133,445 | 2,094,794,841 | 4,150,802,380 | 1,833,846,404 | 2,622,443,089 | 1,712,256,997 | 627,116,321 | 650,790,843 | 16,647,673 | 764,402,680 | 661,394,689 | 2,034,319,736 |
| <= 14.5 | **38,037,274,750** | **8,246,601,640** | **21,430,362,442** | **8,360,310,668** | 4,313,153,152 | 3,933,448,488 | 2,291,191,933 | 4,426,763,069 | 2,052,381,628 | 2,809,546,139 | 1,937,777,366 | 684,346,230 | 713,248,876 | 22,442,912 | 796,487,764 | 725,830,064 | 2,134,329,169 |
| <= 14.6 | **42,912,264,062** | **9,139,079,323** | **24,283,459,986** | **9,489,724,753** | 4,657,373,234 | 4,481,706,089 | 2,505,152,925 | 5,070,353,454 | 2,369,388,490 | 3,115,094,976 | 2,183,213,689 | 783,175,253 | 831,783,438 | 30,497,205 | 899,835,737 | 813,498,128 | 2,501,679,612 |
| <= 14.7 | **48,000,887,696** | **10,588,080,671** | **26,869,953,396** | **10,542,853,628** | 5,489,307,852 | 5,098,772,819 | 2,748,312,913 | 5,636,935,767 | 2,696,756,382 | 3,384,331,712 | 2,434,239,200 | 814,325,755 | 967,884,943 | 43,229,922 | 1,039,703,848 | 908,661,717 | 2,704,978,571 |

| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal |
| Pagsanjan | Lumban | Kalayaan | Paete | Pakil | Pangil | Siniloan | Famy | Mabitac | Jalajala | Pillila | Tanay | Baras | Morong | Cardona | Binangonan | Angono | Taytay |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 397,129 | 882,530 | 0 | 3,916,133 | 147,574 | 1,655,317 | 0 | 0 | 244,673 | 311,185 | 289,981 | 7,264,371 | 1,457,259 | 276,688 | 1,965,573 | 11,639,573 | 4,017,895 | 13,637,739 |
| 564,342 | 2,426,956 | 0 | 6,814,515 | 694,465 | 1,655,317 | 75,063 | 0 | 2,578,989 | 4,621,677 | 2,734,107 | 13,421,879 | 2,073,570 | 2,570,896 | 2,386,355 | 14,718,093 | 7,078,874 | 25,279,053 |
| 1,572,201 | 5,791,917 | 0 | 23,788,874 | 2,674,936 | 7,647,837 | 4,228,533 | 1,099,805 | 3,471,060 | 6,903,957 | 5,476,234 | 37,726,994 | 6,290,279 | 4,742,999 | 7,858,890 | 53,020,516 | 22,342,771 | 71,598,472 |
| 3,201,885 | 12,006,031 | 0 | 32,693,310 | 4,592,397 | 8,635,578 | 4,585,838 | 1,147,036 | 12,701,622 | 19,958,284 | 12,117,012 | 56,897,704 | 8,505,259 | 11,833,530 | 10,765,539 | 81,005,166 | 33,517,957 | 108,500,930 |
| 3,201,885 | 17,575,472 | 198,656 | 57,319,354 | 8,668,071 | 14,374,400 | 18,646,368 | 4,518,452 | 15,373,536 | 24,575,959 | 19,575,645 | 91,502,424 | 12,683,544 | 17,172,198 | 12,426,650 | 107,077,726 | 59,699,289 | 151,678,492 |
| 7,493,979 | 28,206,554 | 437,044 | 75,160,345 | 13,545,779 | 20,394,915 | 21,012,989 | 4,827,241 | 24,284,076 | 32,113,677 | 21,959,495 | 119,776,407 | 17,998,938 | 22,603,472 | 23,161,923 | 191,049,439 | 89,487,097 | 227,528,700 |
| 8,371,463 | 48,094,652 | 1,272,299 | 103,937,522 | 15,323,010 | 23,917,576 | 34,958,649 | 6,711,457 | 34,472,250 | 44,683,501 | 34,818,232 | 191,768,658 | 28,259,919 | 35,958,893 | 26,478,022 | 216,416,710 | 141,242,166 | 307,961,503 |
| 10,559,995 | 61,563,385 | 1,877,293 | 137,105,220 | 27,287,318 | 30,438,533 | 49,324,265 | 10,159,735 | 35,834,693 | 57,411,566 | 42,406,876 | 222,934,251 | 31,884,591 | 46,876,375 | 32,998,788 | 270,605,176 | 194,649,059 | 418,054,705 |
| 14,744,271 | 97,977,559 | 2,717,562 | 158,608,629 | 30,366,173 | 38,116,055 | 66,968,076 | 11,810,580 | 45,737,308 | 66,918,093 | 49,107,328 | 264,050,830 | 42,243,565 | 62,900,792 | 42,370,442 | 348,563,568 | 241,818,763 | 516,168,725 |
| 18,398,641 | 117,378,384 | 3,139,253 | 187,867,704 | 31,335,522 | 49,806,009 | 82,644,404 | 15,097,259 | 52,038,108 | 83,890,958 | 59,790,612 | 333,032,618 | 51,353,270 | 77,743,128 | 46,927,983 | 408,155,392 | 308,730,745 | 602,458,796 |
| 22,189,007 | 152,951,448 | 3,645,282 | 234,678,931 | 39,966,105 | 71,475,569 | 103,621,571 | 17,059,200 | 59,658,602 | 94,306,710 | 68,457,271 | 416,662,827 | 74,014,055 | 90,525,110 | 68,091,706 | 530,029,483 | 394,137,154 | 822,144,827 |
| 26,549,518 | 200,173,114 | 4,348,100 | 277,694,933 | 44,153,088 | 78,842,940 | 132,186,519 | 20,027,894 | 72,978,753 | 122,873,294 | 91,543,871 | 487,417,899 | 83,374,730 | 120,768,110 | 80,144,785 | 614,716,193 | 469,120,207 | 1,005,488,895 |
| 31,333,973 | 243,449,223 | 4,500,403 | 334,723,773 | 54,984,992 | 101,478,632 | 191,349,618 | 28,607,534 | 77,006,479 | 151,656,978 | 113,531,920 | 570,332,242 | 96,386,078 | 144,342,550 | 89,766,134 | 734,353,186 | 551,602,977 | 1,162,092,427 |
| 40,961,420 | 298,961,405 | 4,500,403 | 363,283,628 | 60,459,183 | 122,059,196 | 225,203,166 | 33,559,785 | 102,582,710 | 172,553,422 | 133,535,437 | 638,543,984 | 116,433,305 | 165,688,853 | 111,601,567 | 920,589,767 | 627,947,474 | 1,327,544,837 |
| 49,272,834 | 362,247,739 | 6,111,386 | 417,645,562 | 64,930,230 | 141,351,242 | 327,743,242 | 39,982,800 | 113,721,485 | 194,844,783 | 159,429,138 | 780,799,304 | 141,678,278 | 186,882,876 | 123,526,300 | 1,004,254,338 | 747,471,172 | 1,523,700,324 |
| 54,027,055 | 426,859,557 | 8,789,891 | 459,509,328 | 88,128,004 | 163,387,530 | 402,033,233 | 44,756,768 | 120,521,284 | 217,356,977 | 193,005,413 | 846,706,783 | 158,595,299 | 205,127,558 | 144,859,801 | 1,125,039,803 | 894,709,424 | 1,790,815,018 |
| 63,848,892 | 528,747,551 | 12,125,380 | 497,410,574 | 95,182,034 | 175,896,329 | 445,261,869 | 51,812,142 | 122,657,096 | 235,640,365 | 215,824,992 | 925,085,069 | 177,069,604 | 246,919,212 | 160,619,601 | 1,257,155,939 | 979,432,755 | 2,016,682,660 |
| 77,551,633 | 598,852,404 | 18,386,113 | 540,943,077 | 105,549,254 | 220,087,093 | 525,852,054 | 58,875,761 | 130,522,452 | 290,864,321 | 258,073,999 | 1,027,369,263 | 203,005,134 | 281,042,621 | 178,409,283 | 1,406,261,887 | 1,066,856,427 | 2,215,447,439 |
| 82,218,918 | 680,420,445 | 23,395,639 | 566,286,828 | 120,431,991 | 269,693,188 | 599,296,016 | 69,296,966 | 151,121,562 | 310,907,496 | 289,829,668 | 1,106,481,168 | 242,509,326 | 304,978,755 | 201,035,803 | 1,551,381,060 | 1,184,120,012 | 2,499,469,913 |
| 94,523,129 | 754,282,328 | 32,117,323 | 594,891,452 | 128,310,131 | 317,228,700 | 677,260,422 | 77,663,566 | 159,740,242 | 323,941,074 | 320,236,006 | 1,163,606,184 | 252,016,540 | 346,130,176 | 221,545,363 | 1,706,695,465 | 1,277,421,394 | 2,748,718,466 |
| 109,641,991 | 835,228,776 | 42,377,911 | 676,983,349 | 142,065,383 | 383,618,013 | 728,295,690 | 84,217,791 | 177,358,174 | 347,676,342 | 365,523,548 | 1,322,494,203 | 298,100,043 | 375,038,256 | 260,929,272 | 1,986,260,685 | 1,390,649,384 | 3,143,053,019 |
| 125,049,017 | 918,376,805 | 53,082,682 | 743,203,269 | 165,681,014 | 411,342,789 | 758,773,637 | 95,578,753 | 219,504,700 | 414,423,901 | 447,806,861 | 1,449,717,487 | 322,230,254 | 438,116,644 | 284,773,621 | 2,212,777,859 | 1,481,993,827 | 3,491,013,173 |

# Appendix 3-3 Damage to House and Household Goods by Height (PHP)

| Economic Damage of Industorial (inc. indirect) | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Elevation Range** | **Total** | **Metro Manila** | **Laguna** | **Rizal** | Metro Manila | Metro Manila | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna |
| | | | | | Taguig City | Muntinlupa City | San Pedro | Binan | Santa Rosa | Cabuyao | City of Calamba | Los Banos | Bay | Calauan | Victoria | Pila | Santa Cruz |
| <= 12.5 | **0** | **0** | **0** | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| <= 12.6 | **364,008,779** | **20,909,264** | **231,454,586** | **111,644,929** | 5,059,255 | 15,850,009 | 7,758,287 | 56,676,841 | 10,123,307 | 25,991,696 | 10,011,918 | 12,302,990 | 20,214,615 | 0 | 12,810,390 | 5,212,508 | 34,323,668 |
| <= 12.7 | **756,445,117** | **80,607,143** | **461,509,142** | **214,328,833** | 27,505,434 | 53,101,709 | 22,677,730 | 101,109,378 | 26,548,230 | 59,050,873 | 22,079,992 | 14,271,468 | 45,142,676 | 0 | 30,252,123 | 15,980,288 | 55,121,083 |
| <= 12.8 | **1,462,321,017** | **123,723,804** | **953,932,670** | **384,664,542** | 50,743,871 | 72,979,933 | 37,927,534 | 213,898,589 | 55,550,064 | 113,648,932 | 38,812,022 | 34,663,178 | 75,969,306 | 531,578 | 57,564,676 | 20,205,861 | 135,317,408 |
| <= 12.9 | **2,180,828,829** | **258,242,952** | **1,380,039,949** | **542,545,929** | 115,157,475 | 143,085,477 | 59,757,577 | 314,723,615 | 93,704,755 | 177,397,067 | 67,627,631 | 48,299,147 | 110,785,097 | 620,679 | 78,793,474 | 34,131,286 | 181,665,818 |
| <= 13.0 | **3,095,747,065** | **359,480,500** | **1,958,312,480** | **777,954,085** | 157,712,253 | 201,768,247 | 94,619,494 | 418,327,869 | 130,506,274 | 305,078,209 | 88,594,194 | 57,010,230 | 142,241,562 | 1,389,351 | 104,898,854 | 52,144,293 | 247,244,667 |
| <= 13.1 | **4,492,784,215** | **497,788,146** | **2,809,569,990** | **1,185,426,079** | 201,959,837 | 295,828,309 | 153,598,235 | 607,360,537 | 186,206,080 | 419,387,607 | 141,643,393 | 93,268,652 | 197,811,760 | 1,824,623 | 141,784,667 | 74,173,691 | 351,907,113 |
| <= 13.2 | **6,045,071,805** | **762,472,883** | **3,682,645,456** | **1,599,953,466** | 324,802,466 | 437,670,417 | 241,957,995 | 772,759,796 | 234,440,557 | 591,552,888 | 184,925,644 | 108,510,219 | 247,508,273 | 2,092,496 | 182,331,485 | 105,699,782 | 432,566,632 |
| <= 13.3 | **7,613,505,056** | **900,418,320** | **4,696,594,780** | **2,016,491,956** | 378,738,106 | 521,680,214 | 326,336,962 | 951,208,083 | 296,318,887 | 743,288,826 | 263,662,998 | 156,936,422 | 288,723,377 | 2,986,493 | 229,513,800 | 130,745,937 | 555,057,803 |
| <= 13.4 | **9,384,401,966** | **1,171,015,345** | **5,723,109,865** | **2,490,276,756** | 508,806,573 | 662,208,772 | 439,302,600 | 1,116,418,392 | 353,731,707 | 938,171,752 | 341,960,912 | 195,517,291 | 323,621,393 | 3,097,391 | 260,345,761 | 170,782,495 | 655,129,844 |
| <= 13.5 | **11,266,744,790** | **1,441,033,611** | **6,829,310,926** | **2,996,400,253** | 586,001,530 | 855,032,081 | 541,056,876 | 1,284,991,261 | 412,299,712 | 1,183,059,457 | 431,038,648 | 228,533,827 | 367,910,463 | 3,675,610 | 290,854,609 | 227,106,253 | 729,443,753 |
| <= 13.6 | **14,266,244,286** | **1,773,345,165** | **8,649,682,005** | **3,843,217,116** | 685,348,298 | 1,087,996,867 | 697,499,854 | 1,626,694,076 | 514,875,210 | 1,459,200,749 | 567,767,541 | 295,039,146 | 456,813,026 | 4,160,759 | 364,601,163 | 311,233,508 | 932,604,571 |
| <= 13.7 | **17,330,140,974** | **2,344,507,947** | **10,361,353,838** | **4,624,279,189** | 953,347,861 | 1,391,160,086 | 869,954,230 | 1,963,221,697 | 631,100,383 | 1,734,391,476 | 675,054,641 | 335,636,703 | 544,178,613 | 4,160,759 | 441,409,712 | 402,134,413 | 1,071,309,511 |
| <= 13.8 | **20,609,656,998** | **2,662,713,982** | **12,505,450,552** | **5,441,492,464** | 1,065,403,934 | 1,597,310,048 | 1,041,583,969 | 2,307,240,618 | 768,273,510 | 2,039,300,185 | 812,894,743 | 424,679,680 | 623,034,510 | 5,640,088 | 521,435,024 | 501,517,820 | 1,315,455,996 |
| <= 13.9 | **24,093,085,595** | **3,137,359,698** | **14,582,582,196** | **6,373,143,700** | 1,208,483,368 | 1,928,876,331 | 1,227,199,646 | 2,638,194,562 | 939,496,110 | 2,380,834,167 | 988,642,792 | 493,753,468 | 709,303,045 | 6,809,433 | 587,882,119 | 608,203,704 | 1,513,667,044 |
| <= 14.0 | **28,032,611,787** | **3,736,998,661** | **16,943,580,988** | **7,352,032,139** | 1,401,500,716 | 2,335,497,945 | 1,444,990,450 | 2,958,143,450 | 1,099,766,428 | 2,870,261,260 | 1,135,085,062 | 551,076,118 | 810,392,637 | 9,573,605 | 646,305,697 | 738,704,202 | 1,699,481,176 |
| <= 14.1 | **31,963,321,120** | **4,251,314,188** | **19,273,934,378** | **8,438,072,554** | 1,525,364,377 | 2,725,949,812 | 1,700,735,365 | 3,292,165,755 | 1,290,929,037 | 3,219,143,314 | 1,356,329,170 | 610,906,842 | 896,701,544 | 12,081,550 | 713,520,794 | 866,917,688 | 1,908,465,793 |
| <= 14.2 | **35,816,666,836** | **4,921,237,561** | **21,445,030,320** | **9,450,398,954** | 1,808,129,705 | 3,113,107,856 | 1,985,247,873 | 3,659,744,837 | 1,458,150,189 | 3,562,469,106 | 1,525,199,579 | 675,280,719 | 955,989,838 | 15,252,178 | 772,979,814 | 973,207,107 | 2,089,459,764 |
| <= 14.3 | **39,726,285,656** | **5,385,297,598** | **23,796,028,132** | **10,544,959,926** | 1,931,774,603 | 3,453,522,995 | 2,260,640,966 | 3,907,908,880 | 1,627,246,372 | 3,896,719,411 | 1,780,116,718 | 788,257,674 | 1,027,056,975 | 17,598,228 | 829,490,682 | 1,117,560,296 | 2,279,435,943 |
| <= 14.4 | **43,920,536,630** | **5,954,258,912** | **26,166,767,651** | **11,799,510,067** | 2,116,545,649 | 3,837,713,263 | 2,548,190,692 | 4,103,560,164 | 1,814,049,286 | 4,300,335,567 | 2,022,678,559 | 856,520,588 | 1,086,968,320 | 25,321,888 | 900,371,320 | 1,237,297,479 | 2,486,116,783 |
| <= 14.5 | **48,129,774,512** | **6,742,008,213** | **28,540,342,196** | **12,847,424,103** | 2,379,706,604 | 4,362,301,609 | 2,804,613,318 | 4,417,294,270 | 2,016,020,663 | 4,641,473,010 | 2,257,682,681 | 929,214,556 | 1,180,468,178 | 36,854,953 | 936,832,704 | 1,360,586,584 | 2,636,204,122 |
| <= 14.6 | **53,637,460,731** | **7,488,068,688** | **31,883,326,103** | **14,266,065,940** | 2,568,889,167 | 4,919,179,521 | 3,069,896,469 | 4,970,836,226 | 2,303,118,293 | 5,088,037,870 | 2,546,514,976 | 1,033,771,713 | 1,322,303,426 | 48,078,307 | 1,032,478,020 | 1,534,092,316 | 3,010,423,872 |
| <= 14.7 | **59,074,950,527** | **8,534,091,009** | **34,898,652,049** | **15,642,207,469** | 3,024,583,118 | 5,509,507,891 | 3,356,749,126 | 5,481,521,225 | 2,603,634,334 | 5,457,720,138 | 2,795,576,276 | 1,099,053,801 | 1,478,883,399 | 64,817,778 | 1,167,726,136 | 1,704,754,679 | 3,252,112,917 |

| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Laguna | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal | Rizal |
| Pagsanjan | Lumban | Kalayaan | Paete | Pakil | Pangil | Siniloan | Famy | Mabitac | Jalajala | Pililia | Tanay | Baras | Morong | Cardona | Binangonan | Angono | Taytay |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1,521,013 | 1,486,536 | 0 | 28,051,649 | 1,506,105 | 2,630,414 | 0 | 0 | 832,648 | 969,306 | 1,803,422 | 14,470,438 | 2,247,776 | 2,141,998 | 7,778,083 | 20,797,751 | 13,647,636 | 47,788,517 |
| 1,975,145 | 4,264,808 | 0 | 49,115,219 | 3,597,228 | 2,630,414 | 3,110,491 | 0 | 4,581,996 | 8,884,243 | 15,012,059 | 25,887,400 | 3,129,632 | 13,296,845 | 8,722,322 | 27,394,582 | 23,431,416 | 88,570,335 |
| 2,605,064 | 7,432,139 | 0 | 105,410,830 | 14,885,239 | 8,724,236 | 23,482,052 | 1,411,513 | 5,892,450 | 11,711,998 | 30,858,611 | 47,935,269 | 5,962,224 | 21,509,325 | 13,914,588 | 58,373,143 | 46,119,473 | 148,279,911 |
| 7,646,015 | 15,834,189 | 0 | 121,949,588 | 16,866,307 | 10,237,193 | 25,120,603 | 1,474,444 | 13,405,464 | 23,076,905 | 41,330,795 | 62,553,674 | 8,210,723 | 35,368,300 | 20,521,129 | 96,168,743 | 60,855,216 | 194,460,443 |
| 7,650,229 | 22,711,579 | 675,382 | 181,319,978 | 19,739,017 | 15,271,029 | 49,093,689 | 3,773,141 | 16,023,438 | 27,784,446 | 60,765,981 | 110,323,537 | 13,318,705 | 49,881,479 | 21,976,660 | 118,684,485 | 106,682,416 | 268,536,377 |
| 14,134,350 | 35,861,395 | 1,423,893 | 252,133,686 | 34,680,493 | 20,356,341 | 56,207,395 | 4,081,619 | 21,724,459 | 37,075,336 | 66,416,110 | 143,853,531 | 18,607,619 | 65,812,514 | 45,258,161 | 196,626,679 | 164,218,831 | 447,557,296 |
| 16,457,364 | 54,060,013 | 2,860,569 | 318,964,961 | 39,233,902 | 23,562,347 | 87,768,905 | 5,440,358 | 29,951,270 | 51,895,650 | 92,986,103 | 206,079,928 | 27,180,512 | 97,857,758 | 52,660,537 | 233,695,964 | 231,186,967 | 606,410,048 |
| 20,650,749 | 71,097,934 | 3,226,711 | 406,222,468 | 57,326,276 | 31,650,592 | 121,370,488 | 8,625,386 | 31,644,589 | 68,353,414 | 123,540,907 | 247,531,444 | 30,574,756 | 124,634,531 | 60,559,584 | 298,365,822 | 304,215,834 | 758,715,664 |
| 29,059,478 | 110,112,235 | 3,740,750 | 458,944,546 | 63,142,395 | 42,414,596 | 167,559,079 | 9,950,779 | 40,106,469 | 78,691,987 | 142,627,518 | 291,275,742 | 42,511,947 | 154,400,096 | 74,333,619 | 391,516,007 | 369,147,623 | 945,772,219 |
| 33,305,438 | 135,889,548 | 4,547,333 | 547,093,206 | 63,708,830 | 55,416,840 | 232,056,960 | 12,536,046 | 44,786,258 | 92,214,523 | 171,656,400 | 367,482,127 | 50,848,857 | 182,384,702 | 82,089,779 | 457,869,172 | 468,892,357 | 1,122,962,338 |
| 41,181,135 | 184,117,614 | 5,452,151 | 680,024,895 | 82,544,063 | 74,430,789 | 286,056,425 | 13,967,840 | 51,417,487 | 106,085,426 | 189,096,828 | 457,700,478 | 68,996,593 | 212,418,230 | 120,670,348 | 599,118,540 | 598,030,233 | 1,491,100,439 |
| 50,081,411 | 234,580,381 | 6,799,224 | 798,802,331 | 90,334,310 | 81,167,938 | 345,332,216 | 16,639,815 | 65,064,074 | 138,227,968 | 244,359,950 | 546,228,977 | 80,339,744 | 272,124,850 | 137,801,959 | 697,135,141 | 701,549,655 | 1,806,510,945 |
| 59,609,587 | 292,291,351 | 7,323,852 | 966,784,096 | 121,529,526 | 105,747,789 | 497,401,124 | 24,115,893 | 69,591,190 | 170,422,402 | 307,369,994 | 647,010,798 | 93,386,769 | 319,742,692 | 155,727,447 | 829,730,625 | 828,510,432 | 2,089,591,304 |
| 77,519,601 | 366,490,303 | 7,323,852 | 1,034,673,034 | 132,918,103 | 128,774,891 | 622,308,604 | 28,196,119 | 90,391,597 | 195,026,680 | 351,855,354 | 720,967,843 | 114,366,748 | 369,667,634 | 187,151,044 | 1,030,031,238 | 980,544,238 | 2,423,532,922 |
| 91,987,417 | 454,829,608 | 9,929,875 | 1,182,840,904 | 136,947,878 | 152,959,692 | 817,977,446 | 33,386,765 | 98,941,319 | 217,714,947 | 414,014,372 | 882,467,612 | 136,230,753 | 427,939,113 | 204,413,940 | 1,131,472,116 | 1,155,487,726 | 2,782,291,560 |
| 102,155,917 | 546,619,425 | 15,507,123 | 1,322,268,913 | 174,824,504 | 178,141,507 | 924,372,348 | 36,677,106 | 105,470,681 | 248,290,673 | 455,971,716 | 968,463,052 | 153,768,795 | 472,392,719 | 248,021,835 | 1,286,824,411 | 1,338,468,970 | 3,265,870,383 |
| 115,627,708 | 653,979,133 | 21,344,627 | 1,426,927,103 | 185,373,878 | 193,201,824 | 1,023,733,362 | 43,070,344 | 108,791,336 | 270,419,044 | 500,810,556 | 1,075,242,618 | 173,537,418 | 543,016,705 | 278,372,562 | 1,443,826,961 | 1,471,400,926 | 3,693,772,165 |
| 137,235,903 | 763,601,863 | 27,699,440 | 1,519,124,089 | 198,556,055 | 244,646,088 | 1,206,589,466 | 49,763,916 | 116,779,166 | 323,914,467 | 568,010,556 | 1,207,314,676 | 196,950,717 | 619,438,066 | 308,662,967 | 1,617,320,126 | 1,622,407,445 | 4,080,940,906 |
| 148,005,034 | 877,603,667 | 32,671,969 | 1,603,072,081 | 226,099,648 | 300,068,729 | 1,404,102,723 | 58,363,644 | 135,369,508 | 343,845,991 | 625,201,936 | 1,306,740,446 | 235,502,277 | 671,279,175 | 334,468,080 | 1,808,816,246 | 1,821,087,236 | 4,652,568,680 |
| 178,574,711 | 987,147,644 | 40,531,005 | 1,691,195,314 | 237,838,622 | 352,442,345 | 1,624,727,523 | 64,626,850 | 146,013,144 | 362,825,906 | 689,998,972 | 1,387,904,016 | 243,773,049 | 745,900,732 | 363,659,391 | 1,989,683,199 | 1,970,861,271 | 5,092,817,568 |
| 204,506,048 | 1,109,364,699 | 52,801,806 | 1,867,307,396 | 251,343,665 | 413,778,901 | 1,788,222,420 | 69,471,500 | 166,978,181 | 390,265,706 | 755,254,759 | 1,552,510,157 | 281,416,139 | 803,164,374 | 415,450,596 | 2,276,028,829 | 2,130,320,502 | 5,661,654,879 |
| 231,334,084 | 1,224,481,491 | 62,903,078 | 2,005,914,119 | 283,110,378 | 447,465,881 | 1,899,477,871 | 79,471,296 | 201,944,041 | 451,710,208 | 858,277,813 | 1,701,927,165 | 305,855,033 | 896,201,086 | 445,577,456 | 2,518,980,610 | 2,249,548,067 | 6,214,130,032 |

# Appendix 3-4 Number of Establishments by Sector

| Procince | LGU | C | F | G | H | I | J | K | L | P | Q | R | S | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C - Manufacturing | F - Construction | G - Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles | H - Transport and Storage | I - Accommodation and Food Service Activities | J - Information and Communication | K - Financial and Insurance Activities | L - Real Estate Activities | P - Education | Q - Human Health and Social Work Activities | R - Arts, Entertainment, and Recreation | S - Other Service Activities | |
| Total | | 9,324 | 607 | 32,645 | 793 | 10,431 | 4,138 | 4,130 | 1,888 | 2,009 | 2,939 | 916 | 6,217 | 76,037 |
| Share | | 12% | 1% | 43% | 1% | 14% | 5% | 5% | 2% | 3% | 4% | 1% | 8% | 100% |
| NCR | Makati City | 1,018 | 186 | 4,952 | 255 | 2,214 | 798 | 1,410 | 882 | 324 | 666 | 121 | 1,156 | 13,982 |
| NCR | Muntinlupa City | 444 | 62 | 2,617 | 62 | 632 | 216 | 286 | 82 | 146 | 222 | 55 | 362 | 5,186 |
| NCR | Pasig City | 1,051 | 146 | 4,467 | 126 | 1,189 | 511 | 649 | 374 | 270 | 424 | 139 | 752 | 10,098 |
| NCR | Pateros | 114 | 5 | 211 | 7 | 75 | 41 | 47 | 2 | 19 | 44 | 19 | 60 | 644 |
| NCR | Taguig City | 747 | 25 | 3,099 | 61 | 984 | 335 | 322 | 100 | 184 | 248 | 73 | 670 | 6,848 |
| Rizal | Angono | 179 | 4 | 700 | 4 | 202 | 78 | 46 | 22 | 33 | 76 | 23 | 136 | 1,503 |
| Rizal | Baras | 51 | 1 | 168 | 0 | 50 | 23 | 6 | 3 | 6 | 7 | 4 | 27 | 346 |
| Rizal | Cainta | 595 | 26 | 2,056 | 22 | 660 | 228 | 135 | 31 | 120 | 193 | 87 | 574 | 4,727 |
| Rizal | Jalajala | 26 | 0 | 88 | 0 | 31 | 16 | 3 | 1 | 8 | 2 | 3 | 14 | 192 |
| Rizal | Morong | 98 | 1 | 238 | 1 | 77 | 39 | 30 | 6 | 17 | 30 | 13 | 53 | 603 |
| Rizal | Pililia | 79 | 2 | 224 | 1 | 80 | 29 | 5 | 15 | 13 | 5 | 8 | 33 | 494 |
| Rizal | Tanay | 184 | 3 | 849 | 6 | 220 | 68 | 70 | 78 | 32 | 60 | 23 | 119 | 1,712 |
| Rizal | Taytay | 1,136 | 39 | 2,009 | 21 | 560 | 263 | 106 | 47 | 95 | 157 | 60 | 384 | 4,877 |
| Rizal | Cardona | 65 | 0 | 164 | 0 | 39 | 18 | 5 | 8 | 7 | 6 | 7 | 26 | 345 |
| Rizal | Binangonan | 239 | 9 | 1,232 | 7 | 317 | 129 | 73 | 2 | 60 | 62 | 20 | 168 | 2,318 |
| Laguna | Bay | 100 | 5 | 342 | 0 | 106 | 49 | 10 | 3 | 20 | 13 | 6 | 38 | 692 |
| Laguna | Binan | 456 | 8 | 938 | 51 | 202 | 114 | 89 | 28 | 68 | 64 | 24 | 164 | 2,206 |
| Laguna | Cabuyao | 394 | 15 | 1,502 | 41 | 308 | 202 | 76 | 59 | 103 | 81 | 27 | 239 | 3,047 |
| Laguna | Calauan | 39 | 0 | 154 | 1 | 32 | 13 | 15 | 0 | 8 | 10 | 2 | 16 | 290 |
| Laguna | City of Calamba | 736 | 24 | 1,854 | 51 | 1,095 | 233 | 215 | 51 | 139 | 146 | 74 | 364 | 4,982 |
| Laguna | Famy | 5 | 0 | 32 | 0 | 7 | 0 | 1 | 0 | 1 | 0 | 0 | 3 | 49 |
| Laguna | Kalayaan | 25 | 0 | 65 | 0 | 23 | 10 | 1 | 0 | 2 | 1 | 5 | 5 | 137 |
| Laguna | Los Banos | 100 | 2 | 485 | 7 | 241 | 61 | 65 | 23 | 36 | 37 | 10 | 80 | 1,147 |
| Laguna | Lumban | 144 | 2 | 117 | 0 | 29 | 42 | 8 | 1 | 5 | 2 | 2 | 17 | 369 |
| Laguna | Mabitac | 20 | 0 | 19 | 3 | 13 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 64 |
| Laguna | Paete | 80 | 0 | 164 | 0 | 43 | 25 | 14 | 0 | 6 | 7 | 5 | 22 | 366 |
| Laguna | Pagsanjan | 58 | 0 | 146 | 4 | 58 | 17 | 16 | 1 | 9 | 10 | 3 | 22 | 344 |
| Laguna | Pakil | 28 | 0 | 48 | 0 | 29 | 12 | 4 | 0 | 3 | 8 | 3 | 9 | 144 |
| Laguna | Pangil | 22 | 0 | 44 | 0 | 15 | 19 | 2 | 0 | 3 | 0 | 0 | 4 | 109 |
| Laguna | Pila | 70 | 2 | 181 | 0 | 45 | 27 | 8 | 3 | 10 | 21 | 3 | 28 | 398 |
| Laguna | San Pedro | 455 | 18 | 1,180 | 24 | 297 | 281 | 138 | 32 | 117 | 136 | 40 | 278 | 2,996 |
| Laguna | Santa Cruz | 128 | 2 | 719 | 6 | 150 | 60 | 94 | 5 | 33 | 50 | 12 | 84 | 1,343 |
| Laguna | Santa Rosa | 340 | 19 | 1,061 | 31 | 347 | 130 | 143 | 28 | 100 | 123 | 37 | 260 | 2,619 |
| Laguna | Siniloan | 61 | 1 | 377 | 1 | 41 | 24 | 28 | 0 | 5 | 27 | 5 | 31 | 601 |
| Laguna | Victoria | 37 | 0 | 143 | 0 | 20 | 26 | 7 | 0 | 6 | 1 | 1 | 18 | 259 |

Appendix 3-5 Crop Area of Each Crop, Harvest Volume, Price

| Crop | Country | | Laguna | | Rizal | | Farmgate Price (2017) |
|---|---|---|---|---|---|---|---|
| | Production (ton) | Area (ha) | Production (ton) | Area (ha) | Production (ton) | Area (ha) | (PHP/kg) |
| **Palay** | **18,967,826** | **4,739,672** | **130,904** | **30,619** | **27,243** | **8,073** | **10.46** |
| - Irrigated Palay | 14,405,716 | 3,253,080 | 130,383 | 30,370 | 22,107 | 6,428 | |
| - Raifed Palay | 4,562,110 | 1,486,592 | 521 | 249 | 5,136 | 1,645 | |
| **Corn** | **7,770,603** | **2,611,432** | **2,249** | **1,007** | **1,660** | **551** | **9.32** |
| - White Corn | 2,262,234 | 1,290,213 | 1,455 | 797 | 759 | 363 | |
| - Yellow Corn | 5,508,369 | 1,321,219 | 794 | 210 | 901 | 188 | |
| **Major Cereal 'Total** | | **7,351,104** | | **31,626** | | **8,624** | |
| | | | | | | | |
| Coconut | 14,696,298 | 3,502,011 | 96,110 | 62,200 | 720 | 270 | 7.84 |
| Coffee | 75,454 | 117,451 | 81 | 620 | 82 | 60 | 30.01 |
| Sugarcane | 25,029,880 | 432,026 | 11,250 | 146 | 0 | 0 | **3.28** |
| Banana | 8,884,857 | 442,751 | 15,867 | 6,642 | 3,347 | 2,042 | 9.99 |
| Calamansi | 160,740 | 20,065 | 360 | 420 | 719 | 72 | 19.94 |
| Mango | 885,038 | 188,092 | 557 | 187 | 1,241 | 813 | 25.16 |
| Pinapple | 2,507,098 | 61,643 | 12,670 | 1,020 | 513 | 42 | 12.03 |
| Sweet Potato | 519,855 | 88,968 | 1,125 | 157 | 751 | 96 | 14.99 |
| Cassava | 2,540,254 | 216,775 | 1,970 | 150 | 938 | 110 | 6.29 |
| Eggplant | 225,579 | 21,159 | 1,759 | 159 | 592 | 70 | 24.23 |
| Peanut | 29,196 | 25,048 | 19 | 9 | 38 | 56 | 31.33 |
| Tomato | 214,573 | 16,742 | 6,573 | 520 | 159 | 23 | 16.48 |
| **Other Crops Total** | | **5,186,574** | | **72,284** | | **3,661** | |
| **Total** | | **12,537,678** | | **103,910** | | **12,285** | |

Note: Price of Sugarcane is converted from the price of sugar price

Source : MAJOR CROPS STATISTICS OF THE PHILIPPINES, 2010-2014, PSA

## Appendix 3-6 Economic Price Calculation of Rice and Corn

| | Import Parity | | |
|---|---|---|---|
| | Operation | US$/ton | PHP/Kg |
| 1. Price Forecast of rice, Bangkok, Thailand, f.o.b. | | 344.0 | |
| 2. Quality Adjustment 95 (10% broken) | | 326.8 | |
| 3. Insurance, freight, etc. | | 30.0 | |
| 4. Forecast 2017 c.i.f. price of rice, Manila | | 356.8 | |
| | | | 18.36 |
| 5. Port handling, storage and losses | 5% + | | 0.92 |
| 6. Transportation (port to wholesaler) | + | | 1.00 |
| 7. Ex-wholesaler price | | | 20.28 |
| 8. Merketing Margin | 10% - | | 2.03 |
| 9. Local transportation (village to wholesaler) | - | | 1.00 |
| 10. Value of Milled Rice | | | 17.25 |
| 11. Conversion of Paddy | 65% | | 11.21 |
| 12. Milling Cost | - | | 0.50 |
| 13. Revenue of Rice Bran | + | | 0.75 |
| 14. Transportation and Stabilization of Rice Bran | - | | 0.50 |
| 15. Local transportation (farm to village) | - | | 0.50 |
| 16. Economic farm gate price | | | **10.46** |
| 15. Average economic farm gate price of import and export parity | | | |

1.Thai 5% broken rice, price forecast in nominal US$ in 2030, converted to 2017 constant price (Source: Commodity Market Outlook, April 2017, World Bank)

- Projection in 2030 440 USD/ton
- MUV index 2017-2030 1.280 USD/ton
- Projection in 2030 by constant price in 2017 344 USD/ton

4.1US$=51,45PHP (Oct./2017)

11.Milling recovery is assumed at 65% for paddy

### Economic Price Calculation of Corn

| | Import Parity | | |
|---|---|---|---|
| | Operation | US$/ton | IDR/Kg |
| 1. Price Forecast of maize, Gulf Ports, USA, f.o.b. | | 164.0 | |
| 2. Insurance, freight, etc. | | 40.0 | |
| 3. Forecast 2017 c.i.f. price of maize, Jakarta | | 204.0 | |
| | | | 10.50 |
| 4. Port handling, storage and losses | 5% + | | 0.52 |
| 5. Transportation (port to wholesaler) | + | | 1.00 |
| 6. Ex-wholesaler price | | | 12.02 |
| 7. Merketing Margin | 10% - | | 1.20 |
| 8. Local transportation (village to wholesaler) | - | | 1.00 |
| 9. Local transportation (farm to village) | - | | 0.50 |
| 10. Economic farm gate price | | | **9.32** |
| 11. Average economic farm gate price of import and export parity | | | |

1.USA maize, forecast in nominal US$ in 2030, converted to 2017 constant price (Source: Commodity Market Outlook, April 2017, World Bank)

- Projection in 2030210 USD/ton
- MUV index 2017-2030 1.280 USD/ton
- Projection in 2030 by constant price in 2017 164 USD/ton

4.1US$=51,45PHP (Oct./2017)

# Appendix 3-7 Benefit Amount for Annual Average Damage Mitigation

| No. | Province | LGU | Annual Benefit (PHP/year) | 2017 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 | 2045 | 2046 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metro Manila | | | 0.98% | 0.70% | 0.70% | 0.70% | 0.70% | 0.70% | 0.52% | 0.52% | 0.52% | 0.52% | 0.52% | 0.35% | 0.35% | 0.35% | 0.35% | 0.35% | 0.20% | 0.20% | 0.20% | 0.20% | 0.20% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| | Laguna | | | 2.35% | 2.18% | 2.18% | 2.18% | 2.18% | 2.18% | 2.06% | 2.06% | 2.06% | 2.06% | 2.06% | 1.91% | 1.91% | 1.91% | 1.91% | 1.91% | 1.81% | 1.81% | 1.81% | 1.81% | 1.81% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% |
| | Rizal | | | 2.50% | 2.32% | 2.32% | 2.32% | 2.32% | 2.32% | 2.14% | 2.14% | 2.14% | 2.14% | 2.14% | 1.99% | 1.99% | 1.99% | 1.99% | 1.99% | 1.89% | 1.89% | 1.89% | 1.89% | 1.89% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% |
| 1 | Metro Manila | Taguig City | 156,995,316 | | 161,656,359 | 162,787,954 | 163,927,470 | 165,074,962 | 166,230,487 | 167,394,100 | 168,264,549 | 169,139,525 | 170,019,051 | 170,903,150 | 171,791,846 | 172,393,117 | 172,996,493 | 173,601,981 | 174,209,588 | 174,819,322 | 175,168,961 | 175,519,299 | 175,870,338 | 176,222,079 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 |
| 2 | Metro Manila | Muntinlupa City | 312,939,788 | | 322,230,676 | 324,486,291 | 326,757,693 | 329,044,999 | 331,348,314 | 333,667,752 | 335,402,824 | 337,146,919 | 338,900,083 | 340,662,363 | 342,433,807 | 343,632,325 | 344,835,038 | 346,041,961 | 347,253,108 | 348,468,494 | 349,165,431 | 349,863,762 | 350,563,490 | 351,264,617 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 |
| 3 | Laguna | San Pedro | 177,685,731 | | 190,509,262 | 194,662,364 | 198,906,004 | 203,242,155 | 207,672,834 | 212,200,102 | 216,571,424 | 221,032,795 | 225,586,071 | 230,233,144 | 234,975,947 | 239,463,988 | 244,037,750 | 248,698,871 | 253,449,019 | 258,289,895 | 262,964,942 | 267,724,607 | 272,570,422 | 277,503,947 | 282,526,768 | 287,301,470 | 292,156,865 | 297,094,316 | 302,115,210 | 307,220,957 | 312,412,991 |
| 4 | Laguna | Biñan | 387,328,950 | | 415,282,383 | 424,335,539 | 433,586,054 | 443,038,230 | 452,696,463 | 462,565,246 | 472,094,090 | 481,819,228 | 491,744,704 | 501,874,645 | 512,213,263 | 521,996,536 | 531,966,670 | 542,127,233 | 552,481,863 | 563,034,267 | 573,225,187 | 583,600,563 | 594,161,733 | 604,918,097 | 615,867,115 | 626,275,269 | 636,859,321 | 647,622,244 | 658,567,000 | 669,696,843 | 681,014,720 |
| 5 | Laguna | Santa Rosa | 138,069,098 | | 148,033,507 | 151,260,637 | 154,558,119 | 157,927,486 | 161,370,305 | 164,888,178 | 168,284,874 | 171,751,542 | 175,289,624 | 178,900,590 | 182,585,942 | 186,073,333 | 189,627,334 | 193,249,216 | 196,940,276 | 200,701,835 | 204,334,538 | 208,032,993 | 211,798,390 | 215,631,941 | 219,534,879 | 223,245,018 | 227,017,859 | 230,854,461 | 234,755,901 | 238,723,276 | 242,757,699 |
| 6 | Laguna | Cabuyao | 352,655,208 | | 378,106,238 | 386,348,954 | 394,771,361 | 403,377,377 | 412,171,004 | 421,156,332 | 429,832,152 | 438,686,694 | 447,723,640 | 456,946,747 | 466,359,850 | 475,267,323 | 484,344,929 | 493,595,917 | 503,023,599 | 512,631,350 | 521,909,977 | 531,356,548 | 540,974,102 | 550,765,733 | 560,734,593 | 570,211,008 | 579,847,574 | 589,646,998 | 599,612,032 | 609,745,475 | 620,050,174 |
| 7 | Laguna | City of Calamba | 146,492,232 | | 157,064,536 | 160,488,543 | 163,987,193 | 167,562,114 | 171,214,968 | 174,947,454 | 178,551,372 | 182,229,530 | 185,983,458 | 189,814,717 | 193,724,900 | 197,425,046 | 201,195,864 | 205,038,705 | 208,954,944 | 212,945,983 | 216,800,305 | 220,724,391 | 224,719,502 | 228,786,925 | 232,927,968 | 236,864,451 | 240,867,460 | 244,938,120 | 249,077,574 | 253,286,985 | 257,567,535 |
| 8 | Laguna | Los Baños | 85,852,344 | | 92,048,284 | 94,054,937 | 96,105,335 | 98,200,431 | 100,341,200 | 102,528,638 | 104,640,728 | 106,796,327 | 108,996,331 | 111,241,653 | 113,533,233 | 115,701,718 | 117,911,621 | 120,163,733 | 122,458,860 | 124,797,824 | 127,056,665 | 129,356,391 | 131,697,742 | 134,081,471 | 136,508,346 | 138,815,337 | 141,161,316 | 143,546,942 | 145,972,885 | 148,439,827 | 150,948,460 |
| 9 | Laguna | Bay | 143,852,858 | | 154,234,680 | 157,596,996 | 161,032,611 | 164,543,122 | 168,130,162 | 171,795,400 | 175,334,385 | 178,946,273 | 182,632,566 | 186,394,797 | 190,234,530 | 193,868,010 | 197,570,889 | 201,344,493 | 205,190,173 | 209,109,305 | 212,894,183 | 216,747,568 | 220,670,699 | 224,664,859 | 228,731,273 | 232,596,832 | 236,527,718 | 240,525,036 | 244,589,909 | 248,723,478 | 252,926,905 |
| 10 | Laguna | Calauan | 2,415,235 | | 2,589,542 | 2,645,994 | 2,703,677 | 2,762,617 | 2,822,842 | 2,884,380 | 2,943,798 | 3,004,440 | 3,066,331 | 3,129,497 | 3,193,965 | 3,254,970 | 3,317,140 | 3,380,497 | 3,445,064 | 3,510,865 | 3,574,412 | 3,639,109 | 3,704,977 | 3,772,037 | 3,840,311 | 3,905,212 | 3,971,210 | 4,038,323 | 4,106,571 | 4,175,972 | 4,246,546 |
| 11 | Laguna | Victoria | 90,661,191 | | 97,204,184 | 99,323,235 | 101,488,482 | 103,700,931 | 105,961,611 | 108,271,574 | 110,501,968 | 112,778,309 | 115,101,542 | 117,472,634 | 119,892,570 | 122,182,518 | 124,516,204 | 126,894,463 | 129,318,147 | 131,788,124 | 134,173,489 | 136,602,029 | 139,074,526 | 141,591,775 | 144,154,586 | 146,590,739 | 149,068,184 | 151,587,436 | 154,149,264 | 156,754,387 | 159,403,536 |
| 12 | Laguna | Pila | 88,319,880 | | 94,693,902 | 96,758,229 | 98,867,558 | 101,022,871 | 103,225,170 | 105,475,479 | 107,648,274 | 109,865,828 | 112,129,064 | 114,438,923 | 116,796,365 | 119,027,176 | 121,300,595 | 123,617,436 | 125,978,529 | 128,384,719 | 130,708,482 | 133,074,306 | 135,482,951 | 137,935,192 | 140,431,819 | 142,805,117 | 145,218,523 | 147,672,716 | 150,168,385 | 152,706,231 | 155,286,966 |
| 13 | Laguna | Santa Cruz | 237,933,455 | | 255,105,048 | 260,666,238 | 266,348,864 | 272,155,269 | 278,088,254 | 284,150,578 | 290,004,080 | 295,978,164 | 302,075,314 | 308,298,065 | 314,649,085 | 320,658,801 | 326,783,384 | 333,024,947 | 339,385,723 | 345,867,990 | 352,128,201 | 358,501,721 | 364,990,602 | 371,596,932 | 378,322,836 | 384,716,492 | 391,218,201 | 397,829,789 | 404,553,112 | 411,390,068 | 418,342,552 |
| 14 | Laguna | Pagsanjan | 13,746,828 | | 14,738,933 | 15,060,242 | 15,388,555 | 15,724,025 | 16,066,809 | 16,417,065 | 16,755,257 | 17,100,415 | 17,452,684 | 17,812,209 | 18,179,141 | 18,526,363 | 18,880,217 | 19,240,829 | 19,608,329 | 19,982,848 | 20,344,538 | 20,712,774 | 21,087,675 | 21,469,362 | 21,837,957 | 22,227,356 | 22,602,998 | 22,984,989 | 23,373,435 | 23,768,446 | 24,170,133 |
| 15 | Laguna | Lumban | 56,679,219 | | 60,769,743 | 62,094,522 | 63,448,184 | 64,831,354 | 66,244,078 | 67,688,812 | 69,083,202 | 70,506,216 | 71,958,746 | 73,441,066 | 74,953,983 | 76,385,604 | 77,844,569 | 79,331,408 | 80,846,639 | 82,390,801 | 83,882,074 | 85,400,340 | 86,946,086 | 88,519,810 | 90,122,019 | 91,645,081 | 93,193,883 | 94,768,869 | 96,370,454 | 97,999,115 | 99,655,300 |
| 16 | Laguna | Kalayaan | 2,380,627 | | 2,552,436 | 2,608,079 | 2,664,935 | 2,723,031 | 2,782,393 | 2,843,049 | 2,901,616 | 2,961,389 | 3,022,394 | 3,084,655 | 3,148,199 | 3,208,330 | 3,269,609 | 3,332,059 | 3,395,701 | 3,460,559 | 3,523,195 | 3,586,965 | 3,651,889 | 3,717,988 | 3,785,284 | 3,849,255 | 3,914,307 | 3,980,459 | 4,047,729 | 4,116,136 | 4,185,699 |
| 17 | Laguna | Paete | 162,912,322 | | 174,669,660 | 178,477,459 | 182,368,268 | 186,343,896 | 190,406,193 | 194,557,048 | 198,564,923 | 202,655,360 | 206,830,060 | 211,090,759 | 215,439,229 | 219,554,118 | 223,747,602 | 228,021,181 | 232,376,386 | 236,814,775 | 241,101,122 | 245,465,052 | 249,907,969 | 254,431,303 | 259,036,510 | 263,414,227 | 267,865,927 | 272,392,861 | 276,996,300 | 281,677,537 | 286,437,887 |
| 18 | Laguna | Pakil | 21,309,804 | | 22,847,726 | 23,345,806 | 23,854,745 | 24,374,778 | 24,906,148 | 25,449,102 | 25,973,354 | 26,508,405 | 27,054,478 | 27,611,800 | 28,180,603 | 28,718,853 | 29,267,380 | 29,826,390 | 30,396,074 | 30,976,639 | 31,537,316 | 32,108,141 | 32,689,298 | 33,280,974 | 33,883,360 | 34,455,989 | 35,038,295 | 35,630,442 | 36,232,596 | 36,844,927 | 37,467,606 |
| 19 | Laguna | Pangil | 20,172,048 | | 21,627,860 | 22,099,347 | 22,581,113 | 23,073,381 | 23,576,381 | 24,090,146 | 24,586,607 | 25,093,091 | 25,610,009 | 26,137,575 | 26,676,009 | 27,185,521 | 27,704,764 | 28,233,923 | 28,773,193 | 29,322,761 | 29,853,503 | 30,393,851 | 30,943,980 | 31,504,066 | 32,074,290 | 32,616,346 | 33,167,562 | 33,728,094 | 34,298,099 | 34,877,737 | 35,467,171 |
| 20 | Laguna | Siniloan | 85,749,929 | | 91,938,470 | 93,942,737 | 95,990,689 | 98,083,286 | 100,221,502 | 102,406,331 | 104,515,901 | 106,668,929 | 108,866,309 | 111,108,955 | 113,397,799 | 115,563,607 | 117,770,964 | 120,020,839 | 122,312,778 | 124,648,952 | 126,905,098 | 129,202,080 | 131,540,638 | 133,921,524 | 136,345,504 | 138,649,743 | 140,992,924 | 143,375,704 | 145,798,753 | 148,262,752 | 150,768,393 |
| 21 | Laguna | Famy | 3,603,360 | | 3,863,413 | 3,947,635 | 4,033,693 | 4,121,628 | 4,211,479 | 4,303,289 | 4,391,937 | 4,482,411 | 4,574,749 | 4,668,989 | 4,765,170 | 4,856,185 | 4,948,938 | 5,043,463 | 5,139,793 | 5,237,963 | 5,332,770 | 5,429,293 | 5,527,563 | 5,627,612 | 5,729,472 | 5,826,300 | 5,924,764 | 6,024,893 | 6,126,714 | 6,230,255 | 6,335,546 |
| 22 | Laguna | Mabitac | 15,977,445 | | 17,130,533 | 17,503,979 | 17,885,566 | 18,275,471 | 18,673,876 | 19,080,966 | 19,474,034 | 19,875,199 | 20,284,628 | 20,702,491 | 21,128,962 | 21,532,525 | 21,943,796 | 22,362,923 | 22,790,055 | 23,225,345 | 23,645,724 | 24,073,712 | 24,509,446 | 24,953,067 | 25,404,718 | 25,834,058 | 26,270,654 | 26,714,628 | 27,166,105 | 27,625,212 | 28,092,078 |
| 23 | Rizal | Jala-jala | 32,024,274 | | 34,486,640 | 35,286,730 | 36,105,382 | 36,943,027 | 37,800,105 | 38,677,067 | 39,504,756 | 40,350,158 | 41,213,651 | 42,095,623 | 42,996,469 | 43,852,099 | 44,724,756 | 45,614,779 | 46,522,513 | 47,448,311 | 48,345,084 | 49,258,806 | 50,189,797 | 51,138,384 | 52,104,899 | 53,027,156 | 53,965,737 | 54,920,931 | 55,893,031 | 56,882,338 | 57,889,155 |
| 24 | Rizal | Pililla | 51,220,457 | | 55,158,830 | 56,439,515 | 57,747,889 | 59,087,640 | 60,458,473 | 61,861,110 | 63,184,938 | 64,537,096 | 65,918,190 | 67,328,839 | 68,769,676 | 70,138,193 | 71,533,943 | 72,957,468 | 74,409,322 | 75,890,068 | 77,324,390 | 78,785,821 | 80,274,873 | 81,792,068 | 83,337,930 | 84,813,020 | 86,314,210 | 87,841,972 | 89,396,773 | 90,979,098 | 92,589,428 |
| 25 | Rizal | Tanay | 117,132,795 | | 126,139,208 | 129,065,638 | 132,059,961 | 135,123,752 | 138,258,623 | 141,466,222 | 144,493,600 | 147,585,763 | 150,744,098 | 153,970,022 | 157,264,980 | 160,193,543 | 163,586,405 | 166,841,774 | 170,161,925 | 173,548,147 | 176,828,207 | 180,170,260 | 183,575,478 | 187,045,055 | 190,580,207 | 193,953,477 | 197,386,454 | 200,880,194 | 204,435,773 | 208,054,286 | 211,736,847 |
| 26 | Rizal | Baras | 16,651,887 | | 17,932,261 | 18,348,289 | 18,773,969 | 19,209,525 | 19,655,186 | 20,111,186 | 20,541,565 | 20,981,154 | 21,430,151 | 21,888,756 | 22,357,175 | 22,802,083 | 23,255,844 | 23,718,635 | 24,190,636 | 24,672,030 | 25,138,331 | 25,613,445 | 26,097,539 | 26,590,782 | 27,093,348 | 27,572,900 | 28,060,940 | 28,557,619 | 29,063,089 | 29,577,506 | 30,101,028 |
| 27 | Rizal | Morong | 60,733,742 | | 65,403,597 | 66,920,960 | 68,473,526 | 70,062,112 | 71,687,553 | 73,350,704 | 74,920,409 | 76,523,706 | 78,161,313 | 79,833,965 | 81,542,412 | 83,165,106 | 84,820,092 | 86,508,012 | 88,229,521 | 89,985,288 | 91,686,010 | 93,418,876 | 95,184,493 | 96,983,480 | 98,816,468 | 100,565,519 | 102,345,529 | 104,157,045 | 106,000,625 | 107,876,836 | 109,786,256 |
| 28 | Rizal | Cardona | 41,467,832 | | 44,656,320 | 45,692,247 | 46,752,409 | 47,837,065 | 48,946,885 | 50,082,453 | 51,154,217 | 52,248,917 | 53,367,044 | 54,509,099 | 55,675,594 | 56,783,538 | 57,913,530 | 59,066,009 | 60,241,423 | 61,440,227 | 62,601,447 | 63,784,614 | 64,990,143 | 66,218,457 | 67,469,986 | 68,664,205 | 69,879,561 | 71,116,429 | 72,375,190 | 73,656,231 | 74,959,946 |
| 29 | Rizal | Binangonan | 188,878,976 | | 203,401,999 | 208,120,925 | 212,949,210 | 217,889,754 | 222,944,796 | 228,117,115 | 232,998,821 | 237,984,996 | 243,077,875 | 248,279,742 | 253,592,928 | 258,639,427 | 263,786,352 | 269,035,700 | 274,389,510 | 279,849,861 | 285,139,023 | 290,528,151 | 296,019,133 | 301,613,895 | 307,314,398 | 312,753,863 | 318,289,606 | 323,923,332 | 329,656,275 | 335,491,700 | 341,429,903 |
| 30 | Rizal | Angono | 146,598,412 | | 157,870,455 | 161,533,050 | 165,280,817 | 169,115,127 | 173,038,298 | 177,053,093 | 180,842,029 | 184,712,048 | 188,664,886 | 192,702,315 | 196,826,145 | 200,742,985 | 204,737,770 | 208,812,052 | 212,967,412 | 217,205,463 | 221,310,646 | 225,493,417 | 229,755,243 | 234,097,617 | 238,522,062 | 242,743,902 | 247,040,469 | 251,413,085 | 255,863,097 | 260,391,874 | 265,000,810 |
| 31 | Rizal | Taytay | 396,940,900 | | 427,462,031 | 437,379,150 | 447,526,346 | 457,908,957 | 468,532,445 | 479,402,298 | 489,661,609 | 500,140,367 | 510,843,371 | 521,775,419 | 532,941,413 | 543,546,947 | 554,368,531 | 565,395,365 | 576,646,733 | 588,122,003 | 599,227,500 | 610,563,018 | 622,102,741 | 633,860,483 | 645,840,446 | 657,271,822 | 668,905,533 | 680,745,161 | 692,794,350 | 705,056,810 | 717,536,316 |
| | | | | **3,755,382,239** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | **4,011,408,724** | **4,093,281,422** | **4,176,925,600** | **4,262,380,373** | **4,349,685,737** | **4,438,888,257** | **4,528,623,293** | **4,610,091,294** | **4,698,322,415** | **4,788,353,216** | **4,880,221,110** | **4,963,550,283** | **5,054,503,976** | **5,144,141,806** | **5,235,486,827** | **5,328,572,014** | **5,417,840,760** | **5,508,731,983** | **5,601,275,458** | **5,695,501,512** | **5,791,441,029** | **5,881,732,893** | **5,973,615,253** | **6,067,054,748** | **6,162,098,462** | **6,258,773,956** | **6,357,109,255** |
| | | | | **6,457,132,872** | **6,55,8,873,803** | **6,662,361,551** | **6,767,626,124** | **6,874,698,040** | **6,983,608,345** | **7,094,388,428** | **7,207,071,004** | **7,321,888,141** | **7,438,272,851** | **7,556,860,245** | **7,677,483,402** | **7,800,177,746** | **7,924,978,847** | **8,051,922,904** | **8,181,040,724** | **8,312,187,761** | **8,445,984,106** | **8,581,874,583** | **8,720,098,359** | **8,860,659,577** | **9,003,707,511** | **9,149,175,061** | **9,297,140,613** | **9,447,647,083** | **9,600,738,125** | **9,756,458,143** | **9,914,852,318** | **10,075,946,567** | **10,239,847,053** | **10,406,543,804** | **10,576,101,271** | **10,748,571,345** |

| No. | Province | LGU | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Metro Manila | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| | Laguna | | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% | 1.69% |
| | Rizal | | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% | 1.77% |
| 1 | Metro Manila | Taguig City | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 | 176,574,523 |
| 2 | Metro Manila | Muntinlupa City | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 | 351,967,146 |
| 3 | Laguna | San Pedro | 317,692,771 | 323,061,279 | 328,521,523 | 334,073,537 | 339,719,380 | 345,460,638 | 351,298,923 | 357,235,875 | 363,273,161 | 369,412,477 | 375,655,548 | 382,004,127 | 388,459,997 | 395,024,971 | 401,700,893 | 408,489,638 | 415,393,113 | 422,413,257 | 429,552,041 | 436,811,470 | 444,193,584 | 451,700,456 | 459,334,194 | 467,096,942 | 474,990,880 | 483,018,226 | 491,181,234 | 499,482,197 | 507,923,446 | 516,507,352 | 525,236,326 | 534,112,820 | 543,139,327 |
| 4 | Laguna | Biñan | 692,523,869 | 704,227,522 | 716,128,987 | 728,231,547 | 740,538,660 | 753,053,763 | 765,780,372 | 778,722,060 | 791,882,463 | 805,265,277 | 818,874,260 | 832,713,235 | 846,786,089 | 861,096,774 | 875,649,305 | 890,447,782 | 905,496,350 | 920,799,238 | 936,360,745 | 952,185,242 | 968,277,173 | 984,641,057 | 1,001,281,491 | 1,018,203,148 | 1,035,410,781 | 1,052,909,223 | 1,070,703,389 | 1,088,798,276 | 1,107,198,967 | 1,125,910,630 | 1,144,938,520 | 1,164,287,981 | 1,183,964,448 |
| 5 | Laguna | Santa Rosa | 246,860,304 | 251,032,243 | 255,274,688 | 259,588,830 | 263,975,881 | 268,437,073 | 272,973,660 | 277,586,915 | 282,278,134 | 287,048,634 | 291,899,756 | 296,832,862 | 301,849,337 | 306,950,591 | 312,138,054 | 317,413,189 | 322,777,472 | 328,232,411 | 333,779,509 | 339,420,413 | 345,156,118 | 350,989,765 | 356,921,492 | 362,953,465 | 369,087,379 | 375,324,956 | 381,667,948 | 388,116,136 | 394,677,332 | 401,347,379 | 408,130,159 | 415,027,250 | 422,041,516 |
| 6 | Laguna | Cabuyao | 630,529,022 | 641,184,962 | 652,020,988 | 663,040,143 | 674,245,521 | 685,640,270 | 697,227,591 | 709,010,737 | 720,993,018 | 733,177,800 | 745,568,505 | 758,168,613 | 770,981,663 | 784,011,253 | 797,261,043 | 810,734,755 | 824,436,172 | 838,369,143 | 852,537,582 | 866,945,467 | 881,596,845 | 896,495,832 | 911,646,612 | 927,053,440 | 942,720,643 | 958,652,622 | 974,853,851 | 991,328,881 | 1,008,082,339 | 1,025,118,931 | 1,042,443,441 | 1,060,060,735 | 1,077,975,761 |
| 7 | Laguna | City of Calamba | 261,920,426 | 266,346,881 | 270,848,143 | 275,425,477 | 280,080,168 | 284,813,523 | 289,626,872 | 294,521,566 | 299,498,980 | 304,560,513 | 309,707,586 | 314,941,644 | 320,264,158 | 325,676,622 | 331,180,557 | 336,777,508 | 342,469,048 | 348,256,775 | 354,142,314 | 360,127,319 | 366,213,471 | 372,402,479 | 378,696,081 | 385,096,045 | 391,604,168 | 398,222,278 | 404,952,234 | 411,795,927 | 418,755,278 | 425,832,242 | 433,028,807 | 440,346,994 | 447,788,858 |
| 8 | Laguna | Los Baños | 153,499,489 | 156,093,630 | 158,731,612 | 161,414,176 | 164,142,076 | 166,916,077 | 169,736,959 | 172,605,514 | 175,522,547 | 178,488,878 | 181,505,340 | 184,572,780 | 187,692,060 | 190,864,056 | 194,089,659 | 197,369,774 | 200,705,323 | 204,097,243 | 207,546,486 | 211,054,022 | 214,620,833 | 218,247,927 | 221,936,317 | 225,687,041 | 229,501,152 | 233,379,721 | 237,323,838 | 241,334,611 | 245,413,166 | 249,560,649 | 253,778,224 | 258,067,076 | 262,428,410 |
| 9 | Laguna | Bay | 257,201,370 | 261,548,073 | 265,968,235 | 270,463,098 | 275,033,924 | 279,681,997 | 284,408,623 | 289,215,129 | 294,102,865 | 299,073,203 | 304,127,540 | 309,267,295 | 314,493,912 | 319,808,859 | 325,213,629 | 330,709,739 | 336,298,734 | 341,982,183 | 347,761,682 | 353,638,854 | 359,615,351 | 365,692,850 | 371,873,059 | 378,157,714 | 384,548,579 | 391,047,450 | 397,656,152 | 404,376,541 | 411,210,505 | 418,159,963 | 425,226,866 | 432,413,200 | 439,720,983 |
| 10 | Laguna | Calauan | 4,318,313 | 4,391,292 | 4,465,505 | 4,540,973 | 4,617,714 | 4,695,753 | 4,775,111 | 4,855,810 | 4,937,875 | 5,021,323 | 5,106,183 | 5,192,477 | 5,280,230 | 5,369,466 | 5,460,210 | 5,552,488 | 5,646,325 | 5,741,748 | 5,838,784 | 5,937,459 | 6,037,802 | 6,139,841 | 6,243,604 | 6,349,121 | 6,456,421 | 6,565,535 | 6,676,493 | 6,789,326 | 6,904,066 | 7,020,745 | 7,139,396 | 7,260,052 | 7,382,747 |
| 11 | Laguna | Victoria | 162,097,456 | 164,836,903 | 167,622,647 | 170,455,470 | 173,336,167 | 176,265,548 | 179,244,436 | 182,273,667 | 185,354,092 | 188,486,576 | 191,671,999 | 194,911,256 | 198,205,256 | 201,554,925 | 204,961,203 | 208,425,047 | 211,947,430 | 215,529,342 | 219,171,788 | 222,875,791 | 226,642,392 | 230,472,648 | 234,367,636 | 238,328,449 | 242,356,200 | 246,452,020 | 250,617,059 | 254,852,487 | 259,159,494 | 263,539,289 | 267,993,103 | 272,522,186 | 277,127,811 |
| 12 | Laguna | Pila | 157,911,318 | 160,580,017 | 163,293,819 | 166,053,485 | 168,859,789 | 171,713,519 | 174,615,477 | 177,566,479 | 180,567,352 | 183,618,940 | 186,722,100 | 189,877,703 | 193,086,636 | 196,349,800 | 199,668,112 | 203,042,503 | 206,473,921 | 209,963,330 | 213,511,710 | 217,120,058 | 220,789,387 | 224,520,728 | 228,315,128 | 232,173,654 | 236,097,389 | 240,087,435 | 244,144,913 | 248,270,962 | 252,466,741 | 256,733,429 | 261,072,224 | 265,484,345 | 269,971,030 |
| 13 | Laguna | Santa Cruz | 425,412,541 | 432,602,013 | 439,912,987 | 447,347,516 | 454,907,689 | 462,595,629 | 470,413,495 | 478,363,483 | 486,447,826 | 494,668,794 | 503,028,697 | 511,529,882 | 520,174,737 | 528,965,650 | 537,905,210 | 546,995,808 | 556,240,037 | 565,640,494 | 575,199,818 | 584,920,695 | 594,805,853 | 604,858,074 | 615,080,175 | 625,475,030 | 636,045,558 | 646,794,728 | 657,725,559 | 668,841,121 | 680,144,536 | 691,638,979 | 703,327,670 | 715,213,916 | 727,301,031 |
| 14 | Laguna | Pagsanjan | 24,578,608 | 24,993,986 | 25,416,384 | 25,845,921 | 26,282,717 | 26,726,895 | 27,178,580 | 27,637,898 | 28,104,978 | 28,579,952 | 29,062,953 | 29,554,117 | 30,053,582 | 30,561,488 | 31,077,977 | 31,603,195 | 32,137,289 | 32,680,409 | 33,232,708 | 33,794,341 | 34,365,465 | 34,946,241 | 35,536,832 | 36,137,404 | 36,748,126 | 37,369,169 | 38,000,708 | 38,642,920 | 39,295,985 | 39,960,087 | 40,635,412 | 41,322,150 | 42,020,494 |
| 15 | Laguna | Lumban | 101,339,473 | 103,052,112 | 104,793,693 | 106,564,706 | 108,365,650 | 110,197,029 | 112,059,359 | 113,953,162 | 115,878,970 | 117,837,325 | 119,828,776 | 121,853,882 | 123,913,213 | 126,007,346 | 128,136,870 | 130,302,383 | 132,504,493 | 134,743,819 | 137,020,990 | 139,336,645 | 141,691,434 | 144,086,019 | 146,521,073 | 148,997,279 | 151,515,333 | 154,075,942 | 156,679,825 | 159,327,714 | 162,020,352 | 164,758,496 | 167,542,915 | 170,374,390 | 173,253,717 |
| 16 | Laguna | Kalayaan | 4,256,437 | 4,328,371 | 4,401,520 | 4,475,906 | 4,551,549 | 4,628,470 | 4,706,691 | 4,786,234 | 4,867,121 | 4,949,375 | 5,033,019 | 5,118,077 | 5,204,573 | 5,292,530 | 5,381,974 | 5,472,929 | 5,565,422 | 5,659,478 | 5,755,123 | 5,852,385 | 5,951,290 | 6,051,867 | 6,154,144 | 6,258,149 | 6,363,912 | 6,471,462 | 6,580,830 | 6,692,046 | 6,805,142 | 6,920,149 | 7,037,100 | 7,156,027 | 7,276,964 |
| 17 | Laguna | Paete | 291,278,687 | 296,201,297 | 301,207,099 | 306,297,499 | 311,473,927 | 316,737,836 | 322,090,705 | 327,534,038 | 333,069,363 | 338,698,235 | 344,422,235 | 350,242,971 | 356,162,077 | 362,181,216 | 368,302,078 | 374,526,384 | 380,855,880 | 387,292,344 | 393,837,585 | 400,493,440 | 407,261,779 | 414,144,503 | 421,143,545 | 428,260,871 | 435,498,489 | 442,858,404 | 450,342,711 | 457,953,503 | 465,692,917 | 473,563,127 | 481,566,344 | 489,704,815 | 497,980,826 |
| 18 | Laguna | Pakil | 38,100,809 | 38,744,713 | 39,399,499 | 40,065,351 | 40,742,455 | 41,431,002 | 42,131,186 | 42,843,203 | 43,567,253 | 44,303,540 | 45,052,270 | 45,813,653 | 46,587,904 | 47,375,240 | 48,175,882 | 48,990,054 | 49,817,986 | 50,659,910 | 51,516,062 | 52,386,683 | 53,272,018 | 54,172,315 | 55,087,827 | 56,018,811 | 56,965,529 | 57,928,246 | 58,907,233 | 59,902,765 | 60,915,122 | 61,944,588 | 62,991,452 | 64,056,008 | 65,138,555 |
| 19 | Laguna | Pangil | 36,066,566 | 36,676,091 | 37,295,917 | 37,926,218 | 38,567,171 | 39,218,956 | 39,881,756 | 40,555,758 | 41,241,150 | 41,938,125 | 42,646,879 | 43,367,611 | 44,100,524 | 44,845,823 | 45,603,717 | 46,374,420 | 47,158,148 | 47,955,121 | 48,765,563 | 49,589,701 | 50,427,767 | 51,279,996 | 52,146,628 | 53,027,906 | 53,924,078 | 54,835,395 | 55,762,113 | 56,704,493 | 57,662,799 | 58,637,300 | 59,628,270 | 60,635,988 | 61,660,736 |
| 20 | Laguna | Siniloan | 153,316,379 | 155,907,426 | 158,542,261 | 161,221,625 | 163,946,270 | 166,716,962 | 169,534,479 | 172,399,612 | 175,313,165 | 178,275,957 | 181,288,821 | 184,352,602 | 187,468,161 | 190,636,373 | 193,858,128 | 197,134,330 | 200,465,900 | 203,853,774 | 207,298,903 | 210,802,254 | 214,364,812 | 217,987,577 | 221,671,567 | 225,417,816 | 229,227,377 | 233,101,320 | 237,040,732 | 241,046,720 | 245,120,410 | 249,262,945 | 253,475,489 | 257,759,225 | 262,115,356 |
| 21 | Laguna | Famy | 6,442,617 | 6,551,497 | 6,662,217 | 6,774,808 | 6,889,302 | 7,005,731 | 7,124,128 | 7,244,526 | 7,366,958 | 7,491,460 | 7,618,066 | 7,746,811 | 7,877,733 | 8,010,866 | 8,146,254 | 8,283,922 | 8,423,920 | 8,566,284 | 8,711,054 | 8,858,271 | 9,007,976 | 9,160,211 | 9,315,019 | 9,472,443 | 9,632,527 | 9,795,317 | 9,960,858 | 10,129,197 | 10,300,380 | 10,474,456 | 10,651,474 | 10,831,484 | 11,014,536 |
| 22 | Laguna | Mabitac | 28,566,834 | 29,049,613 | 29,540,551 | 30,039,786 | 30,547,458 | 31,063,710 | 31,588,687 | 32,122,536 | 32,665,407 | 33,217,452 | 33,778,827 | 34,349,689 | 34,930,199 | 35,520,519 | 36,120,816 | 36,731,258 | 37,352,016 | 37,983,263 | 38,625,182 | 39,277,948 | 39,941,745 | 40,616,760 | 41,303,183 | 42,001,207 | 42,711,027 | 43,432,843 | 44,166,858 | 44,913,278 | 45,672,312 | 46,444,174 | 47,229,081 | 48,027,252 | 48,838,913 |
| 23 | Laguna | Pila | 58,913,793 | 59,956

**Economic Analysis of Pre F/S Project (Option1: Route1, Shield)**

(million PHP)

| Items | Total | NPV (D.R. 10%) | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| **Construction** | | | | | Spillway | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Phase I | | | | | | | | | Phase II | | | | | | | | Phase III | | |
| **Economic Cost** | **-52,029** | **-25,331** | **-964** | **-975** | **-3,418** | **-3,424** | **-5,406** | **-7,660** | **-7,338** | **-7,231** | **-5,323** | **-2,518** | **-516** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** |
| - Project Cost | -44,624 | -24,765 | -964 | -975 | -3,418 | -3,424 | -5,406 | -7,660 | -7,338 | -7,231 | -5,323 | -2,518 | -367 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -6,790 | -519 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 |
| - Cleaning Cost | -570 | -44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 |
| - Cleaning of Spillway | -45 | -3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **373,021** | **22,150** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **4,880** | **4,967** | **5,055** | **5,144** | **5,235** | **5,329** | **5,418** | **5,509** | **5,601** | **5,696** | **5,791** | **5,882** | **5,974** | **6,067** | **6,162** |
| - Benefit of Spillway | 373,021 | 22,150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,880 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Economic Cost** | **-52,029** | **-25,331** | -964 | -975 | -3,418 | -3,424 | -5,406 | -7,660 | -7,338 | -7,231 | -5,323 | -2,518 | -516 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 |
| **Economic Benefit** | **373,021** | **22,150** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,880 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Balance** | **320,992** | **-3,181** | **-964** | **-975** | **-3,418** | **-3,424** | **-5,406** | **-7,660** | **-7,338** | **-7,231** | **-5,323** | **-2,518** | **4,365** | **4,818** | **4,906** | **4,996** | **5,087** | **5,180** | **5,270** | **5,361** | **5,453** | **5,547** | **5,643** | **5,734** | **5,826** | **5,919** | **6,014** |
| | **B/C** | **0.87** | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **EIRR** | **9.1%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Benefits** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case2) Land Price Increase** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - Land Price Increase | 15,202 | 3,601 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 0 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | 336,194 | 420 | -964 | -975 | -3,418 | -3,424 | -5,406 | -7,660 | -7,338 | -7,231 | -5,323 | -2,518 | 5,885 | 6,339 | 6,427 | 6,516 | 6,608 | 6,701 | 6,790 | 6,881 | 6,973 | 7,068 | 5,643 | 5,734 | 5,826 | 5,919 | 6,014 |
| | **1.02** | **10.1%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case3) Case2) + Landfill** | **-1,930** | **-1,064** | 0 | 0 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| landfill Benefit | **9,000** | **3,154** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | **343,264** | **2,511** | -964 | -975 | -3,660 | -3,665 | -5,647 | -7,901 | -7,579 | -7,472 | -5,565 | -2,759 | 14,885 | 6,339 | 6,427 | 6,516 | 6,608 | 6,701 | 6,790 | 6,881 | 6,973 | 7,068 | 5,643 | 5,734 | 5,826 | 5,919 | 6,014 |
| | **1.11** | **10.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sensitivity Analsys (Case1)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S1) Cost +10%** | **-57,231** | **-27,864** | -1,060 | -1,072 | -3,760 | -3,766 | -5,946 | -8,426 | -8,072 | -7,954 | -5,856 | -2,769 | -567 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 |
| Cost-Benefit Flow | **315,789** | **-5,714** | -1,060 | -1,072 | -3,760 | -3,766 | -5,946 | -8,426 | -8,072 | -7,954 | -5,856 | -2,769 | 4,313 | 4,804 | 4,892 | 4,981 | 5,073 | 5,166 | 5,255 | 5,346 | 5,438 | 5,533 | 5,629 | 5,719 | 5,811 | 5,904 | 5,999 |
| | **0.79** | **8.5%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S2) Benefit -10%** | **335,719** | **19,935** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,392 | 4,470 | 4,549 | 4,630 | 4,712 | 4,796 | 4,876 | 4,958 | 5,041 | 5,126 | 5,212 | 5,294 | 5,376 | 5,460 | 5,546 |
| Cost-Benefit Flow | **283,690** | **-5,396** | -964 | -975 | -3,418 | -3,424 | -5,406 | -7,660 | -7,338 | -7,231 | -5,323 | -2,518 | 3,877 | 4,322 | 4,401 | 4,482 | 4,564 | 4,648 | 4,728 | 4,810 | 4,893 | 4,978 | 5,064 | 5,145 | 5,228 | 5,312 | 5,398 |
| | **0.79** | **8.4%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S3) Cost +10%, Benefit -10%** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost-Benefit Flow | **278,487** | **-7,929** | -1,060 | -1,072 | -3,760 | -3,766 | -5,946 | -8,426 | -8,072 | -7,954 | -5,856 | -2,769 | 3,825 | 4,307 | 4,386 | 4,467 | 4,549 | 4,633 | 4,713 | 4,795 | 4,878 | 4,963 | 5,049 | 5,131 | 5,213 | 5,297 | 5,383 |
| | **0.72** | **7.8%** | | | | | | | | | | | | | | | | | | | | | | | | | |

| Items | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 |
| | | | Phase III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Cost** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** |
| - Project Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 |
| - Cleaning Cost | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 |
| - Cleaning of Spillway | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **6,259** | **6,357** | **6,457** | **6,559** | **6,662** | **6,768** | **6,875** | **6,984** | **7,094** | **7,207** | **7,322** | **7,438** | **7,557** | **7,677** | **7,800** | **7,925** | **8,052** | **8,181** | **8,312** | **8,446** | **8,582** | **8,720** | **8,861** | **9,004** | **9,149** | **9,297** | **9,448** | **9,601** | **9,756** | **9,915** | **10,076** | **10,240** | **10,407** | **10,576** | **10,749** |
| - Benefit of Spillway | 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **Economic Cost** | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 |
| **Economic Benefit** | 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **Balance** | **6,111** | **6,209** | **6,309** | **6,411** | **6,514** | **6,620** | **6,727** | **6,836** | **6,946** | **7,059** | **7,174** | **7,290** | **7,409** | **7,529** | **7,652** | **7,777** | **7,904** | **8,033** | **8,164** | **8,298** | **8,434** | **8,572** | **8,713** | **8,856** | **9,001** | **9,149** | **9,300** | **9,453** | **9,608** | **9,767** | **9,928** | **10,092** | **10,258** | **10,428** | **10,600** |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6,111 | 6,209 | 6,309 | 6,411 | 6,514 | 6,620 | 6,727 | 6,836 | 6,946 | 7,059 | 7,174 | 7,290 | 7,409 | 7,529 | 7,652 | 7,777 | 7,904 | 8,033 | 8,164 | 8,298 | 8,434 | 8,572 | 8,713 | 8,856 | 9,001 | 9,149 | 9,300 | 9,453 | 9,608 | 9,767 | 9,928 | 10,092 | 10,258 | 10,428 | 10,600 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6,111 | 6,209 | 6,309 | 6,411 | 6,514 | 6,620 | 6,727 | 6,836 | 6,946 | 7,059 | 7,174 | 7,290 | 7,409 | 7,529 | 7,652 | 7,777 | 7,904 | 8,033 | 8,164 | 8,298 | 8,434 | 8,572 | 8,713 | 8,856 | 9,001 | 9,149 | 9,300 | 9,453 | 9,608 | 9,767 | 9,928 | 10,092 | 10,258 | 10,428 | 10,600 |
| | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 |
| | 6,096 | 6,194 | 6,294 | 6,396 | 6,499 | 6,605 | 6,712 | 6,821 | 6,931 | 7,044 | 7,159 | 7,275 | 7,394 | 7,515 | 7,637 | 7,762 | 7,889 | 8,018 | 8,149 | 8,283 | 8,419 | 8,557 | 8,698 | 8,841 | 8,986 | 9,134 | 9,285 | 9,438 | 9,594 | 9,752 | 9,913 | 10,077 | 10,244 | 10,413 | 10,586 |
| | 5,633 | 5,721 | 5,811 | 5,903 | 5,996 | 6,091 | 6,187 | 6,285 | 6,385 | 6,486 | 6,590 | 6,694 | 6,801 | 6,910 | 7,020 | 7,132 | 7,247 | 7,363 | 7,481 | 7,601 | 7,724 | 7,848 | 7,975 | 8,103 | 8,234 | 8,367 | 8,503 | 8,641 | 8,781 | 8,923 | 9,068 | 9,216 | 9,366 | 9,518 | 9,674 |
| | 5,485 | 5,573 | 5,663 | 5,755 | 5,848 | 5,943 | 6,039 | 6,137 | 6,237 | 6,338 | 6,441 | 6,546 | 6,653 | 6,762 | 6,872 | 6,984 | 7,099 | 7,215 | 7,333 | 7,453 | 7,576 | 7,700 | 7,827 | 7,955 | 8,086 | 8,219 | 8,355 | 8,493 | 8,633 | 8,775 | 8,920 | 9,068 | 9,218 | 9,370 | 9,526 |
| | 5,470 | 5,558 | 5,649 | 5,740 | 5,833 | 5,928 | 6,024 | 6,122 | 6,222 | 6,323 | 6,427 | 6,532 | 6,638 | 6,747 | 6,857 | 6,970 | 7,084 | 7,200 | 7,318 | 7,438 | 7,561 | 7,685 | 7,812 | 7,940 | 8,071 | 8,205 | 8,340 | 8,478 | 8,618 | 8,760 | 8,905 | 9,053 | 9,203 | 9,356 | 9,511 |

# Appendix 3-8 (2) Calculation Table of Economic Analysis (Option2 : Route1, NATM)

**Economic Analysis of Pre F/S Project (Option2: Route1, NATM)**

(million PHP)

| Items | Total | NPV (D.R. 10%) | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| **Construction** | | | | | Spillway | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Phase I | | | | | Phase II | | | | | | | | | | Phase III | | | | |
| **Economic Cost** | **-42,288** | **-19,330** | **-855** | **-866** | **-3,342** | **-3,348** | **-3,353** | **-3,866** | **-3,658** | **-3,664** | **-3,670** | **-5,044** | **-3,184** | **-329** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** |
| - Project Cost | -35,031 | -18,816 | -855 | -866 | -3,342 | -3,348 | -3,353 | -3,866 | -3,658 | -3,664 | -3,670 | -5,044 | -3,184 | -181 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -6,654 | -472 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 |
| - O&M of Machines | -559 | -40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 |
| - Cleaning of Spillway | -44 | -3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **368,140** | **20,439** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **4,967** | **5,055** | **5,144** | **5,235** | **5,329** | **5,418** | **5,509** | **5,601** | **5,696** | **5,791** | **5,882** | **5,974** | **6,067** | **6,162** |
| - Benefit of Spillway | 368,140 | 20,439 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Economic Cost** | **-42,288** | **-19,330** | -855 | -866 | -3,342 | -3,348 | -3,353 | -3,866 | -3,658 | -3,664 | -3,670 | -5,044 | -3,184 | -329 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 |
| **Economic Benefit** | **368,140** | **20,439** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Balance** | **325,853** | **1,109** | **-855** | **-866** | **-3,342** | **-3,348** | **-3,353** | **-3,866** | **-3,658** | **-3,664** | **-3,670** | **-5,044** | **-3,184** | **4,637** | **4,906** | **4,996** | **5,087** | **5,180** | **5,270** | **5,361** | **5,453** | **5,547** | **5,643** | **5,734** | **5,826** | **5,919** | **6,014** |
| | **B/C** | **1.06** | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **EIRR** | **10.4%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Benefits** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case2) Land Price Increase** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - Land Price Increase | 15,202 | 3,274 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | 341,054 | 4,383 | -855 | -866 | -3,342 | -3,348 | -3,353 | -3,866 | -3,658 | -3,664 | -3,670 | -5,044 | -3,184 | 6,157 | 6,427 | 6,516 | 6,608 | 6,701 | 6,790 | 6,881 | 6,973 | 7,068 | 7,164 | 5,734 | 5,826 | 5,919 | 6,014 |
| | **1.23** | **11.5%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case3) Case2) + Landfill** | **-1,930** | **-1,064** | 0 | 0 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| landfill Benefit | **9,000** | **3,154** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | **348,124** | **6,474** | -855 | -866 | -3,584 | -3,589 | -3,594 | -4,107 | -3,899 | -3,905 | -3,911 | -5,285 | 5,816 | 6,157 | 6,427 | 6,516 | 6,608 | 6,701 | 6,790 | 6,881 | 6,973 | 7,068 | 7,164 | 5,734 | 5,826 | 5,919 | 6,014 |
| | **1.38** | **12.3%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sensitivity Analsys (Case1)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S1) Cost +10%** | **-46,516** | **-21,263** | -941 | -952 | -3,677 | -3,682 | -3,688 | -4,253 | -4,024 | -4,030 | -4,037 | -5,548 | -3,502 | -362 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 |
| Cost-Benefit Flow | **321,624** | **-824** | -941 | -952 | -3,677 | -3,682 | -3,688 | -4,253 | -4,024 | -4,030 | -4,037 | -5,548 | -3,502 | 4,604 | 4,892 | 4,981 | 5,073 | 5,166 | 5,255 | 5,346 | 5,438 | 5,533 | 5,629 | 5,719 | 5,811 | 5,904 | 5,999 |
| | **0.96** | **9.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S2) Benefit -10%** | **331,326** | **18,395** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,470 | 4,549 | 4,630 | 4,712 | 4,796 | 4,876 | 4,958 | 5,041 | 5,126 | 5,212 | 5,294 | 5,376 | 5,460 | 5,546 |
| Cost-Benefit Flow | **289,039** | **-935** | -855 | -866 | -3,342 | -3,348 | -3,353 | -3,866 | -3,658 | -3,664 | -3,670 | -5,044 | -3,184 | 4,140 | 4,401 | 4,482 | 4,564 | 4,648 | 4,728 | 4,810 | 4,893 | 4,978 | 5,064 | 5,145 | 5,228 | 5,312 | 5,398 |
| | **0.95** | **9.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S3) Cost +10%, Benefit -10%** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost-Benefit Flow | **284,810** | **-2,868** | -941 | -952 | -3,677 | -3,682 | -3,688 | -4,253 | -4,024 | -4,030 | -4,037 | -5,548 | -3,502 | 4,108 | 4,386 | 4,467 | 4,549 | 4,633 | 4,713 | 4,795 | 4,878 | 4,963 | 5,049 | 5,131 | 5,213 | 5,297 | 5,383 |
| | **0.87** | **9.1%** | | | | | | | | | | | | | | | | | | | | | | | | | |

| 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 |
| | | Phase III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** | **-148** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 | -136 |
| -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 |
| -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| **6,259** | **6,357** | **6,457** | **6,559** | **6,662** | **6,768** | **6,875** | **6,984** | **7,094** | **7,207** | **7,322** | **7,438** | **7,557** | **7,677** | **7,800** | **7,925** | **8,052** | **8,181** | **8,312** | **8,446** | **8,582** | **8,720** | **8,861** | **9,004** | **9,149** | **9,297** | **9,448** | **9,601** | **9,756** | **9,915** | **10,076** | **10,240** | **10,407** | **10,576** | **10,749** |
| 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 | -148 |
| 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **6,111** | **6,209** | **6,309** | **6,411** | **6,514** | **6,620** | **6,727** | **6,836** | **6,946** | **7,059** | **7,174** | **7,290** | **7,409** | **7,529** | **7,652** | **7,777** | **7,904** | **8,033** | **8,164** | **8,298** | **8,434** | **8,572** | **8,713** | **8,856** | **9,001** | **9,149** | **9,300** | **9,453** | **9,608** | **9,767** | **9,928** | **10,092** | **10,258** | **10,428** | **10,600** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,111 | 6,209 | 6,309 | 6,411 | 6,514 | 6,620 | 6,727 | 6,836 | 6,946 | 7,059 | 7,174 | 7,290 | 7,409 | 7,529 | 7,652 | 7,777 | 7,904 | 8,033 | 8,164 | 8,298 | 8,434 | 8,572 | 8,713 | 8,856 | 9,001 | 9,149 | 9,300 | 9,453 | 9,608 | 9,767 | 9,928 | 10,092 | 10,258 | 10,428 | 10,600 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,111 | 6,209 | 6,309 | 6,411 | 6,514 | 6,620 | 6,727 | 6,836 | 6,946 | 7,059 | 7,174 | 7,290 | 7,409 | 7,529 | 7,652 | 7,777 | 7,904 | 8,033 | 8,164 | 8,298 | 8,434 | 8,572 | 8,713 | 8,856 | 9,001 | 9,149 | 9,300 | 9,453 | 9,608 | 9,767 | 9,928 | 10,092 | 10,258 | 10,428 | 10,600 |
| -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 | -163 |
| 6,096 | 6,194 | 6,294 | 6,396 | 6,499 | 6,605 | 6,712 | 6,821 | 6,931 | 7,044 | 7,159 | 7,275 | 7,394 | 7,515 | 7,637 | 7,762 | 7,889 | 8,018 | 8,149 | 8,283 | 8,419 | 8,557 | 8,698 | 8,841 | 8,986 | 9,134 | 9,285 | 9,438 | 9,594 | 9,752 | 9,913 | 10,077 | 10,244 | 10,413 | 10,586 |
| 5,633 | 5,721 | 5,811 | 5,903 | 5,996 | 6,091 | 6,187 | 6,285 | 6,385 | 6,486 | 6,590 | 6,694 | 6,801 | 6,910 | 7,020 | 7,132 | 7,247 | 7,363 | 7,481 | 7,601 | 7,724 | 7,848 | 7,975 | 8,103 | 8,234 | 8,367 | 8,503 | 8,641 | 8,781 | 8,923 | 9,068 | 9,216 | 9,366 | 9,518 | 9,674 |
| 5,485 | 5,573 | 5,663 | 5,755 | 5,848 | 5,943 | 6,039 | 6,137 | 6,237 | 6,338 | 6,441 | 6,546 | 6,653 | 6,762 | 6,872 | 6,984 | 7,099 | 7,215 | 7,333 | 7,453 | 7,576 | 7,700 | 7,827 | 7,955 | 8,086 | 8,219 | 8,355 | 8,493 | 8,633 | 8,775 | 8,920 | 9,068 | 9,218 | 9,370 | 9,526 |
| 5,470 | 5,558 | 5,649 | 5,740 | 5,833 | 5,928 | 6,024 | 6,122 | 6,222 | 6,323 | 6,427 | 6,532 | 6,638 | 6,747 | 6,857 | 6,970 | 7,084 | 7,200 | 7,318 | 7,438 | 7,561 | 7,685 | 7,812 | 7,940 | 8,071 | 8,205 | 8,340 | 8,478 | 8,618 | 8,760 | 8,905 | 9,053 | 9,203 | 9,356 | 9,511 |

# Appendix 3-8 (3) Calculation Table of Economic Analysis (Option3 : Route3, Shield)

**Economic Analysis of Pre F/S Project (Option3: Route3, Shield)**

| Items | Total | NPV (D.R. 10%) | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| **Construction** | | | | | Spillway | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Phase I | | | | | Phase II | | | | | | | | | | Phase III | | | | |
| **Economic Cost** | **-57,856** | **-26,718** | **-930** | **-944** | **-3,334** | **-2,989** | **-5,443** | **-7,840** | **-7,945** | **-7,524** | **-6,168** | **-3,321** | **-1,603** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** |
| - Project Cost | -48,041 | -26,022 | -930 | -944 | -3,334 | -2,989 | -5,443 | -7,840 | -7,945 | -7,524 | -6,168 | -3,321 | -1,603 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -9,090 | -644 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 |
| - O&M of Machines | -681 | -48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 |
| - Cleaning of Spillway | -44 | -3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **368,140** | **20,439** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **4,967** | **5,055** | **5,144** | **5,235** | **5,329** | **5,418** | **5,509** | **5,601** | **5,696** | **5,791** | **5,882** | **5,974** | **6,067** | **6,162** |
| - Benefit of Spillway | 368,140 | 20,439 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Economic Cost** | **-57,856** | **-26,718** | -930 | -944 | -3,334 | -2,989 | -5,443 | -7,840 | -7,945 | -7,524 | -6,168 | -3,321 | -1,603 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 |
| **Economic Benefit** | **368,140** | **20,439** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,967 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Balance** | **310,285** | **-6,279** | **-930** | **-944** | **-3,334** | **-2,989** | **-5,443** | **-7,840** | **-7,945** | **-7,524** | **-6,168** | **-3,321** | **-1,603** | **4,766** | **4,854** | **4,944** | **5,035** | **5,128** | **5,218** | **5,308** | **5,401** | **5,495** | **5,591** | **5,681** | **5,773** | **5,867** | **5,962** |
| | **B/C** | **0.76** | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **EIRR** | **8.3%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Benefits** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case2) Land Price Increase** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - Land Price Increase | 15,202 | 3,274 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | 325,486 | -3,005 | -930 | -944 | -3,334 | -2,989 | -5,443 | -7,840 | -7,945 | -7,524 | -6,168 | -3,321 | -1,603 | 6,286 | 6,374 | 6,464 | 6,555 | 6,648 | 6,738 | 6,829 | 6,921 | 7,015 | 7,111 | 5,681 | 5,773 | 5,867 | 5,962 |
| | **0.89** | **9.2%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case3) Case2) + Landfill** | **-1,930** | **-1,064** | 0 | 0 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| landfill Benefit | **9,000** | **3,154** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | **332,556** | **-914** | -930 | -944 | -3,576 | -3,230 | -5,684 | -8,082 | -8,186 | -7,765 | -6,409 | -3,562 | 7,397 | 6,286 | 6,374 | 6,464 | 6,555 | 6,648 | 6,738 | 6,829 | 6,921 | 7,015 | 7,111 | 5,681 | 5,773 | 5,867 | 5,962 |
| | **0.96** | **9.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sensitivity Analsys (Case1)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S1) Cost +10%** | **-63,641** | **-29,390** | -1,023 | -1,039 | -3,668 | -3,288 | -5,987 | -8,624 | -8,740 | -8,276 | -6,785 | -3,653 | -1,763 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 |
| Cost-Benefit Flow | **304,499** | **-8,951** | -1,023 | -1,039 | -3,668 | -3,288 | -5,987 | -8,624 | -8,740 | -8,276 | -6,785 | -3,653 | -1,763 | 4,746 | 4,834 | 4,924 | 5,015 | 5,108 | 5,198 | 5,288 | 5,381 | 5,475 | 5,571 | 5,661 | 5,753 | 5,847 | 5,942 |
| | **0.70** | **7.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S2) Benefit -10%** | **331,326** | **18,395** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,470 | 4,549 | 4,630 | 4,712 | 4,796 | 4,876 | 4,958 | 5,041 | 5,126 | 5,212 | 5,294 | 5,376 | 5,460 | 5,546 |
| Cost-Benefit Flow | **273,470** | **-8,323** | -930 | -944 | -3,334 | -2,989 | -5,443 | -7,840 | -7,945 | -7,524 | -6,168 | -3,321 | -1,603 | 4,270 | 4,349 | 4,429 | 4,512 | 4,595 | 4,676 | 4,758 | 4,841 | 4,926 | 5,012 | 5,093 | 5,176 | 5,260 | 5,346 |
| | **0.69** | **7.7%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S3) Cost +10%, Benefit -10%** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost-Benefit Flow | **267,685** | **-10,995** | -1,023 | -1,039 | -3,668 | -3,288 | -5,987 | -8,624 | -8,740 | -8,276 | -6,785 | -3,653 | -1,763 | 4,250 | 4,329 | 4,409 | 4,492 | 4,575 | 4,656 | 4,738 | 4,821 | 4,906 | 4,992 | 5,073 | 5,156 | 5,240 | 5,326 |
| | **0.63** | **7.2%** | | | | | | | | | | | | | | | | | | | | | | | | | |

(million PHP)

| 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 |
| | | Phase III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 |
| -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 |
| -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| **6,259** | **6,357** | **6,457** | **6,559** | **6,662** | **6,768** | **6,875** | **6,984** | **7,094** | **7,207** | **7,322** | **7,438** | **7,557** | **7,677** | **7,800** | **7,925** | **8,052** | **8,181** | **8,312** | **8,446** | **8,582** | **8,720** | **8,861** | **9,004** | **9,149** | **9,297** | **9,448** | **9,601** | **9,756** | **9,915** | **10,076** | **10,240** | **10,407** | **10,576** | **10,749** |
| 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 |
| 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **6,058** | **6,157** | **6,257** | **6,359** | **6,462** | **6,567** | **6,674** | **6,783** | **6,894** | **7,007** | **7,121** | **7,238** | **7,357** | **7,477** | **7,600** | **7,725** | **7,852** | **7,981** | **8,112** | **8,246** | **8,382** | **8,520** | **8,660** | **8,803** | **8,949** | **9,097** | **9,247** | **9,400** | **9,556** | **9,715** | **9,876** | **10,040** | **10,206** | **10,376** | **10,548** |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,058 | 6,157 | 6,257 | 6,359 | 6,462 | 6,567 | 6,674 | 6,783 | 6,894 | 7,007 | 7,121 | 7,238 | 7,357 | 7,477 | 7,600 | 7,725 | 7,852 | 7,981 | 8,112 | 8,246 | 8,382 | 8,520 | 8,660 | 8,803 | 8,949 | 9,097 | 9,247 | 9,400 | 9,556 | 9,715 | 9,876 | 10,040 | 10,206 | 10,376 | 10,548 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6,058 | 6,157 | 6,257 | 6,359 | 6,462 | 6,567 | 6,674 | 6,783 | 6,894 | 7,007 | 7,121 | 7,238 | 7,357 | 7,477 | 7,600 | 7,725 | 7,852 | 7,981 | 8,112 | 8,246 | 8,382 | 8,520 | 8,660 | 8,803 | 8,949 | 9,097 | 9,247 | 9,400 | 9,556 | 9,715 | 9,876 | 10,040 | 10,206 | 10,376 | 10,548 |
| -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 |
| 6,038 | 6,137 | 6,237 | 6,339 | 6,442 | 6,547 | 6,654 | 6,763 | 6,874 | 6,987 | 7,101 | 7,218 | 7,337 | 7,457 | 7,580 | 7,705 | 7,832 | 7,961 | 8,092 | 8,226 | 8,362 | 8,500 | 8,640 | 8,783 | 8,929 | 9,077 | 9,227 | 9,380 | 9,536 | 9,695 | 9,856 | 10,020 | 10,186 | 10,356 | 10,528 |
| 5,633 | 5,721 | 5,811 | 5,903 | 5,996 | 6,091 | 6,187 | 6,285 | 6,385 | 6,486 | 6,590 | 6,694 | 6,801 | 6,910 | 7,020 | 7,132 | 7,247 | 7,363 | 7,481 | 7,601 | 7,724 | 7,848 | 7,975 | 8,103 | 8,234 | 8,367 | 8,503 | 8,641 | 8,781 | 8,923 | 9,068 | 9,216 | 9,366 | 9,518 | 9,674 |
| 5,433 | 5,521 | 5,611 | 5,703 | 5,796 | 5,891 | 5,987 | 6,085 | 6,185 | 6,286 | 6,389 | 6,494 | 6,601 | 6,709 | 6,820 | 6,932 | 7,046 | 7,163 | 7,281 | 7,401 | 7,523 | 7,648 | 7,774 | 7,903 | 8,034 | 8,167 | 8,303 | 8,440 | 8,581 | 8,723 | 8,868 | 9,016 | 9,166 | 9,318 | 9,473 |
| 5,413 | 5,501 | 5,591 | 5,683 | 5,776 | 5,871 | 5,967 | 6,065 | 6,165 | 6,266 | 6,369 | 6,474 | 6,581 | 6,689 | 6,800 | 6,912 | 7,026 | 7,143 | 7,261 | 7,381 | 7,503 | 7,628 | 7,754 | 7,883 | 8,014 | 8,147 | 8,283 | 8,420 | 8,560 | 8,703 | 8,848 | 8,996 | 9,146 | 9,298 | 9,453 |

# Appendix 3-8 (4) Calculation Table of Economic Analysis (Option4 : Route3, NATM)

**Economic Analysis of Pre F/S Project (Option4: Route3, NATM)**

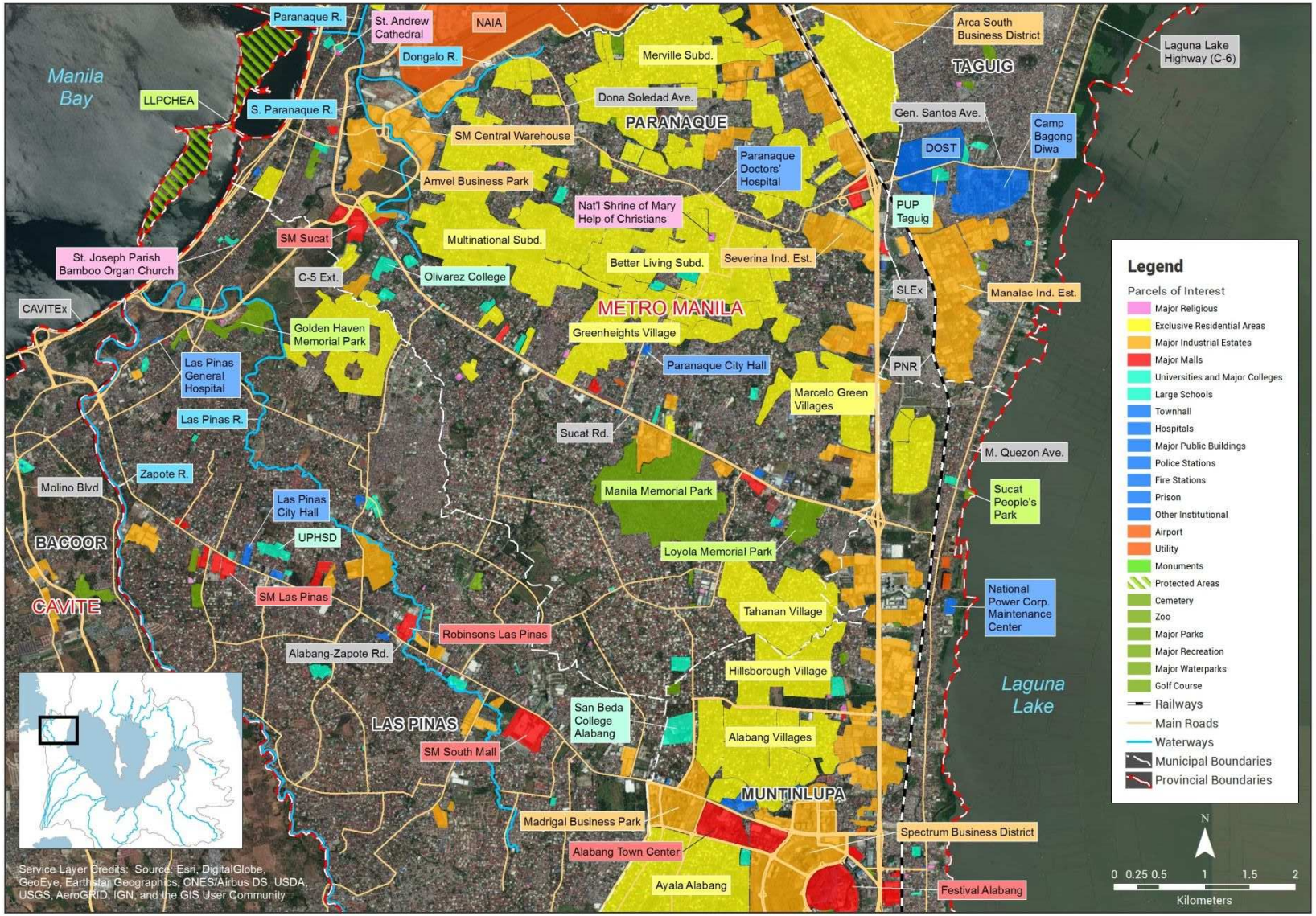
(million PHP)

| Items | Total | NPV (D.R. 10%) | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 | 2038 | 2039 | 2040 | 2041 | 2042 | 2043 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
| **Construction** | | | | | Spillway | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | Phase I | | | | | Phase II | | | | | | | | | | Phase III | | | | |
| **Economic Cost** | **-47,390** | **-19,919** | **-827** | **-837** | **-3,568** | **-3,169** | **-2,364** | **-3,614** | **-3,769** | **-3,775** | **-3,781** | **-3,788** | **-3,896** | **-3,290** | **-1,297** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** |
| - Project Cost | -37,775 | -19,287 | -827 | -837 | -3,568 | -3,169 | -2,364 | -3,614 | -3,769 | -3,775 | -3,781 | -3,788 | -3,896 | -3,290 | -1,097 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -8,904 | -585 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 |
| - O&M of Machines | -667 | -44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 |
| - Cleaning of Spillway | -43 | -3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **363,174** | **18,857** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **5,055** | **5,144** | **5,235** | **5,329** | **5,418** | **5,509** | **5,601** | **5,696** | **5,791** | **5,882** | **5,974** | **6,067** | **6,162** |
| - Benefit of Spillway | 363,174 | 18,857 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Economic Cost** | **-47,390** | **-19,919** | -827 | -837 | -3,568 | -3,169 | -2,364 | -3,614 | -3,769 | -3,775 | -3,781 | -3,788 | -3,896 | -3,290 | -1,297 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 |
| **Economic Benefit** | **363,174** | **18,857** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,055 | 5,144 | 5,235 | 5,329 | 5,418 | 5,509 | 5,601 | 5,696 | 5,791 | 5,882 | 5,974 | 6,067 | 6,162 |
| **Balance** | **315,784** | **-1,062** | **-827** | **-837** | **-3,568** | **-3,169** | **-2,364** | **-3,614** | **-3,769** | **-3,775** | **-3,781** | **-3,788** | **-3,896** | **-3,290** | **3,757** | **4,944** | **5,035** | **5,128** | **5,218** | **5,308** | **5,401** | **5,495** | **5,591** | **5,681** | **5,773** | **5,867** | **5,962** |
| | **B/C** | **0.95** | | | | | | | | | | | | | | | | | | | | | | | | | |
| | **EIRR** | **9.6%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Benefits** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case2) Land Price Increase** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| - Land Price Increase | 15,202 | 2,976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 1,520 | 0 | 0 | 0 |
| Cost-Benefit Flow | 330,986 | 1,914 | -827 | -837 | -3,568 | -3,169 | -2,364 | -3,614 | -3,769 | -3,775 | -3,781 | -3,788 | -3,896 | -3,290 | 5,277 | 6,464 | 6,555 | 6,648 | 6,738 | 6,829 | 6,921 | 7,015 | 7,111 | 7,202 | 5,773 | 5,867 | 5,962 |
| | **1.10** | **10.6%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Case3) Case2) + Landfill** | **-1,930** | **-1,064** | 0 | 0 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | -241 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| landfill Benefit | **9,000** | **3,154** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cost-Benefit Flow | **338,056** | **4,005** | -827 | -837 | -3,809 | -3,410 | -2,605 | -3,855 | -4,010 | -4,016 | -4,023 | -4,029 | 5,104 | -3,290 | 5,277 | 6,464 | 6,555 | 6,648 | 6,738 | 6,829 | 6,921 | 7,015 | 7,111 | 7,202 | 5,773 | 5,867 | 5,962 |
| | **1.22** | **11.4%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sensitivity Analsys (Case1)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S1) Cost +10%** | **-52,129** | **-21,911** | -910 | -921 | -3,924 | -3,486 | -2,600 | -3,975 | -4,145 | -4,152 | -4,160 | -4,167 | -4,286 | -3,619 | -1,427 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 |
| Cost-Benefit Flow | **311,045** | **-3,054** | -910 | -921 | -3,924 | -3,486 | -2,600 | -3,975 | -4,145 | -4,152 | -4,160 | -4,167 | -4,286 | -3,619 | 3,627 | 4,924 | 5,015 | 5,108 | 5,198 | 5,288 | 5,381 | 5,475 | 5,571 | 5,661 | 5,753 | 5,847 | 5,942 |
| | **0.86** | **9.1%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S2) Benefit -10%** | **326,856** | **16,971** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,549 | 4,630 | 4,712 | 4,796 | 4,876 | 4,958 | 5,041 | 5,126 | 5,212 | 5,294 | 5,376 | 5,460 | 5,546 |
| Cost-Benefit Flow | **279,467** | **-2,948** | -827 | -837 | -3,568 | -3,169 | -2,364 | -3,614 | -3,769 | -3,775 | -3,781 | -3,788 | -3,896 | -3,290 | 3,252 | 4,429 | 4,512 | 4,595 | 4,676 | 4,758 | 4,841 | 4,926 | 5,012 | 5,093 | 5,176 | 5,260 | 5,346 |
| | **0.85** | **9.0%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **S3) Cost +10%, Benefit -10%** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cost-Benefit Flow | **274,728** | **-4,940** | -910 | -921 | -3,924 | -3,486 | -2,600 | -3,975 | -4,145 | -4,152 | -4,160 | -4,167 | -4,286 | -3,619 | 3,122 | 4,409 | 4,492 | 4,575 | 4,656 | 4,738 | 4,821 | 4,906 | 4,992 | 5,073 | 5,156 | 5,240 | 5,326 |
| | **0.77** | **8.4%** | | | | | | | | | | | | | | | | | | | | | | | | | |

| Items | 2045 | 2046 | 2047 | 2048 | 2049 | 2050 | 2051 | 2052 | 2053 | 2054 | 2055 | 2056 | 2057 | 2058 | 2059 | 2060 | 2061 | 2062 | 2063 | 2064 | 2065 | 2066 | 2067 | 2068 | 2069 | 2070 | 2071 | 2072 | 2073 | 2074 | 2075 | 2076 | 2077 | 2078 | 2079 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 |
| **Construction** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | Phase III | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Cost** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** | **-200** |
| - Project Cost | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - O&M Cost | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 | -186 |
| - O&M of Machines | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 | -14 |
| - Cleaning of Spillway | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| - Rehabilitation Cost | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Economic Benefit** | **6,259** | **6,357** | **6,457** | **6,559** | **6,662** | **6,768** | **6,875** | **6,984** | **7,094** | **7,207** | **7,322** | **7,438** | **7,557** | **7,677** | **7,800** | **7,925** | **8,052** | **8,181** | **8,312** | **8,446** | **8,582** | **8,720** | **8,861** | **9,004** | **9,149** | **9,297** | **9,448** | **9,601** | **9,756** | **9,915** | **10,076** | **10,240** | **10,407** | **10,576** | **10,749** |
| - Benefit of Spillway | 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **Economic Cost** | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 | -200 |
| **Economic Benefit** | 6,259 | 6,357 | 6,457 | 6,559 | 6,662 | 6,768 | 6,875 | 6,984 | 7,094 | 7,207 | 7,322 | 7,438 | 7,557 | 7,677 | 7,800 | 7,925 | 8,052 | 8,181 | 8,312 | 8,446 | 8,582 | 8,720 | 8,861 | 9,004 | 9,149 | 9,297 | 9,448 | 9,601 | 9,756 | 9,915 | 10,076 | 10,240 | 10,407 | 10,576 | 10,749 |
| **Balance** | **6,058** | **6,157** | **6,257** | **6,359** | **6,462** | **6,567** | **6,674** | **6,783** | **6,894** | **7,007** | **7,121** | **7,238** | **7,357** | **7,477** | **7,600** | **7,725** | **7,852** | **7,981** | **8,112** | **8,246** | **8,382** | **8,520** | **8,660** | **8,803** | **8,949** | **9,097** | **9,247** | **9,400** | **9,556** | **9,715** | **9,876** | **10,040** | **10,206** | **10,376** | **10,548** |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6,058 | 6,157 | 6,257 | 6,359 | 6,462 | 6,567 | 6,674 | 6,783 | 6,894 | 7,007 | 7,121 | 7,238 | 7,357 | 7,477 | 7,600 | 7,725 | 7,852 | 7,981 | 8,112 | 8,246 | 8,382 | 8,520 | 8,660 | 8,803 | 8,949 | 9,097 | 9,247 | 9,400 | 9,556 | 9,715 | 9,876 | 10,040 | 10,206 | 10,376 | 10,548 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6,058 | 6,157 | 6,257 | 6,359 | 6,462 | 6,567 | 6,674 | 6,783 | 6,894 | 7,007 | 7,121 | 7,238 | 7,357 | 7,477 | 7,600 | 7,725 | 7,852 | 7,981 | 8,112 | 8,246 | 8,382 | 8,520 | 8,660 | 8,803 | 8,949 | 9,097 | 9,247 | 9,400 | 9,556 | 9,715 | 9,876 | 10,040 | 10,206 | 10,376 | 10,548 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 | -220 |
| | 6,038 | 6,137 | 6,237 | 6,339 | 6,442 | 6,547 | 6,654 | 6,763 | 6,874 | 6,987 | 7,101 | 7,218 | 7,337 | 7,457 | 7,580 | 7,705 | 7,832 | 7,961 | 8,092 | 8,226 | 8,362 | 8,500 | 8,640 | 8,783 | 8,929 | 9,077 | 9,227 | 9,380 | 9,536 | 9,695 | 9,856 | 10,020 | 10,186 | 10,356 | 10,528 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5,633 | 5,721 | 5,811 | 5,903 | 5,996 | 6,091 | 6,187 | 6,285 | 6,385 | 6,486 | 6,590 | 6,694 | 6,801 | 6,910 | 7,020 | 7,132 | 7,247 | 7,363 | 7,481 | 7,601 | 7,724 | 7,848 | 7,975 | 8,103 | 8,234 | 8,367 | 8,503 | 8,641 | 8,781 | 8,923 | 9,068 | 9,216 | 9,366 | 9,518 | 9,674 |
| | 5,433 | 5,521 | 5,611 | 5,703 | 5,796 | 5,891 | 5,987 | 6,085 | 6,185 | 6,286 | 6,389 | 6,494 | 6,601 | 6,709 | 6,820 | 6,932 | 7,046 | 7,163 | 7,281 | 7,401 | 7,523 | 7,648 | 7,774 | 7,903 | 8,034 | 8,167 | 8,303 | 8,440 | 8,581 | 8,723 | 8,868 | 9,016 | 9,166 | 9,318 | 9,473 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 5,413 | 5,501 | 5,591 | 5,683 | 5,776 | 5,871 | 5,967 | 6,065 | 6,165 | 6,266 | 6,369 | 6,474 | 6,581 | 6,689 | 6,800 | 6,912 | 7,026 | 7,143 | 7,261 | 7,381 | 7,503 | 7,628 | 7,754 | 7,883 | 8,014 | 8,147 | 8,283 | 8,420 | 8,560 | 8,703 | 8,848 | 8,996 | 9,146 | 9,298 | 9,453 |

# APPENDIX 4

Land Use and Locations of Facilities and Structures

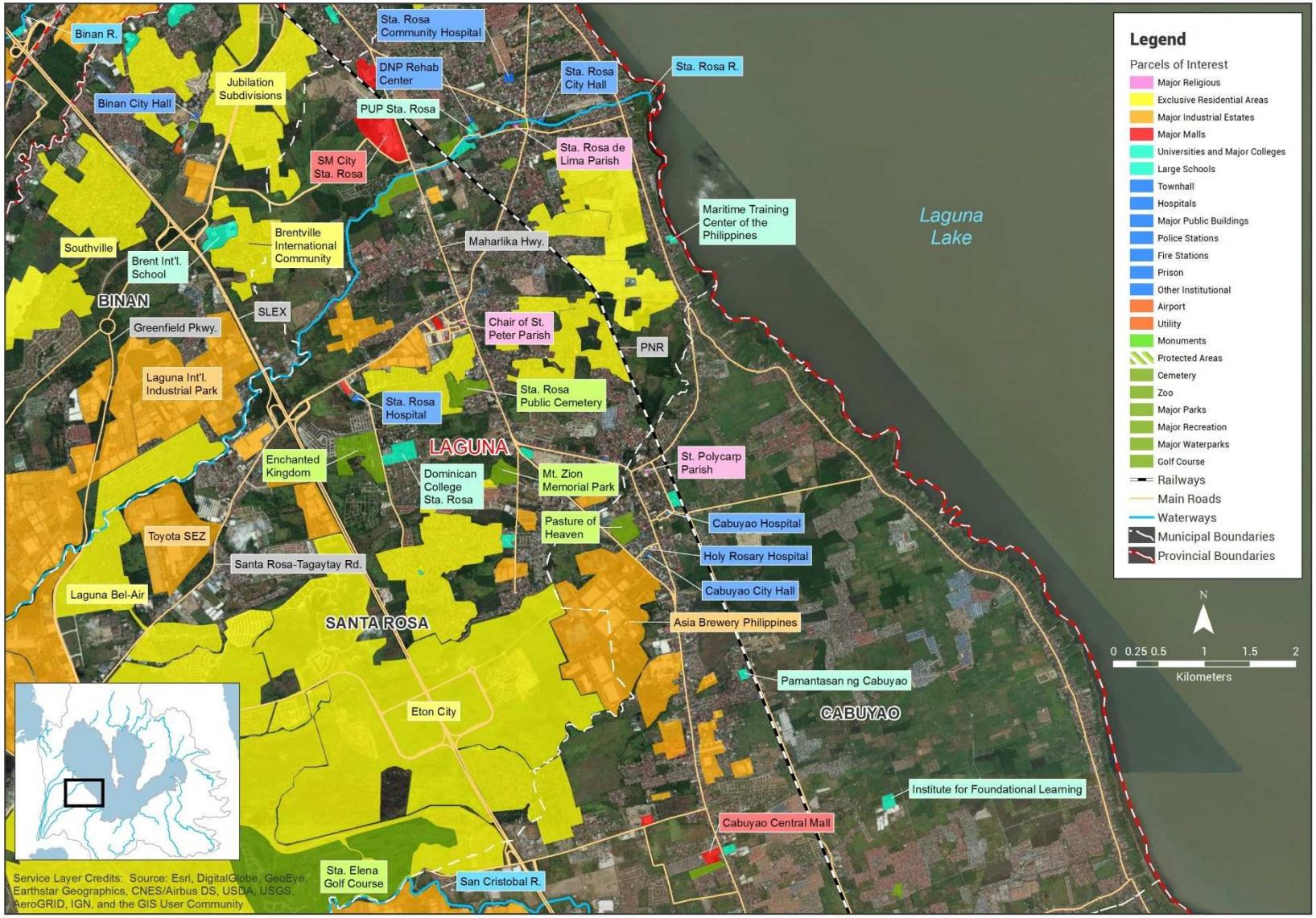



Source:JICA Survey Team

Fig-A 1-1 1. Land Use and Locations of Facilities and Structures (Area 1)

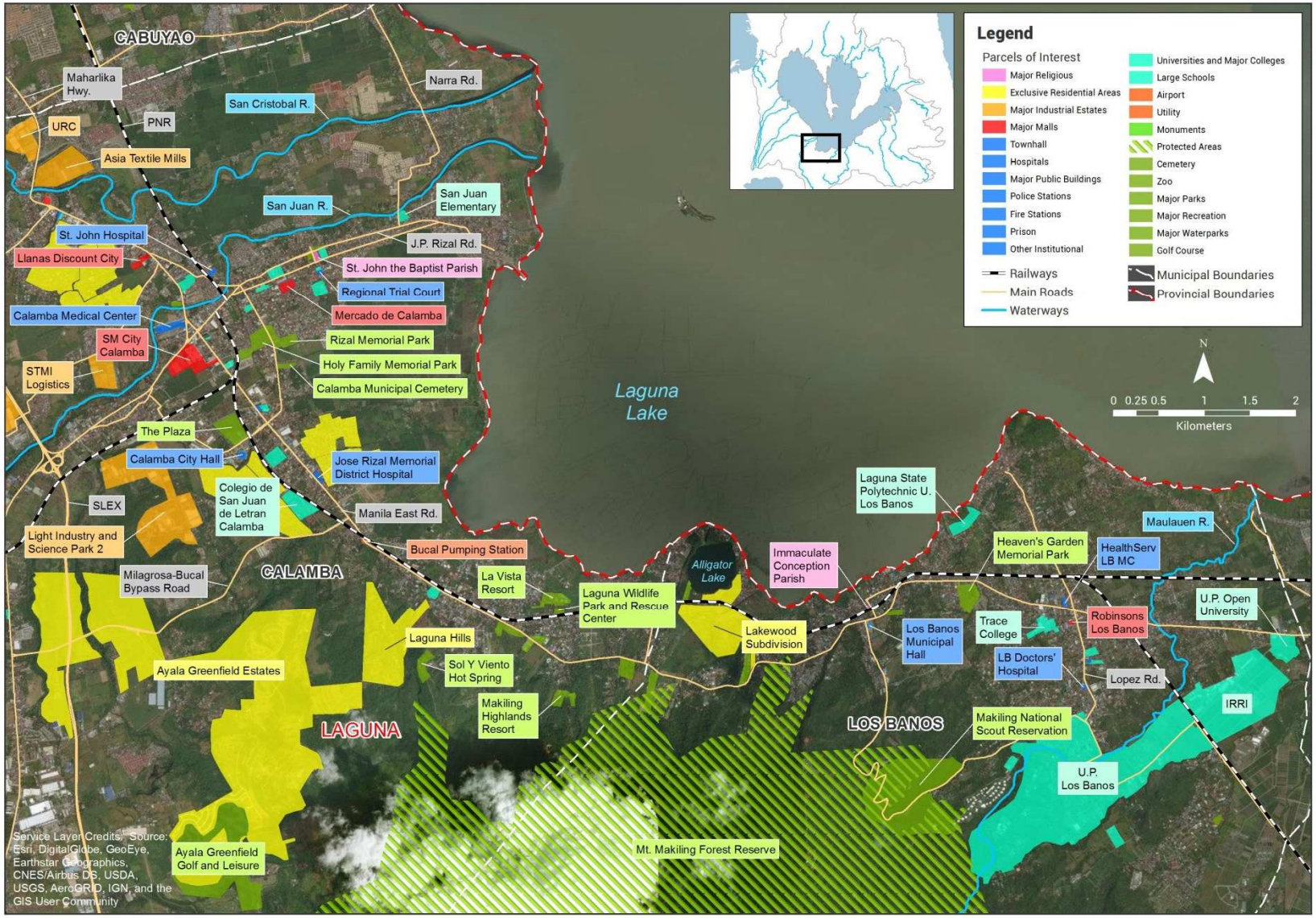
Source:JICA Survey Team

Fig-A 1-2 Land Use and Locations of Facilities and Structures (Area 2)



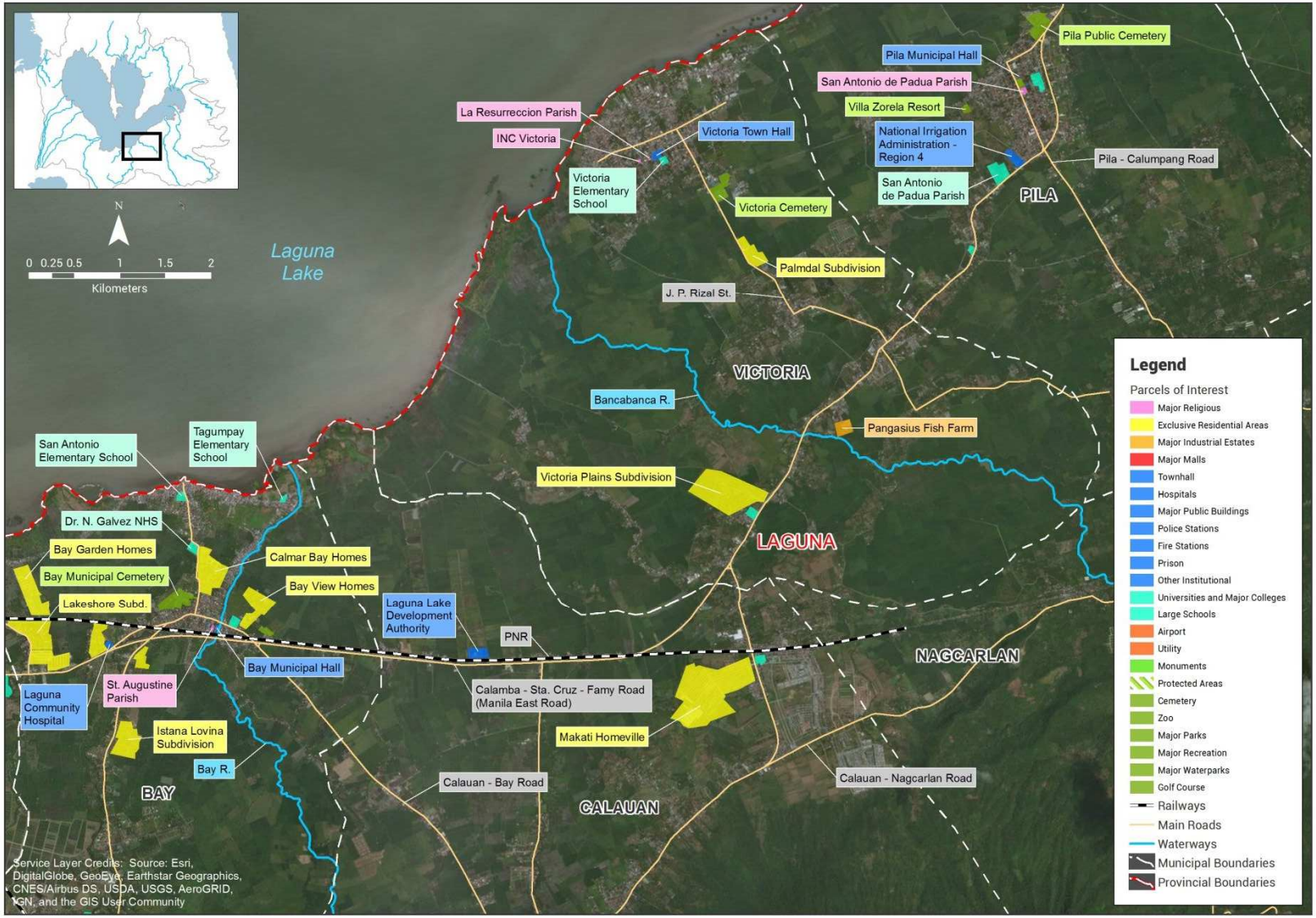

Source:JICA Survey Team

Fig-A 1-3 Land Use and Locations of Facilities and Structures (Area 3)



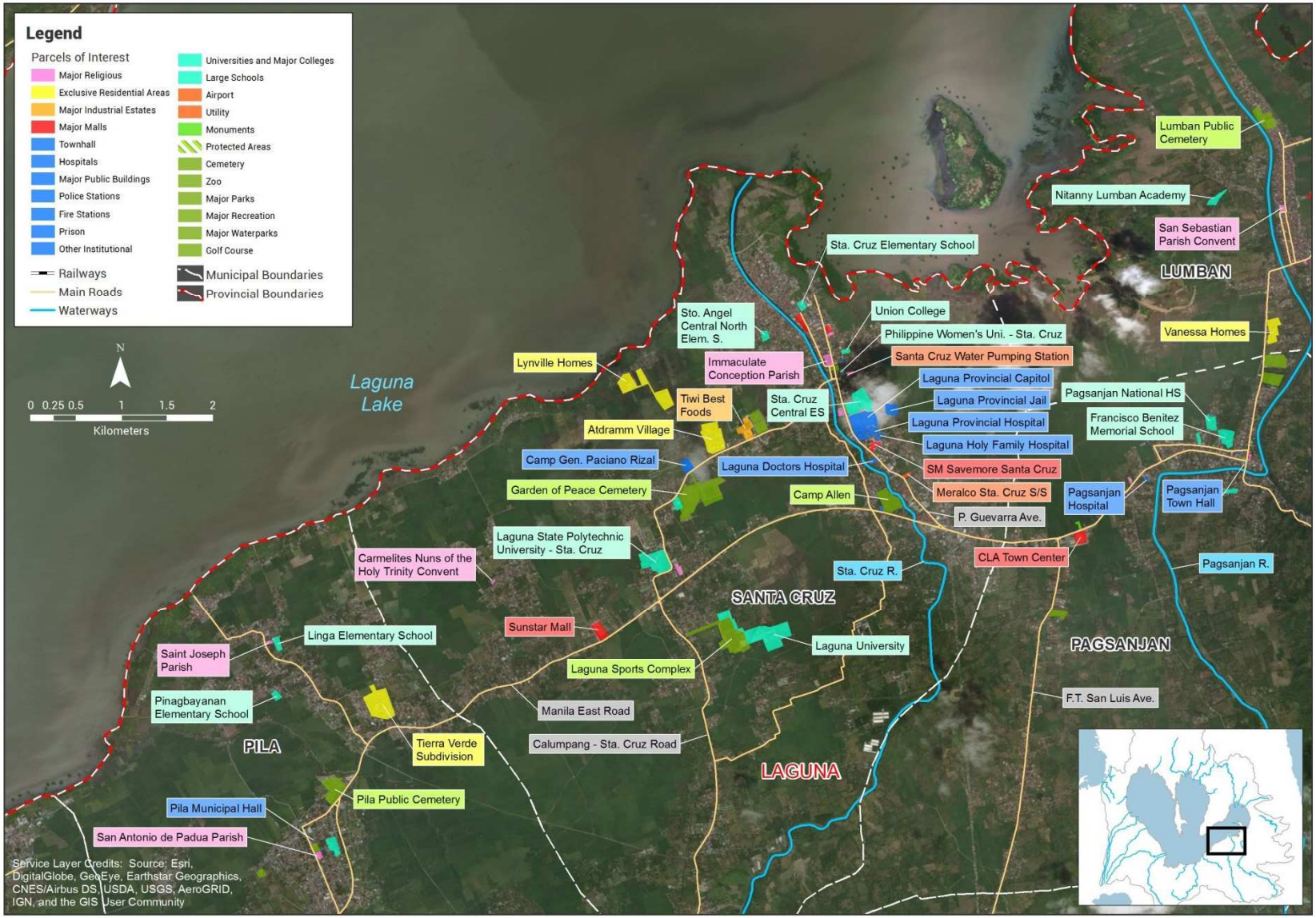

Source:JICA Survey Team

Fig-A 1-4 Land Use and Locations of Facilities and Structures (Area 4)



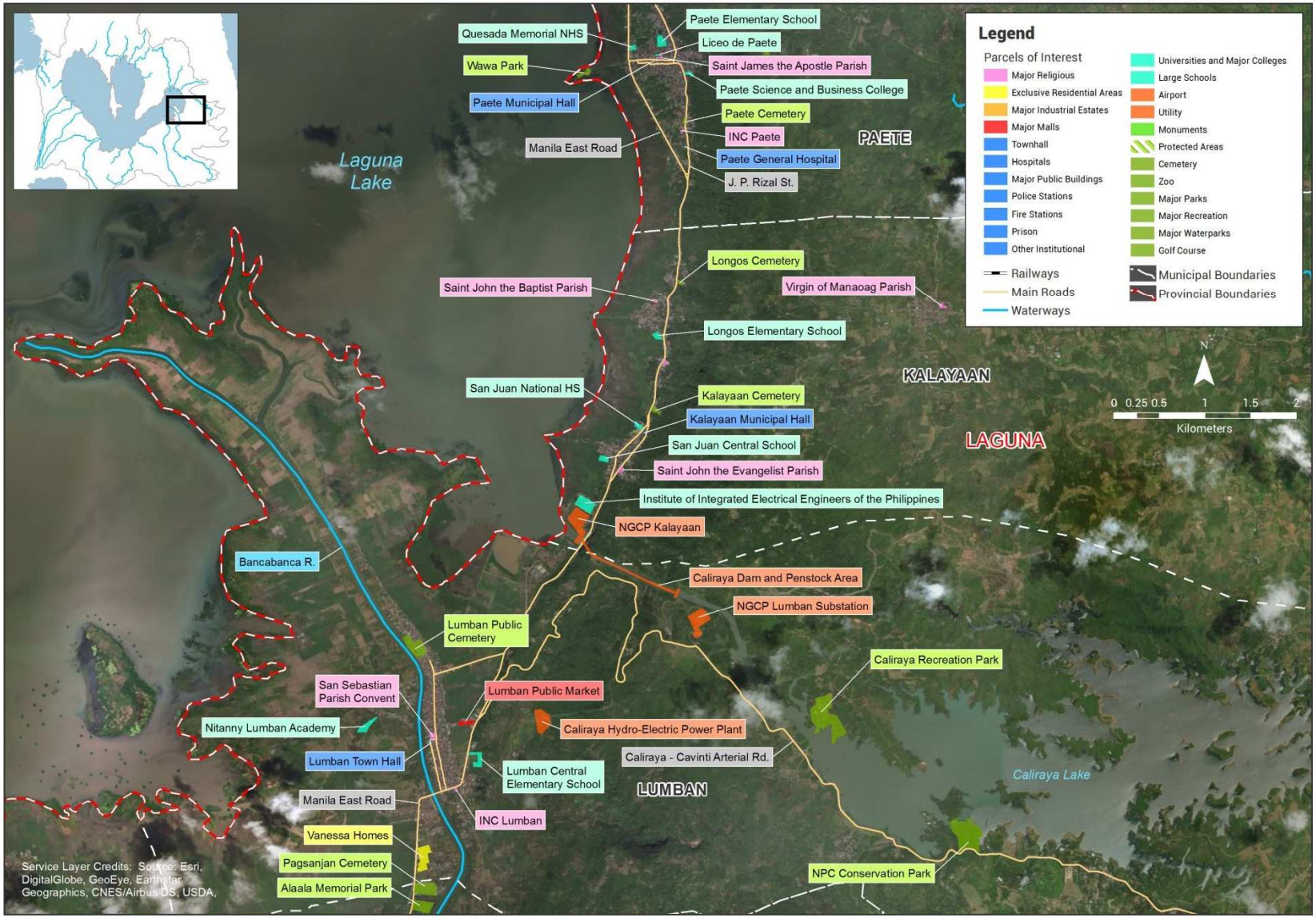

Source:JICA Survey Team

Fig-A 1-5 Land Use and Locations of Facilities and Structures (Area 5)



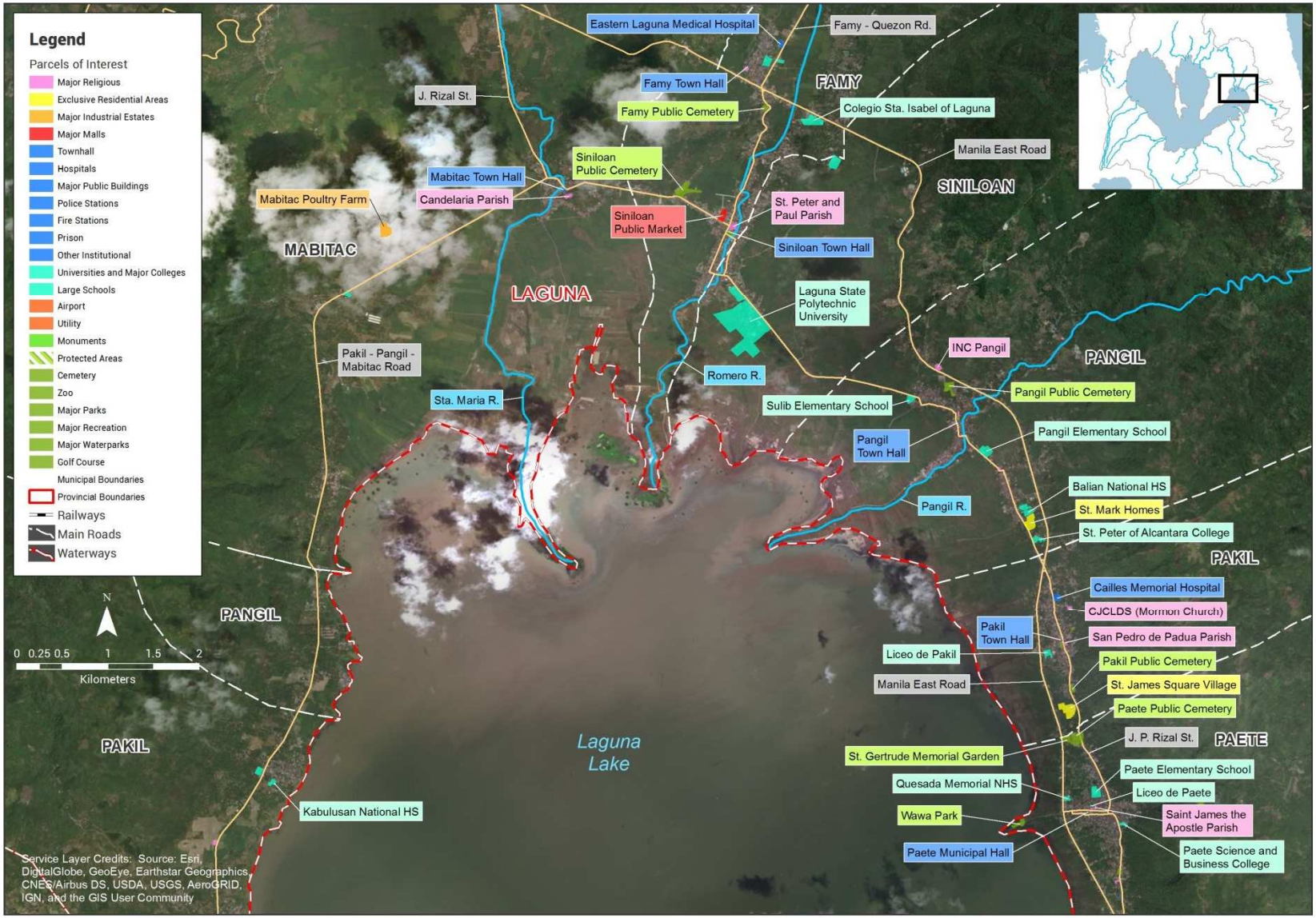

Source:JICA Survey Team

Fig-A 1-6 Land Use and Locations of Facilities and Structures (Area 6)



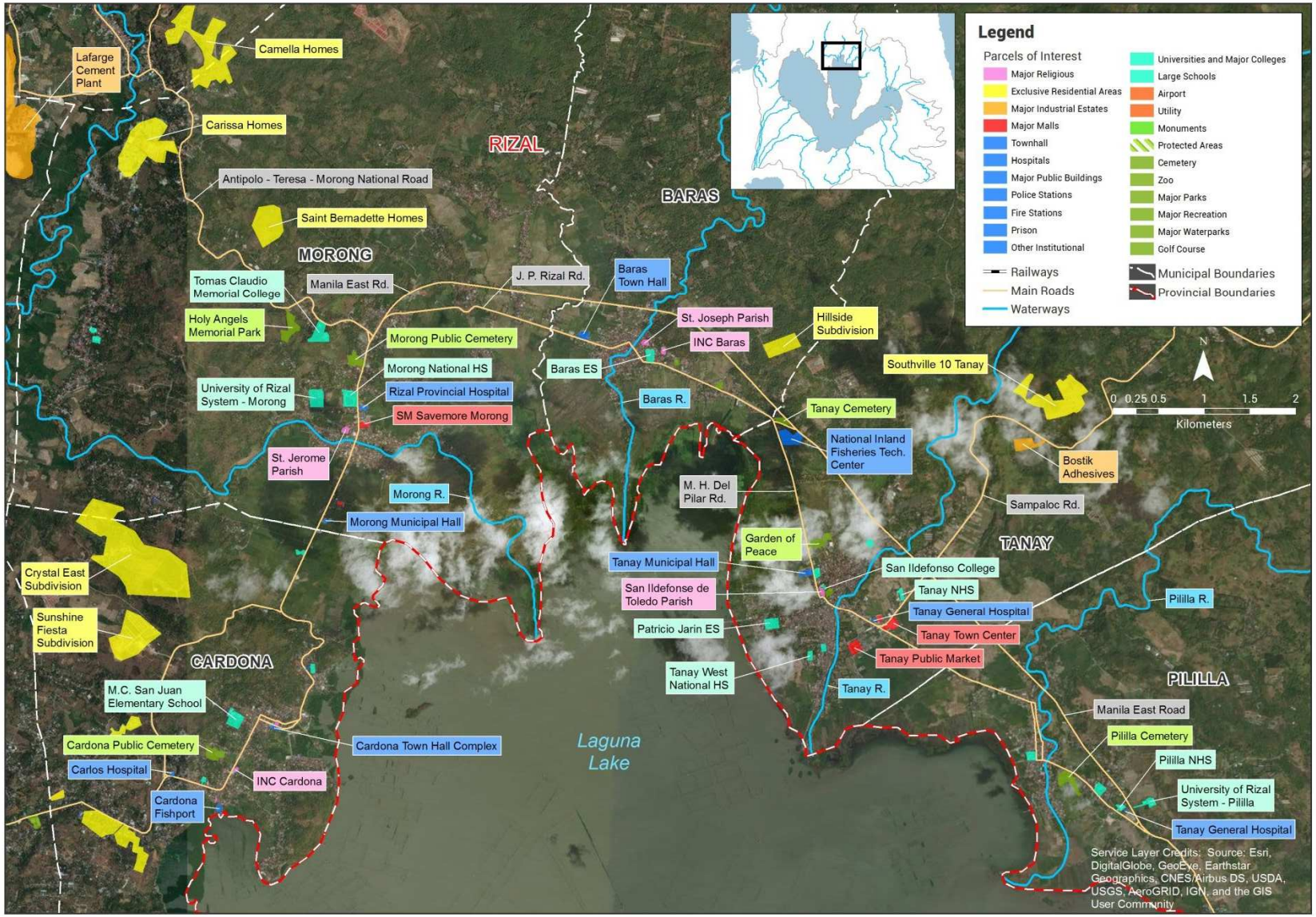

Source:JICA Survey Team

Fig-A 1-7 Land Use and Locations of Facilities and Structures (Area 7)




Source:JICA Survey Team

Fig-A 1-8 Land Use and Locations of Facilities and Structures (Area 8)




Source:JICA Survey Team

Fig-A 1-9 Land Use and Locations of Facilities and Structures (Area 9)

Source:JICA Survey Team

Fig-A 1-10 Land Use and Locations of Facilities and Structures (Area 10)

# APPENDIX 5

Leaflet

Location Map

**Republic of the Philippines**
**Department of Public Works and Highways**

**Japan International Cooperation Agency**
**CTI Engineering International Co., Ltd. (CTII)**
**Nippon Koei Co., Ltd. (NK)**
**CTI Engineering Co., Ltd. (CTIE)**



# PARAÑAQUE SPILLWAY PROJECT
## (DRAFT)

October 2000
Typhoon Seniang

September, 2009
Typhoon Ondoy

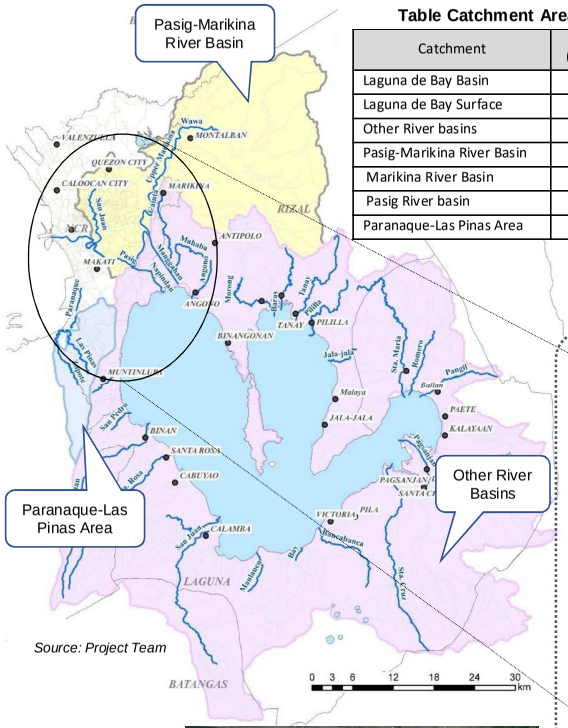
## Background

Typhoon Ondoy occurred in September 2009 and recorded the daily rainfall of 453 mm which caused massive flood damage in the whole Metro Manila area including the areas along the Marikina River and around the Laguna de Bay. In the West Mangahan district located in the Laguna de Bay lakeshore area where measures were implemented in the project entitled "Metro Manila Flood Control Project – West of Mangahan Floodway", about 80% of the low-lying residential areas were inundated for 1 to 3 weeks due to the flooding caused by the overflow of the Marikina River, inland inundation, and the water level rise of Laguna de Bay. In the lakeshore area of Laguna de Bay, low-lying areas without flood management countermeasures widely spread and these areas experienced inundation for more than one month.

The flood management measures in the lakeshore area of Laguna de Bay are behind as compared to those implemented in the center of Manila, so that flood management countermeasures are urgent matters to be addressed.

## About Laguna de Bay

The survey area is the entire lakeshore of Laguna de Bay in Metro Manila, Rizal Province and Laguna Province in the Philippines.




Source: Project Team

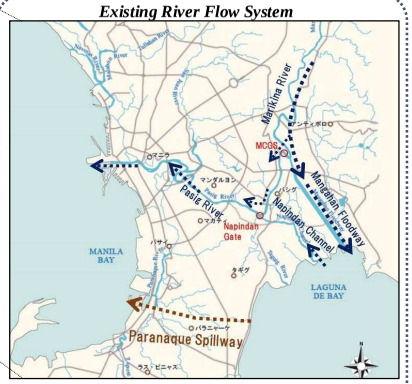
**Table Catchment Area**

| Catchment | Area (km²) |
|---|---|
| Laguna de Bay Basin | 3,280 |
| Laguna de Bay Surface | 900 |
| Other River basins | 2,380 |
| Pasig-Marikina River Basin | 640 |
| Marikina River Basin | 538 |
| Pasig River basin | 102 |
| Paranaque-Las Pinas Area | 74 |

Photo taken in 2009

Source: Google Earth

***Existing River Flow System***




Source: Project Team

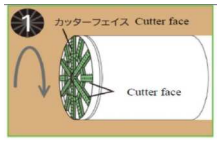
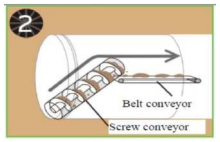
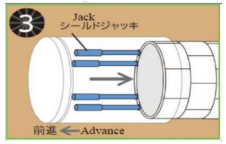
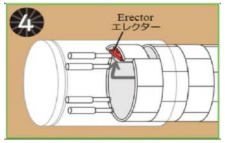
### Mangahan Floodway

Floodwaters of the Pasig-Marikina River and Laguna de Bay were once flowing into Manila Bay. However, the completion of the Mangahan Floodway changed the hydrological system. From the viewpoint of Laguna de Bay side, the current hydrological system is that the large volume of flood water from the Marikina River is temporarily stored in Laguna de Bay, and the stored water is released via Napindan Channel and the Mangahan Floodway.



## Shield Tunneling Method

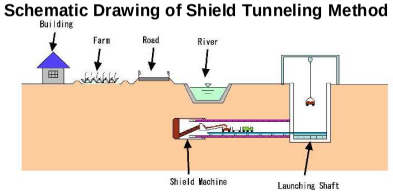
Excavate with the shield machine by stabilizing the face against earth pressure and water pressure using mud pressure or muddy water pressure and assemble segments to retain the ground.

| Step-1: Excavation | | | Step-2: Segment Assembly |
|---|---|---|---|
| 1.Cutting | 2.Transporting excavated soil | 3.Advancing Shield Machine | 4. assemble/insert segment |
|  |  |  |  |
| Revolve the cutter face to cut the ground | Load excavated soil into the machine by a screw conveyor and transport it to the outside | Apply reaction force with jacks installed in the machine against segments and advance the machine accommodating the speed of excavation | Secure the space to assemble segments by shortening jacks situated at the element to assemble and insert the segment using an erector |

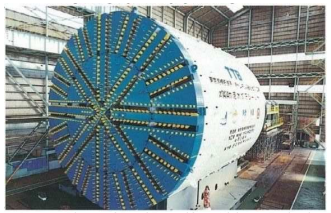


Source: North Line HP from Metropolitan Expressway Company Limited

**Schematic Drawing of Shield Tunneling Method**



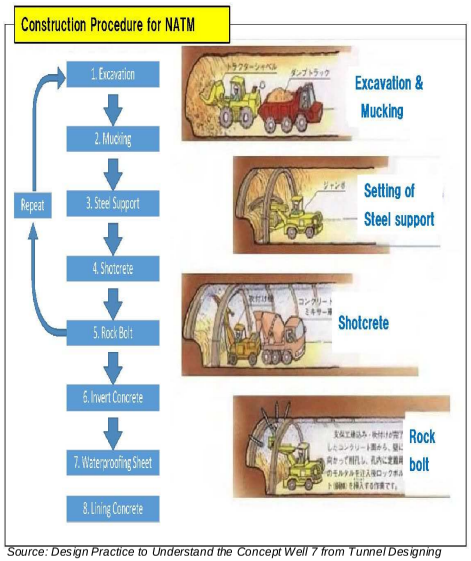

Source: Introduction of Tunnel Construction Method from Japan Water Agency



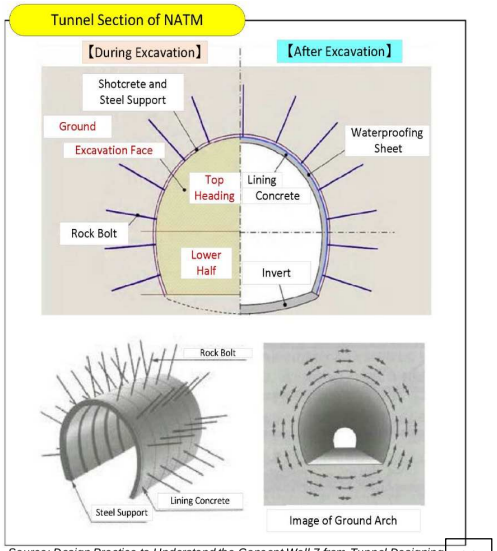
Source: Picture of Road Tunnel from Highway Technology Research Center

## NATM (New Austrian Tunneling Method)

Excavate by stabilizing the ground using shotcrete, rock-bolts and steel support, etc., utilizing the support function of surrounding ground




Source: Design Practice to Understand the Concept Well 7 from Tunnel Designing



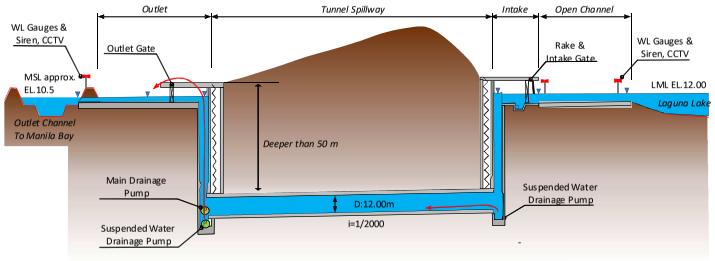

Source: Design Practice to Understand the Concept Well 7 from Tunnel Designing

## ■ Basic Design of Parañaque Spillway

### Concept of Parañaque Spillway

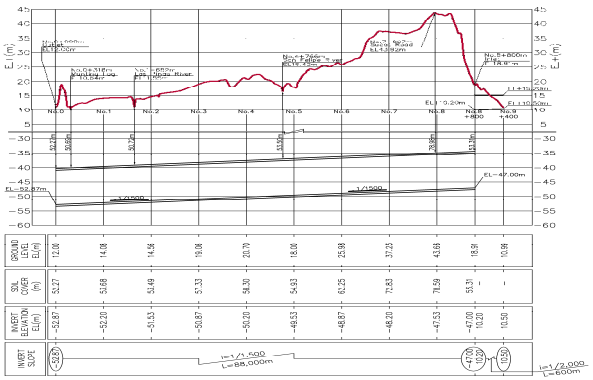
- Tunnel is planned deeper than fifty (50) m from the surface*1.
- Siphon discharges excess water using the pressure difference caused by the water head.
- Siphon will do without pump discharge

*1 IRR of RA10752 (2016) states that the government shall not be prevented from use of such private and government lands by surface owners or occupants, if such entry and use are made more than fifty (50) m from the surface.



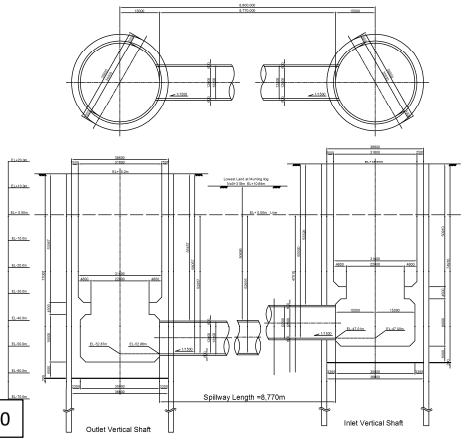

Source: Project Team

### i) Longitudinal Profile of Paranaque Spillway

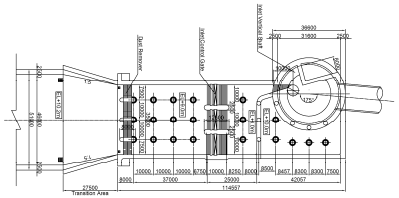


Source: Project Team

### ii) Plan Drawing of Vertical Shaft of Inlet and Outlet




### iii) Outline Drawing



### Ⅳ) Standard Cross Section of Intake Open Channel

Source: Project Team

## ■ Historical Flooding Damage

The inhabited areas In the Laguna de Bay Lakeshore could be seen at EL 12m and many residents and infrastructures are seen at EL 12.5 m. According to the 71-year records between 1946 to 2016, the peak water level exceeded EL 12m 47 times; whereas, it was 23 times over EL 12.5m, 10 times over EL 13.0m, 5 times over EL 13.5m, and only once over EL 14m. The water level when the media such as newspapers started reporting the flood damage is EL 12.5m or more, which occurs once in every three years.
Although Laguna de Bay is a large lake where flood waters can be stored, the only main river outflowing from the lake is the Napindan Channel. Therefore, the area has the characteristics that once the water level rises, the high water level continues for a long period and the extended area is damaged by inundation.
Two typhoons in 2009 (Typhoon Ondoy and Typhoon Pepeng) caused the peak water level of 13.85 m and it took 73 days for the peak level to drop to 12.78 m which was the water level before the water level rise, while the water level was 12.5 m and more for about 108 days.

Source: Project Team

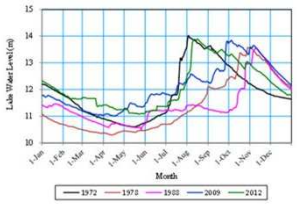
Source: LLDA ,Floodings in the Laguna de Bay Region

Source: LLDA ,Floodings in the Laguna de Bay Region

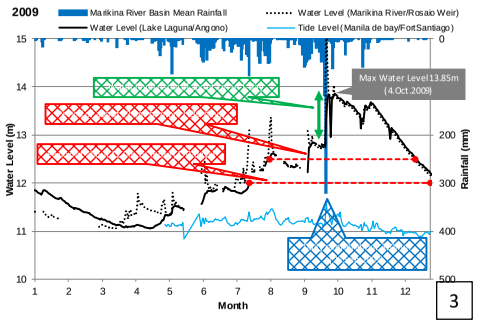
Source: LLDA ,Floodings in the Laguna de Bay Region

### Major Flood Events in Laguna de Bay

| No. | Year | Month | Day | Surface water level m | Typhoon or Cyclon | Date | |
|---|---|---|---|---|---|---|---|
| | | | | | | Start | End |
| 1 | 1972 | 8 | 3 | 14.03 | Tropical Storm Winnie | 1972/7/29 | 1972/8/3 |
| 2 | 2009 | 10 | 4 | 13.85 | Typhoon Ondoy | 2009/9/25 | 2009/9/30 |
| 3 | 2012 | 8 | 11 | 13.83 | 2012 Habagat | | |
| 4 | 1978 | 10 | 28 | 13.58 | Super Typhoon Rita | 1978/10/15 | 1978/10/29 |
| 5 | 1988 | 11 | 9 | 13.55 | Tropical Storm Tess | 1988/11/1 | 1988/11/6 |




### Flood Event in Laguna de Bay by Typhoon Ondoy and Typhoon Pepeng in 2009



## ■ Past Flooding Damage

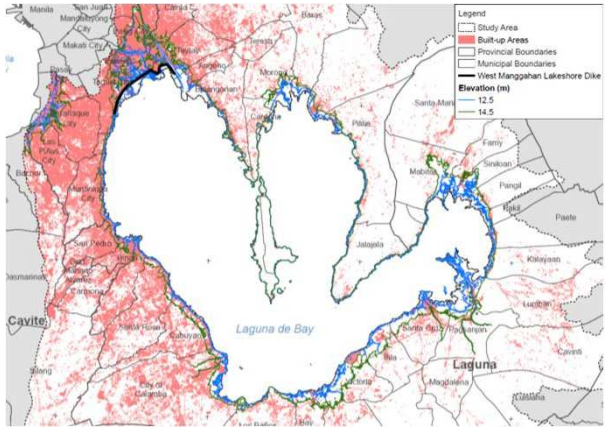
Since Laguna de Bay has a nearly trapezoidal shape and the capacity of the Napindan River (the outflow river) is limited, it has the characteristics of long flood duration. This indicates that flooding of Laguna de Bay has reached the same ground elevation as the flood level.

**Table Inundation Area and Number of affected People for every 0.5 m Elevation**

| Water Level (m) | Inundation Area*1 ($km^2$) | Number of affected People*2 (person) |
|---|---|---|
| 12.0 | 0.0 | 0 |
| 12.5 | 20.8 | 48,000 |
| 13.0 | 44.6 | 179,000 |
| 13.5 | 69.6 | 353,000 |
| 14.0 | 95.6 | 554,000 |
| 14.5 | 120.9 | 749,000 |

*1 Estimated by the JICA Survey Team based on the DEM Data (NAMRIA).
*2 Estimated by the JICA Survey Team based on the Built-up Area in LANDSAT 2016 and Census 2015.

For example, when the highest water level reaches 13.0 m, it is assumed that 44.6 $km^2$ of the residential area is flooded and the inundated population is 179 thousand from the water level 12.0 m.




*Source: Project Team*

**Laguna de Bay Lakeshore Area and Assumed Flood Area (12.5 m, 14.5 m Ground Elevation Lines)**

## ■ Setting of Design Scale

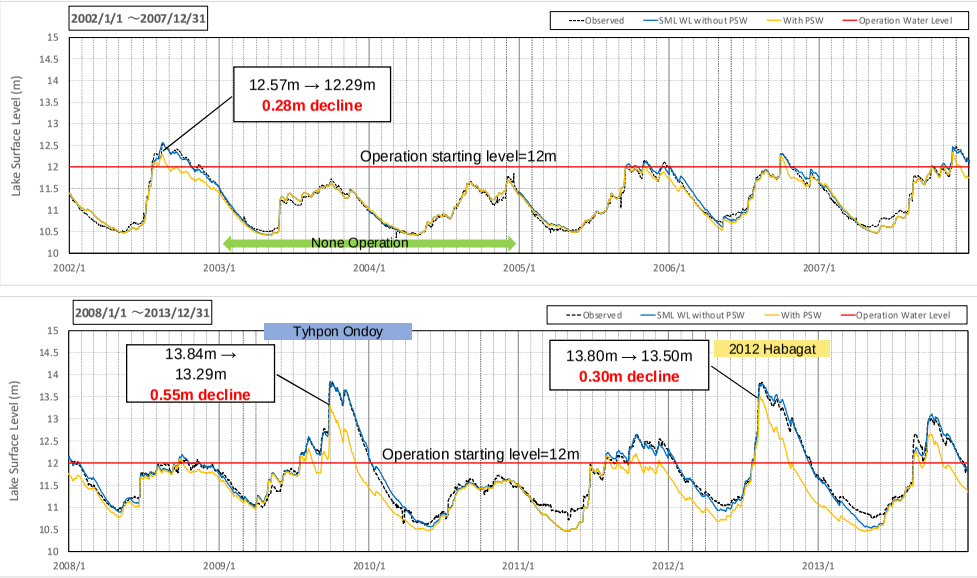
The design scale is set by comprehensively evaluating the importance of the target basin, the actual condition of the past flood damages, the existing plan in the vicinity area and the design scale specified in the DPWH Standard Guideline of 2015.

- ✓ For the **Pasig – Marikina River Basin** which is the vicinity of this study, the design scale is the **100-year return period**. Typhoon Ondoy in 2009 brought massive damages to the Laguna de Bay Basin, and the basin average rainfall in the Marikina River Basin was 290.8mm (one day) which is equivalent to a 100-year return period.
- ✓ According to the "Manual on Flood Control Planning , March 2003" which was prepared in the JICA Technology Cooperation Project - ENCA, the eighteen (18) principal river basins in the Philippines are specified, including **Laguna de Bay in the Pasig-Laguna Bay Basin**.
- ✓ According to the DPWH Standard Guideline of 2015, design scales have been specified for rivers and drainage canals. In addition to the DPWH Standard Guideline, there is the memorandum of understanding in 2011 which specifies the design scales.
- ✓ The catchment area of Laguna de Bay is 3,280$km^2$, and the design scale in the DPWH Standard Guideline (Rivers) is a **100-year scale**.

**Table Design Scale of Flood Management in the Laguna de Bay Basin**

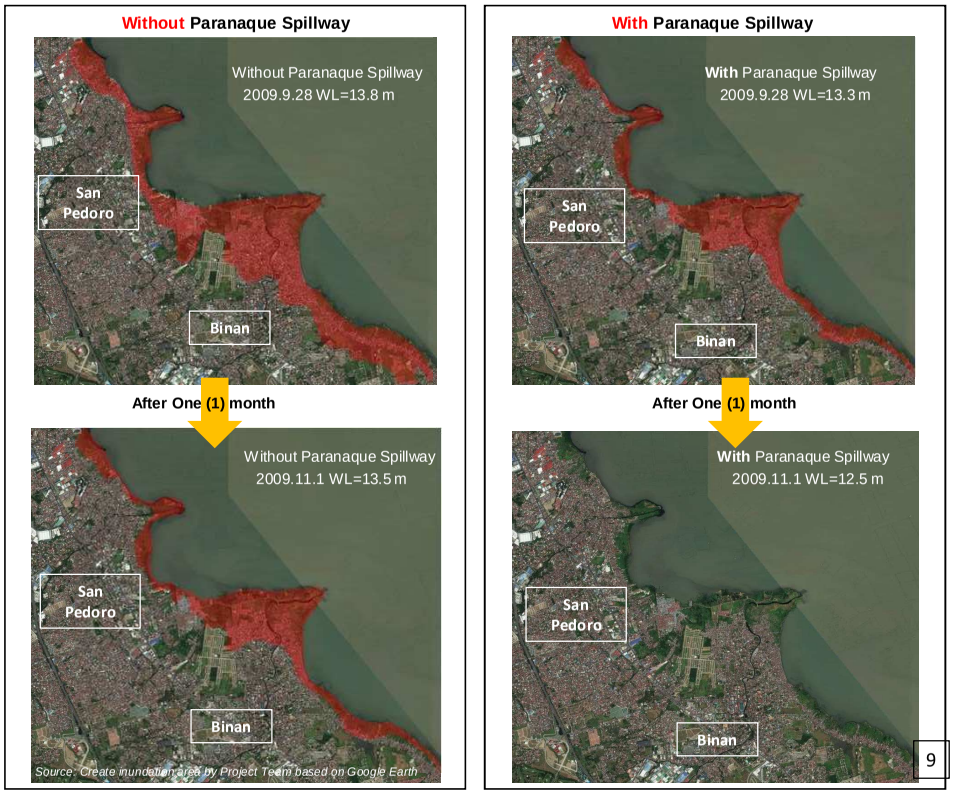
| Classification | Evaluation Index | Design Scale | Setting Rationale |
|---|---|---|---|
| **Flood caused by water level rise of Laguna de Bay** | Water Level | **100-year** | • Since Laguna de Bay is considered as one of the important basins in the Philippines, the design scale is set to a 100-year which is equivalent to the value for the Pasig-Marikina River Basin.<br>• The water level observed for Laguna de Bay has accumulated over a long period of time as compared to the rainfall data. Therefore, the water level probability scale is adopted. |
| **Laguna de Bay Basin (21 River Basins)** | Rainfall | **【Rivers】**<br>A≧40$km^2$ **50-year**<br>10$km^2$≦A＜40$km^2$ **25-year**<br>A≦10$km^2$ **15-year** | • Since there are several rivers in 21 river basins located in the Laguna de Bay Lakeshore Area, the design scale is set based on the basin area of each river.<br>• The design scale used in the DPWH Standard Guideline of 2015 may be an excessive design scale; therefore, the design scale of each basin area is set based on the memorandum of 2011. |
| | | **【Drainage canal】**<br>Drainage canal**: 15-year** | • This will be the design scale when internal water (drainage) countermeasures are targeted. |
| **Las Piñas-Parañaque District** | Rainfall | **【Rivers】**<br>A≧40$km^2$ **50-year**<br>10$km^2$≦A＜40$km^2$ **25-year**<br>A≦10$km^2$ **:15-year** | • This will be the design scale when the external water countermeasures are targeted. |
| | | **【Drainage Canal】**<br>Drainage Canal**: 15-year** | • This will be the design scale when internal water (drainage) countermeasures are targeted. |






*Source: Project Team*

**Long-term Prediction Calculation Results from 2002 to 2013 with Operation Starting Level of EL 12.0m**




*Source: Create inundation area by Project Team based on Google Earth*

## ■ Effect of Water Level Reduction by Parañaque Spillway

**<< Analysis of Factors and Trends of Lake Water Level Rise>>**

- Based on the calculation results in 2009, the factors causing the water level rise in Laguna de Bay were examined. The water level rise at the time of Typhoon Ondoy in 2009 is summarized below.

【Breakdown of Inflow and Outflow of Laguna de Bay ※Total Amount of 25 to 28 September 2009】

| | | |
|---|---|---|
| Inflow from the Laguna de Bay Basin | $V_{IN}$ | = 736.0 MCM (**64.6%**) |
| Inflow from the Mangahan Floodway | $V_{M,IN}$ | = 181.0 MCM (15.9%) |
| Inflow from the Napindan Channel | $V_{N,IN}$ | = 11.8 MCM (1.0%) |
| Rainfall to the Laguna de Bay Lake Surface | $V_R$ | = 211.0 MCM (18.5%) |
| Evapotranspiration from the Laguna de Bay Lake Surface | $V_{EVA}$ | = 4.7 MCM (7.0%) |
| Outflow from the Napindan Channel | $V_{N,OUT}$ | = 53.8 MCM (80.4%) |
| Outflow from the Mangahan Floodway | $V_{M,OUT}$ | = 8.4 MCM (12.6%) |

Inflow from lakeshore area mostly influenced the lake level raising.

**Inflow V=1,139.8 MCM**

**outflow V =66.9 MCM**

**Inflow V**

$$\Delta V = V_{IN} + V_{M,IN} + V_{N,IN} + V_R - (V_{EVA} + V_{N,OUT} + V_{M,OUT})$$

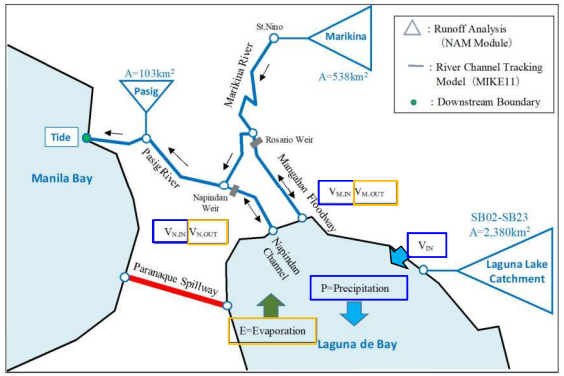
**outflow V**

= 1,139.8 – 66.9

= **1,072.6 MCM**

**(1.11m water level up)**

2009/9/25 WL=12.77m (Observed)
2009/9/28 WL=13.81m(Observed)
ΔL=1.04m




*Source: Project Team*

### ◆ Effect of Water Level Reduction by the Construction of Parañaque Spillway

< Operation Starting Water Level = 12.0m >

- Regarding the peak water level, the maximum water level decrease of 0.55 m was in 2009, the water level lowering effect of 0.24 m on a 12-year average.
- The duration of water level over 12.5m was shortened from 110 days to 46 days (42% reduction) in 2009, from 108 days to 63 days (58% reduction) in 2012, and from 62 days to 15 days (24% reduction) in 2013.
- Laguna de Bay is utilized as source of drinking and irrigation water, and fishery. The operation starting water level of 12.0 m does not affect these water utilization purposes.

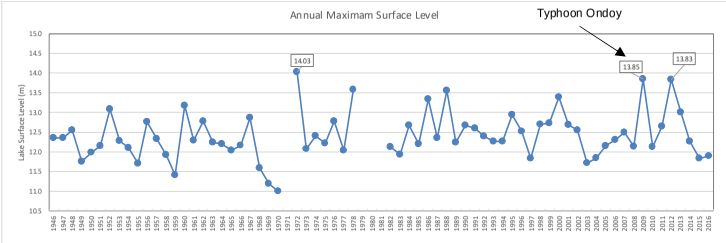
| Year | Maximum Water level | | | | Days of more than 12.5m | | |
|---|---|---|---|---|---|---|---|
| | Observed | SML | | | | | |
| | | [1] | [2] | [3]=[1]-[2] | [4] | [5] | [6]=[4]-[5] |
| | | WL without PSW | With PSW | Difference | WL without PSW | With PSW | Days |
| 2002 | 12.55 | 12.57 | 12.29 | 0.28 | 8 | 0 | 8 |
| 2003 | 11.72 | 11.64 | 11.64 | 0.00 | 0 | 0 | 0 |
| 2004 | 11.85 | 11.69 | 11.69 | 0.00 | 0 | 0 | 0 |
| 2005 | 12.15 | 12.12 | 12.03 | 0.10 | 0 | 0 | 0 |
| 2006 | 12.30 | 12.30 | 12.27 | 0.03 | 0 | 0 | 0 |
| 2007 | 12.49 | 12.47 | 12.33 | 0.14 | 0 | 0 | 0 |
| 2008 | 12.14 | 12.19 | 12.10 | 0.10 | 0 | 0 | 0 |
| 2009 | 13.85 | 13.84 | 13.29 | 0.55 | 110 | 46 | 64 |
| 2010 | 12.12 | 12.12 | 11.64 | 0.48 | 0 | 0 | 0 |
| 2011 | 12.65 | 12.65 | 12.22 | 0.43 | 17 | 0 | 17 |
| 2012 | 13.83 | 13.80 | 13.50 | 0.30 | 108 | 63 | 45 |
| 2013 | 13.01 | 13.11 | 12.66 | 0.45 | 62 | 15 | 47 |
| **Min** | **11.72** | **11.64** | **11.64** | **0.00** | **0** | **0** | **0** |
| **Ave** | **12.56** | **12.54** | **12.31** | **0.24** | **25** | **10** | **15** |
| **Max** | **13.85** | **13.84** | **13.50** | **0.55** | **110** | **63** | **64** |

**[Parañaque Spillway]**

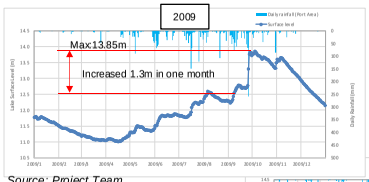
Design Discharge : 200m³/S
Floodway Length : it is considered as 10km.
Pipe Diameter : 12.0m
Inflow Gate : 10.0m x 3 sluice gates



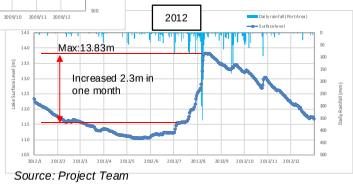
## ■ Changes of Lake Level




**Long-term Change of Year Maximum Lake Level**

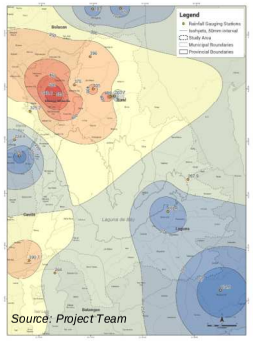



*Source: Project Team*



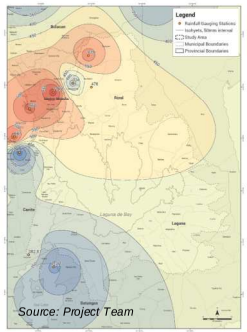

*Source: Project Team*

<2009.Sep.25 – 26 2 days rainfall>



*Source: Project Team*

<2012.Aug.6 – 7 2 days rainfall>



*Source: Project Team*

**Maximum Lake Level at Laguna de Bay (1946 to 2016)**

| Year | Surface water level m | Days of above 12.5m | Year | Surface water level m | Days of above 12.5m |
|---|---|---|---|---|---|
| 1946 | 12.36 | 0 | 1983 | 11.94 | 0 |
| 1947 | 12.36 | 0 | 1984 | 12.67 | 16 |
| 1948 | 12.54 | 19 | 1985 | 12.20 | 0 |
| 1949 | 11.76 | 0 | 1986 | 13.34 | 93 |
| 1950 | 11.98 | 0 | 1987 | 12.35 | 0 |
| 1951 | 12.15 | 0 | 1988 | 12.55 | 48 |
| 1952 | 13.08 | 68 | 1989 | 12.24 | 0 |
| 1953 | 12.28 | 0 | 1990 | 12.67 | 21 |
| 1954 | 12.10 | 0 | 1991 | 12.60 | 26 |
| 1955 | 11.71 | 0 | 1992 | 12.39 | 3 |
| 1956 | 12.76 | 38 | 1993 | 12.27 | 0 |
| 1957 | 12.33 | 0 | 1994 | 12.27 | 0 |
| 1958 | 11.92 | 0 | 1995 | 12.94 | 81 |
| 1959 | 11.41 | 0 | 1996 | 12.52 | 0 |
| 1960 | 13.17 | 64 | 1997 | 11.83 | 0 |
| 1961 | 12.29 | 0 | 1998 | 12.70 | 20 |
| 1962 | 12.77 | 36 | 1999 | 12.72 | 37 |
| 1963 | 12.24 | 0 | 2000 | 13.39 | 65 |
| 1964 | 12.20 | 0 | 2001 | 12.69 | 6 |
| 1965 | 12.04 | 0 | 2002 | 12.55 | 5 |
| 1966 | 12.16 | 0 | 2003 | 11.72 | 0 |
| 1967 | 12.87 | 3 | 2004 | 11.85 | 0 |
| 1968 | 11.59 | 0 | 2005 | 12.15 | 0 |
| 1969 | 11.19 | 0 | 2006 | 12.30 | 0 |
| 1970 | 11.00 | 246 | 2007 | 12.49 | 0 |
| 1971 | No data | - | 2008 | 12.14 | 0 |
| 1972 | 14.03 | 88 | 2009 | 13.85 | 108 |
| 1973 | 12.08 | 0 | 2010 | 12.12 | 0 |
| 1974 | 12.40 | 0 | 2011 | 12.65 | 21 |
| 1975 | 12.22 | 0 | 2012 | 13.83 | 111 |
| 1976 | 12.77 | 16 | 2013 | 13.01 | 61 |
| 1977 | 12.03 | 0 | 2014 | 12.26 | 0 |
| 1978 | 13.58 | 62 | 2015 | 11.83 | 0 |
| 1979 | No data | - | 2016 | 11.89 | 0 |
| 1980 | No data | - | **Min** | **11.00** | **0** |
| 1981 | No data | - | **Ave** | **12.41** | **22** |
| 1982 | 12.13 | 119 | **Max** | **14.03** | **246** |

## ■ Hydrological Statistical Analysis

Lake Water Level Statistical Analysis

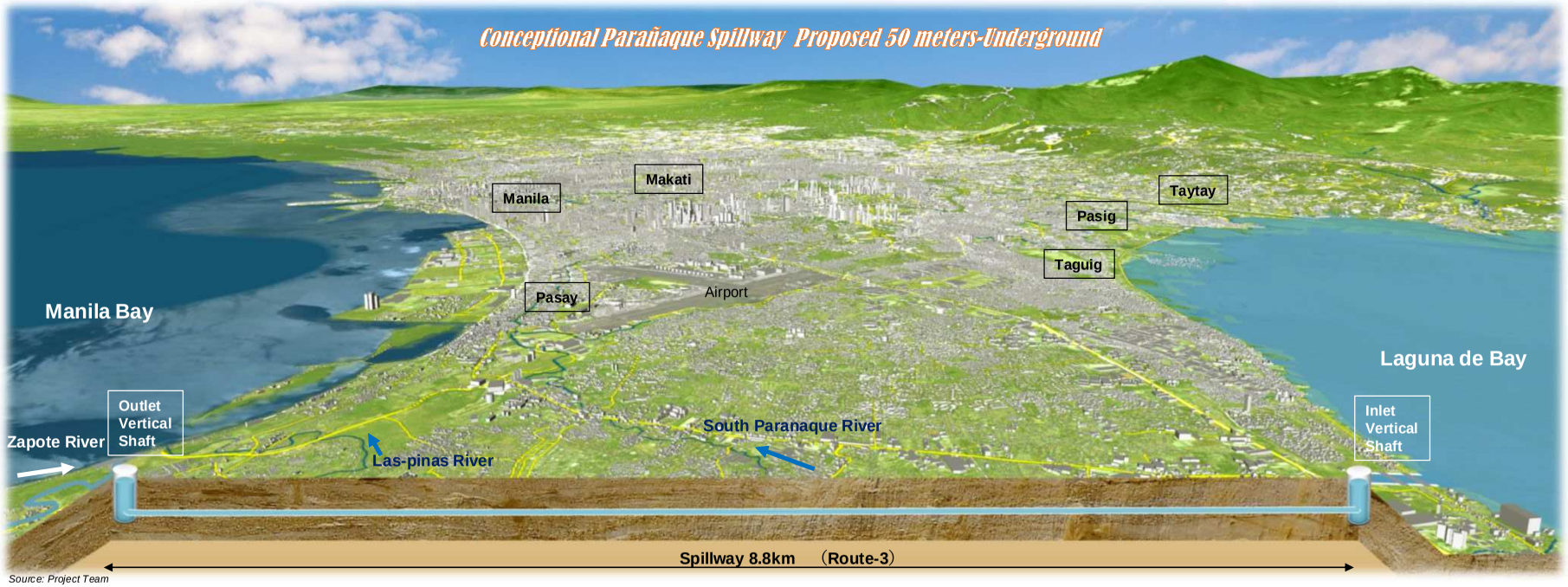
- Probable lake water level was computed using annual maximum lake water level from 1946 to 2016.
- Lake water level in 100-year return period is at 14.3m.

☐ Lake Water Level*
Mean Lower Water Level : 10.69 m
Maximum Lower Water Level : 11.19 m
Mean Water Level : 11.33 m
Mean Higher Water Level : 12.07 m
Maximum Higher Water Level : 14.03 m

* Estimated using by observed data from 1947 to 2016.

☐ Tide Level
Mean Sea Level : 10.47 m
Maximum Sea Level : 11.87 m
Syzygy average high water level : 11.24 m

| Return Period (year) | Water Level (m) |
|---|---|
| 2 | 12.3 |
| 3 | 12.6 |
| 5 | 12.9 |
| 10 | 13.2 |
| 20 | 13.6 |
| 30 | 13.7 |
| 50 | 14.0 |
| 80 | 14.2 |
| 100 | 14.3 |
| 200 | 14.7 |




Source: Project Team

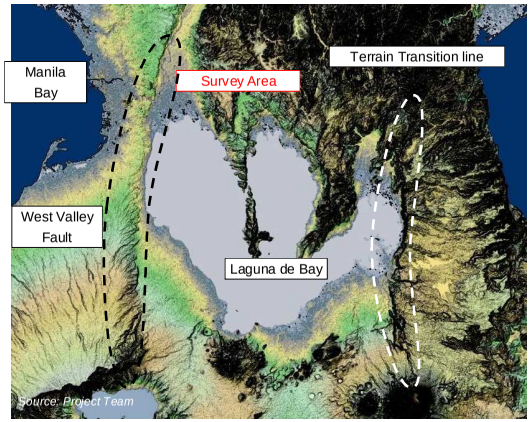
## ■ Route

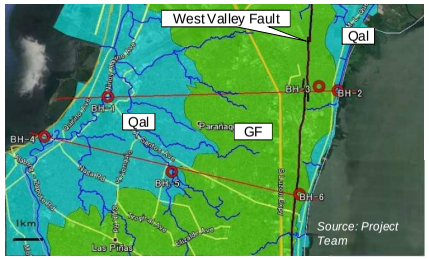
| Route | Route-1: Lower Bicutan to South Paranaque River | Route-2: Sucat to San Dionisio River | Route-3: Sucat to Zapote River |
|---|---|---|---|
| Summary | Basically straight line between Lower Bicutan and South Paranaque River | Basically straight line between Sucat and San Dionisio River | Basically straight line between Sucat and Zapote River |
| Spillway Length | Spillway Lp=6.0km<br>Open Channel Lo=1.2km | Spillway Lp=7.2km<br>Open Channel Lo=0.6km | Spillway Lp=8.8km<br>Open Channel Lo=0.6km |
| Site | It is necessary to relocate large-scale facilities. such as Polytechnic University | Mainly unused ground is widely spaced but adjacent to church. | |
| River Improvement | Wide river improvement area required due to the narrow channel. | Required river improvement areas are up & downstream of drainage facility. | Required river improvement area is smallest among 3 rivers. |
| Social Environment | The length of 1200m of the Open Channel is longer than Route-2. | Resettlement is necessary in the Laguna de Bay lakeshore area. | |
| Evaluation | O: Possible | △ | O: Promising |

Source: Project Team

**Alignment Plan Drawing of Parañaque Spillway**

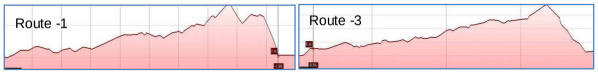
## ■ Geological Condition

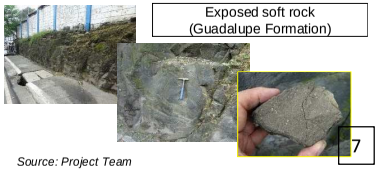



- The West Valley Fault in the Valley Fault System can be seen in north-south direction, west side of Laguna de Bay.
- The elevation becomes gradually higher toward Laguna de Bay. After the peak of hilly land at around 40m, the elevation drops at lakeshore area of Laguna de Bay.

Basement rock in this hilly land:
Pleistocene Guadalupe Formation (GF), mainly composed of volcanic clastic rocks (tuff, lapilli tuff, tuff gravel rock, volcanic ash, silt, etc.,), the so-called "soft rocks."
Lowlands on the western side of the hill and the lakeshore area of Laguna de Bay: Holocene Quaternary Alluvium (Qal), unconsolidated deposits such as clay, silt, sand, and gravel covers the basement soft rocks.




Source: Project Team

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