HYDROLOGICAL MONITORING
AT PUTRAJAYA

By:
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### PUTRAJAYA - MASTERPLAN

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Acreage (Acre)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>597.7</td>
<td>5.3</td>
</tr>
<tr>
<td>Commercial</td>
<td>327.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Housing</td>
<td>2,888.8</td>
<td>25.5</td>
</tr>
<tr>
<td>Civic &amp; Cultural</td>
<td>25.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Public Facilities</td>
<td>1,103.0</td>
<td>9.7</td>
</tr>
<tr>
<td>Utility &amp; Infrastructure</td>
<td>2,123.2</td>
<td>18.8</td>
</tr>
<tr>
<td>Open Space</td>
<td>4,254.1</td>
<td>37.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11,320ac</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Note:**
- 1 ac = 4,046.86 square meters
- 1 hec = 100 acres
Impact of Development to Sg. Langat

• Runoff Quantity
  – Flood
  – Low Flow

• Runoff Quality
Solution - (Putra Jaya Lake)

- Part of Sg. Langat River Basin (2350 km²)
- Putrajaya Lake catchment (52 km²)
- 70% of the catchment within Putrajaya
- Consists of eight sub-catchments and predominantly controlled by the Sungai Chua which cover an area of 52.2 km² (97.2 % of the total catchment area). Sungai Limau Manis creates a small sub-catchment, (1.5km²)
- Putrajaya wetland is about 197 hectares
Putra Jaya Lake System

- Consists of Putrajaya Lake and 6 artificial wetlands
- 6 wetlands comprise of 24 cells, separated by weir
- UW (8 cells), UE (3 cells), UN (8 cells), LE (2 cells), Central (1 cell) and UB (2 cells)
- About 60% of lake water flow comes from wetland
- 40% comes from direct discharge from bordering lakes and promenades
- Total lake volume is 23.5 million cubic meter
- Depth ranges from 3 – 14m.
- Multifunctional use: recreation, fishing, water sport, water transport and flood control
# Putra Jaya Lakes Features

## Table 2: Features of Putrajaya Wetlands (Area in hectares)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Area</td>
<td>197.20</td>
</tr>
<tr>
<td>Planted Area</td>
<td>77.70</td>
</tr>
<tr>
<td>Open Water</td>
<td>76.80</td>
</tr>
<tr>
<td>Weirs &amp; Islands</td>
<td>9.60</td>
</tr>
<tr>
<td>Zone of Intermittent Inundation</td>
<td>23.70</td>
</tr>
<tr>
<td>Maintenance Tracks</td>
<td>9.40</td>
</tr>
</tbody>
</table>

## Table 4: Principal Features of Putrajaya Lake

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchments Area</td>
<td>51.0 KM²</td>
</tr>
<tr>
<td>Water Level</td>
<td>RL 21.00 M</td>
</tr>
<tr>
<td>Surface Area</td>
<td>400 ha (4 KM²)</td>
</tr>
<tr>
<td>Storage Volume</td>
<td>23.50 mil. M³</td>
</tr>
<tr>
<td>Average Depth</td>
<td>6.60 M</td>
</tr>
<tr>
<td>Average Catchments Inflow</td>
<td>200 million liters</td>
</tr>
<tr>
<td>Average Retention Time</td>
<td>132 days</td>
</tr>
</tbody>
</table>
## Hydrological Characteristics of Putra Jaya Catchment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>2166mm at Ldg Galloway</td>
<td>Long Term MAR</td>
</tr>
<tr>
<td></td>
<td>2140 mm at Stor JPS Kajang</td>
<td>1981-1994</td>
</tr>
<tr>
<td></td>
<td>2137 mm at Ldg Sedgeley</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2111 mm at Prang Besar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2278 mm at West County</td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>1720 mm at Prang Besar</td>
<td>Long Term MAE</td>
</tr>
<tr>
<td></td>
<td>0.01m³/s - 3.46 m³/s</td>
<td>1981-1992</td>
</tr>
<tr>
<td>Streamflow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Putrajaya Catchment Area and River System

• Putrajaya hydrological system is a key element of the survival of Putrajaya Lake and wetland ecosystem.
• It is composed of eight (8) sub-catchments predominantly controlled by Sg. Chua (52.2 km²; 97.2% of total catchment area).
• Sg Limau Manis creates small catchment (1.5km²; 2.5%)
Objectives

The objectives of the hydrological monitoring are:

i. To establish reliable hydrological decision-making information and databases for the Putrajaya catchment.

ii. To compare rainfall and evaporation data with historical data

iii. To establish the rainfall, recharge and water level relationship.

iv. To provide information for the water resources management and water balance estimation for the Putrajaya catchment.

v. To estimate high and low flow within the catchment

vi. To provide hydrological databases for correlation analysis between parameters from other fields.
Scope of Work

• The scope for the hydrological monitoring works includes:
  i. Field data measurement and collection
  ii. Data monitoring
  iii. Data analysis
  iv. Hydrologic Modelling
  v. Report submission
Study Area
Sg. Chua Catchment
Present Status Of Putrajaya Hydrological Stations (Water Level)
The field data measurements include the following parameters:

1. Daily Rainfall

<table>
<thead>
<tr>
<th>Station</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMS</td>
<td>Precinct 1</td>
</tr>
<tr>
<td>R-01</td>
<td>Precinct 13</td>
</tr>
<tr>
<td>R-02</td>
<td>Precinct 2</td>
</tr>
<tr>
<td>R-03</td>
<td>Precinct 11</td>
</tr>
<tr>
<td>R-04</td>
<td>Precinct 1</td>
</tr>
</tbody>
</table>
The field data measurements include the following parameters:

2. Water Level and Flow

<table>
<thead>
<tr>
<th>Sub-catchment</th>
<th>Station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper West</td>
<td>- UW7</td>
</tr>
<tr>
<td></td>
<td>- UW1</td>
</tr>
<tr>
<td>Upper North</td>
<td>- UN8</td>
</tr>
<tr>
<td></td>
<td>- UN3</td>
</tr>
<tr>
<td></td>
<td>- UN1</td>
</tr>
<tr>
<td>Upper East</td>
<td>- UE1</td>
</tr>
<tr>
<td>Lower East</td>
<td>- LE2</td>
</tr>
<tr>
<td></td>
<td>- LE1</td>
</tr>
<tr>
<td>- Upper Bisa</td>
<td>- UB1</td>
</tr>
<tr>
<td>- Pump House*</td>
<td>- PH</td>
</tr>
<tr>
<td>Central Wetland</td>
<td>- CW</td>
</tr>
</tbody>
</table>
Monitoring Procedures

• Eleven (11) water level auto-logger with solar panel and battery were installed within the study area
Flow (discharge)

- **Weir Method**

\[ Q = 1.3 \cdot B \cdot H^{1.5} \]

Q= discharge \((m^3/ s)\), B= weir crest length \((m)\), H= upstream water head above the crest \((m)\)

- **Flow meter**

\[ Q = V \cdot A = \sum_{i=0}^{n} q_i = \sum_{i=0}^{n} v_i \cdot a_i \]

area \((a)\) multiplied by measured velocity \((v)\)
Analyses on Rainfall Data

January – December 2015
<table>
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<tr>
<th>Parameter</th>
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<th>Remark</th>
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</tr>
<tr>
<td>Streamflow</td>
<td>0.01m3/s - 3.46 m3/s</td>
<td>1981-1992</td>
</tr>
</tbody>
</table>
Results: Average monthly rainfall for 2011
Monthly Rainfall 2015 (mm)
Monthly Rainfall 2015 (mm)
Monthly Rainfall 2015 (mm)
Dry Days
Number of Dry Days (Average = 145 days)
Rainfall - Runoff
Theissen Polygon Coverage

- RMS 01 – UN 1, UN 8, UE 1, UW7
- RMS 02 - PH
- RMS 03 – no WL station
- RMS 04 – no WL station
- WMS – UB1, UW1, LE1 & LE7
Average Water Level November (mm)
Hydrological Modelling

1) Observed Rainfall
   - Short Term (hourly) Long term (Daily)

2) Design Rainfall
   2, 5, 10, 20, 50 and 100 year
Neighbouring Rainfall Station
<table>
<thead>
<tr>
<th>Selangor</th>
<th>IDF Station</th>
<th>Location Description</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Indo 正常 (健康)</th>
<th>Indo 可疑 (健康)</th>
<th>Indo 疑似 (健康)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2815001</td>
<td>JPS Sungai Manggis</td>
<td>56.052</td>
<td>0.152</td>
<td>0.194</td>
<td>0.857</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2913001</td>
<td>Pusat Kwl. JPS T Gong</td>
<td>63.493</td>
<td>0.170</td>
<td>0.254</td>
<td>0.872</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2917001</td>
<td>Setor JPS Kajang</td>
<td>59.153</td>
<td>0.161</td>
<td>0.118</td>
<td>0.812</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3117070</td>
<td>JPS Ampang</td>
<td>65.809</td>
<td>0.148</td>
<td>0.156</td>
<td>0.837</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>31118102</td>
<td>SK Sungai Lui</td>
<td>63.155</td>
<td>0.177</td>
<td>0.122</td>
<td>0.842</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>3314001</td>
<td>Rumah Pam JPS P Setia</td>
<td>62.273</td>
<td>0.175</td>
<td>0.205</td>
<td>0.841</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3411017</td>
<td>Setor JPS Tj. Karang</td>
<td>68.290</td>
<td>0.175</td>
<td>0.243</td>
<td>0.894</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>3416002</td>
<td>Kg Kalong Tengah</td>
<td>61.811</td>
<td>0.161</td>
<td>0.188</td>
<td>0.816</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>3516022</td>
<td>Loji Air Kuala Kubu Baru</td>
<td>67.793</td>
<td>0.176</td>
<td>0.278</td>
<td>0.854</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3710006</td>
<td>Rmh Pam Bagan Terap</td>
<td>60.793</td>
<td>0.173</td>
<td>0.185</td>
<td>0.884</td>
<td></td>
</tr>
</tbody>
</table>
Hydrological Stations
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-catchment</th>
<th>Area(km²)</th>
<th>Area(%)</th>
<th>Landlord</th>
<th>Current situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuau River</td>
<td>Upper North (UN)</td>
<td>12.4</td>
<td>23.1</td>
<td>UPM Mardi PPJ IOI</td>
<td>Agriculture, Institutional, Parks, Golf course, Commercial, Health Facility</td>
</tr>
<tr>
<td></td>
<td>Upper West (UW) (Sg. Kuyoh)</td>
<td>6.2</td>
<td>11.5</td>
<td>Mardi PPJ TNB</td>
<td>Agriculture, Power station, Parks, Residential,</td>
</tr>
<tr>
<td></td>
<td>Upper East (UE)</td>
<td>4.2</td>
<td>7.8</td>
<td>PPJ Uniten West Country</td>
<td>Residential, Parks, Government, Institutional, Commercial</td>
</tr>
<tr>
<td></td>
<td>Lower East (LE)</td>
<td>1.7</td>
<td>3.2</td>
<td>PPJ</td>
<td>Residential, Government, Parks,</td>
</tr>
<tr>
<td></td>
<td>Central (CW) (Sg. Chuau)</td>
<td>7.1</td>
<td>13.2</td>
<td>PPJ</td>
<td>Residential, Parks, Government, Health Facility Parks,</td>
</tr>
<tr>
<td></td>
<td>Upper Bisa (UB) (Sg. Bisa)</td>
<td>5.9</td>
<td>11</td>
<td>PPJ</td>
<td>Residential, Parks, Government, Commercial</td>
</tr>
<tr>
<td></td>
<td>Lower (Sg. Chuau)</td>
<td>14.7</td>
<td>27.4</td>
<td>PPJ, Cyberjaya</td>
<td>Residential, Commercial, Government, Government</td>
</tr>
<tr>
<td>Limau Manis River</td>
<td>Sg. Limau Manis</td>
<td>1.5</td>
<td>2.8</td>
<td>PPJ</td>
<td>Residential, Government</td>
</tr>
<tr>
<td>Total Area of Catchment</td>
<td></td>
<td>53.7</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusion

• Rainfall and evaporation data is consistent with historical data
• Some rainfall stations are well below national and site average
• Number of continuous dry days is getting longer
• Extreme events becoming more frequent
RECOMMENDATION

• Rainfall Station
  – Variations of rainfall data problems (R01, R02, R03, R04 and WMS)
  – To install manual rain gage to check the auto rain gage
  – To check rainfall data between different type of gages
RECOMMENDATION 2
• Stage gauge – missing, broken, displaced, dirty
  – This measuring gauge is used to determine the water level.
  – Some gauges are missing (must be replaced), broken (must be repaired) and some are dirty (need for clean-up).
  – UW1, UN8, UN3, UN1, UE1
  – CW AND UB1 (not installed)
RECOMMENDATION 3

- Water lever measurement: Measuring gauge was incorrectly installed in terms of height – resulting in different value of datum height.
- Measuring gauge must be properly adjusted and correctly re-installed.
RECOMMENDATION 4

- Weather Station-some of the data gives –ve values (evaporation).
- Need to maintain equipment regularly
RECOMMENDATION 5

• Some of the locations of the installed equipment should be reviewed-
  • rainfall station-canopy issue
  • Water level station- sedimentation issue
  • Weather station
RECOMMENDATION 6

– To get reliable water level data
– To check the functionality of the instruments

• To install additional automatic logger to measure the discharge at every weir / sampling stations.