Sludge Treatment Facilities
Presented by
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Presentation Outline
- Current Situation
- Need for the STF
- Alternative Treatment Option
- Site Location
- EIA Study
- Programme
Sources of Sludge

CEPT & Secondary Treatment
Mainly include SCISTW & other 10 regional large STWs

Sewage generated from daily lives

Sewage is treated in Sewage Treatment Works (STW)

Treated effluent is discharged to nearby water bodies

Sludge generated from sewage treatment is disposed of at landfills
Sludge Treatment Facilities (STF)

Sludge Production Forecast

<table>
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<tr>
<th>Year</th>
<th>2008</th>
<th>2012</th>
<th>2014</th>
<th>2016</th>
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<tr>
<td>Wet tonnes/day</td>
<td>800</td>
<td>1,160</td>
<td>1,430</td>
<td>1,540</td>
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</table>

Sludge Contribution

- San Wai STW (4.00%)
- Yuen Long STW (1.58%)
- Shek Wu Hoi STW (1.74%)
- Tai Po STW (2.90%)
- Sha Tin STW (5.71%)
- Sai Kung STW (0.40%)
- Stanley STW (0.14%)
- Sham Tseng STW (0.25%)
- Siu Ho Wan STW (2.71%)
- Stonecutters Island STW (75.96%)
At present, landfilling is the only means for disposal of sewage sludge in Hong Kong. Sludge generated from sewage treatment works is transported by vessels (75% in total) and by trucks (25% in total) to landfill sites for disposal. About 800 tonnes of sludge were disposed of at landfill sites in 2008.

**Increase in Sludge Production:**
- Commissioning of HATS Stage 2A and expansion / upgrading of some existing STWs
- Increased from 800 tpd at present to over 1,400 tpd by 2014

As a result, the current disposal ratio of 1:10 (sludge : MSW / construction waste) cannot be maintained.
## Need for the STF

- The current practice of disposing of dewatered sludge at landfill is not sustainable:
  - Co-disposal problem: The current safe co-disposal ratio 1:10 cannot be maintained
  - Limited landfill life: Existing landfills would only last until early to mid 2010 decade, there is an urgent need to prolong the landfill life
  - International trend: Disposal of biodegradable waste at landfill is not in line with international trend

## Alternative Treatment Option

### Development

- Sludge Treatment and Disposal Strategy Study (STDSS)
  - Completed in 1999
  - Recommended all HK’s dewatered sewage sludge to be treated in an incineration facility
- Advisory Council on the Environment (ACE)
  - Consulted in Dec 1999
  - Agreed that incineration would be the right direction
- Preliminary Project Feasibility Study (PPFS)
  - Completed in 2001
  - Concluded that fluidized bed incineration is a feasible technology for sewage sludge in Hong Kong
- Sludge Treatment Facilities (STF)
  - Commenced in 2004
International Practices

Japanese Experience
- Over 80% of Japan sludge is incinerated
- Fluid bed incineration predominates
  (over 160 plants)
- Other treatments including heat drying/composting
  for sludge reuse and landfiling

U.S. Experience
- Mainly reuse for land application
- Incineration represents about 20%
  (over 250 plants)
- Landfilling is decreasing
- Fluidized bed incinerators replacing multiple
  hearth incinerators
International Practices

European Experience
- Landfilling is decreasing (about 15%)
- Incineration is increasing (about 40%)
  - Denmark
  - Italy
  - Germany
  - U.K.
- Fluidized bed incineration predominates
- Land application will remain stable (about 45%)

Summary
- Incineration is a proven technology and is being increasingly used in Japan and Europe
- Many major US cities plan to continue to use incineration
- Heat drying and composting are the key technologies for sludge reuse
- Landfilling is decreasing in Japan, U.S., and Europe
- Land application including soil conditioners and fertilizers and need to meet US EPA Part 503 Class A
HK Sludge

- High chloride content due to seawater flushing
- Except sludge generated in Shek Wu Hui STW and Sai Kung STW
- Current demand of recycled sludge is limited
- Separate study conducted by EPD

Options for Volume Reduction

- Updated review of sludge treatment technologies
- Options considered
  - Co-incineration with MSW
  - Heat Drying
  - Fluidized-Bed Incineration
Co-Incineration

- Mix sludge with municipal solid waste (MSW)
- Moisture content
  - Sludge: 70 to 80 percent
  - Solid waste: 20 to 30 percent
- Primary differences between sludge incinerators and MSW incinerators
  - Residence time
  - Grate design
- MSW incinerators
  - Short retention time
  - Grates are designed with openings to permit the introduction of air
  - Openings can permit unburned sludge particles to fall through

Co-Incineration

- Requirements for complete combustion of sludge
  - Limiting the amount of sludge introduced to the MSW incinerators and distributing sludge evenly with the MSW
  - MSW-to-Sludge rate: 15 to 30:1
- Typical problems encountered with co-incineration
  - Poor mixing of the sludge and MSW
  - Too thick a layer of sludge
  - Too low a ratio of MSW-to-Sludge
- These factors result in only partially burned sludge and air and heat balance problems. The partially dried, unburned sludge is discharged along with the incinerator ash causing potential odour problems
Heat Drying

- Description
  - Evaporate water using low temperature evaporation equipment
  - Proven technology
  - If use as incineration pre-treatment, flexibility is gained
  - Direct dryers (sludge contacts drying air)
  - Indirect dryers (heated jackets/shells)

- Issues
  - High energy consumption
  - Air pollution control needed
  - Marketing of high salt content sludge will be difficult

Fluidized Bed Incineration

- Description
  - Proven in large plants
  - Large volume reduction
  - Time, temperature, turbulence
  - > 850 °C & 2 sec

- Issues
  - Trained Personnel
  - Concern on air emission e.g. dioxin
  - USEPA considers regular monitoring of dioxin emission from municipal sewage sludge incinerators is not required
Sludge Treatment Facilities (STF)

Recommend Option

- Sludge Receiving
- Incineration
- Flue Gas Treatment
- Ash & Residue Storage
- Landfilling
- Emission

Potential Site Locations

- A site search study was conducted to identify potential suitable sites and 9 sites were short-listed for detailed assessment.
Site Selection Assessment Criteria

- Cumulative environmental impact
- Engineering feasibility
- Operational convenience
- Financial issues
- Strategic planning issues

The assessment concludes that the ash lagoon at Tsang Tsui near Nim Wan, Tuen Mun is the most technically viable location.
Existing Condition of Proposed Site

Sludge Transportation Routes

- Stonecutters Island STW
- Proposed Sludge Treatment Facilities
- Siu Ho Wan STW
Sludge Treatment Facilities (STF)

- Sludge Reception & Storage
- Incinerators & Flue Gas Treatment System & Stack
- Flue Gas Residuals Silos, Ash Silos, Chemical/ Fuel Storage
- Administration Building & Visitor Centre
- Maintenance Workshop
- Desalination Plant
- Sewage Treatment Plant

Green Design for the STF

- Compliance with the most stringent emission standard
- Sustainable development – 90% reduction in volume of waste disposal of at landfill
- Renewable energy from incineration can be used to generate electricity for daily operation
- Effluent reuse for on-site cleaning and irrigation
- Water supply by desalination of seawater
- Rain water collection and reuse

Based on the green design concept, STF will be a self-sustainable facility and compliance with both stringent air emission and water discharge standard.
### Air Emission Standard

<table>
<thead>
<tr>
<th>Air Pollutant</th>
<th>Target Emission Limits (mg/m³)</th>
<th>(a)</th>
<th>(b)</th>
<th>(c)</th>
<th>(d)</th>
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<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>Half - Hourly</td>
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<tr>
<td>Particulates</td>
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<td>Carbon Monoxide (CO)</td>
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<td>Total Cadmium &amp; Thallium</td>
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<td>Total Heavy Metals</td>
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<tr>
<td>Dioxins &amp; Furans</td>
<td>1 × 10⁻¹</td>
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(a) Emission limits are reference to 0°C and 101.325 kPa.
(b) Average values over a sampling period of a minimum of 30 minutes and a maximum of 8 hours. Including Sn, As, Pb, Cu, Cr, Co, Mn, V and Ni.
(c) The unit is I-TEQ (The emission limit is equal to 0.1 ng I-TEQ m⁻³), according to the BPM 12/1, the averaging time for dioxin is 6 to 8 hours.
(d) The particulate emission limit is assumed to be RSP.
Objective of EIA Study

- To provide information on the nature and extent of environmental impacts arising from the construction and operation of the Project and related activities that take place concurrently
- To apply for Environmental Permit before construction and operation of STF

Scope of EIA Study

- Air Quality
- Human Health Risk
- Ecology
- Waste Management
- Water Pollution
- Noise
- Landscape and Visual
- Landfill Gas Hazard
Target emission limits for STF are equivalent to Hong Kong BPM for Municipal Waste Incineration and EC’s Waste Incineration Directive.

Emissions from other sources are based on maximum allowable emission in SP licence.

Five years average monitoring data recorded at Yuen Long Station adopted as background air pollution concentrations.
Air Pollution Control

- Air pollution control and stack monitoring system to ensure STF stack emissions meet the stringent target emission limits
- Sludge reception hall and sludge hopper system are enclosed to control odour emissions
- Potential odour emissions from STF will be collected and destroyed by incineration process or ventilated to deodorizer before discharge

Human Health Risk

- Cancer risk associated with STF emissions is predicted to comply with risk guideline
- Cumulative acute and long term non-carcinogenic health impact are found to be insignificant when compared to local and overseas guideline levels
Ecology

- The identified habitats in the Assessment Area have low to moderate ecological value, including:
  - East Lagoon
  - Secondary woodland
  - Breeding ground for Little Grebe

Mitigation Measures
- Thorough inspections before construction to confirm no breeding activities
- If breeding activities are found in East Lagoon:
  - Erect hoarding and provide buffer area around breeding ground
  - Restriction of access to breeding site
- Erect a barrier with climbing plant between East and Middle Lagoon to provide screening effect

Enhancement Measures
- Native tree planting within project site
- Creation of pond habitat within project site
Waste Management

- **During Construction Phase**
  - To avoid off-site disposal, excavated PFA would be totally reused as filling material within the STF site area.

- **During Operation Phase**
  - The incinerator ash (bottom ash and fly ash) and flue gas cleaning residue will be disposed of at the landfill after checked for compliance with the proposed incineration residue pollution control limits.

Water Pollution

- During operation phase, all generated wastewater will be discharged to the on-site wastewater treatment plant.
- The treated effluent will be reused in the STF.
- There would be no wastewater effluent discharged to the coastal waters of Deep Bay.
Noise Impact

- No existing or planned noise sensitive receivers identified within 1km from the project site boundary
- All noise generating activities of STF would be enclosed within building structures
- Off-site road traffic noise impacts generated from STF were assessed and would not result in significant impact

Landscape and Visual
Landscape and Visual

View from Ha Pak Nai

View from Lung Kwu Tan
Landscape and Visual

- Construction phase measures:
  - Compensatory planting
  - Control of night-time lighting
  - Erection of decorative screen hoarding

- Operation phase measures:
  - Aesthetic design of façade, chimneys of STF and associated structures to harmonize with the surrounding settings
  - Shrub and climbing planting to soften structures
  - Tree planting to screen STF

Aesthetic Design of Incinerators Overseas Examples

Crossness, UK

Osaka, Japan
Landfill Gas Hazard

- Risk of landfill gas hazard assessed by source-pathway-target analysis
- Overall risk level associated with:
  - Existing WENT Landfill = Low
  - Proposed WENT Landfill Extension = Medium
- With implementation of protection measures, no adverse impact of landfill gas hazard on this Project is anticipated

Conclusion of EIA Study

- The EIA has determined the likely nature and extent of environmental impacts predicted to arise from the Project
- With the recommended mitigation measures applied, the Project would be environmentally acceptable and no unacceptable residual impacts are anticipated.
- Approved EIA Report available at EPD website
# Tentative Programme

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<th>Description</th>
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<tr>
<td>EIA Report Approval</td>
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<td>Public Works Subcommittee (PWSC)</td>
<td>Apr 2009</td>
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<td>Finance Committee (FC)</td>
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<td>Commissioning</td>
<td>End 2012</td>
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**Sludge Treatment Facilities**

Thank you