

## COMPANY

AECOM Asia Company Limited (AECOM)  
Drainage Services Department, HKSAR  
Government (DSD)

## PROJECT

Shek Wu Hui Sewage Treatment Works  
- Further Expansion Phases 1A and 1B  
- Design and Construction

## LOCATION

Sheung Shui, Hong Kong

## TYPE

Sewage Treatment Works Design and  
Construction and Hand-over to Facilitate  
Facility Management During Operation

## SCHEDULED TIME OF COMPLETION

Project duration 2015-2025 (tentative)

# Sewage Treatment Works Makeover Boosted by BIM

“The best practices developed during this project will be used to implement BIM in wastewater treatment works worldwide. By using BIM we are confident the complex design is viable and as a result we can reduce rework and coordination issues and also improve safety during construction and operation.”

—Jugal Makwana  
BIM Director, Asia Pacific



One of The Initial Architecture Schemes of SWHSTW Expansion  
Image courtesy of AECOM Asia Company Limited

**DSD and AECOM explore benefits from the use of 3D design while working on the first large scale sewage treatment works project to follow a BIM approach.**

Shek Wu Hui Sewage Treatment Works (SWHSTW), in North District of Hong Kong, is operated and maintained by DSD. It was commissioned in 1984, and AECOM was contracted to provide design and construction services for an expansion and upgrade of the facility.

## Tight space, previous upgrades

The project's major challenges include a very limited construction space in which to perform an in-situ upgrade and expansion. The project was further complicated by performing work in a live plant. Mr. W.W. Lau, Senior Engineer of DSD reports, “the SWHSTW expansion is a very challenging project. We have to double the treatment capacity within an existing footprint plus a small adjacent site, and we have to maintain the daily sewage treatment operation with incoming sewage already reaching 90% of the plant's capacity.

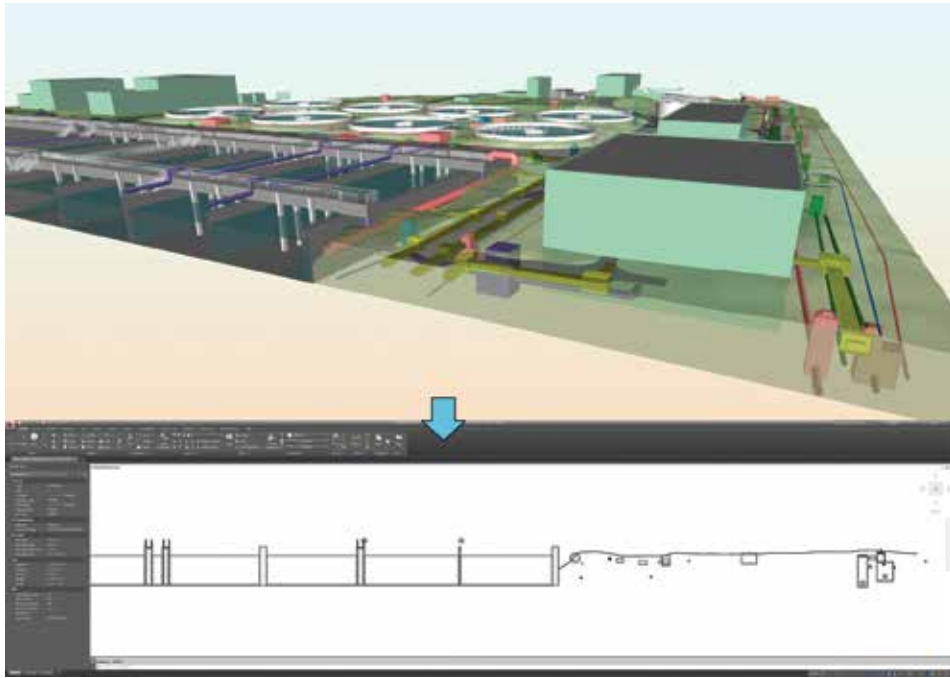
There are five treatment trains that have to be upgraded one by one. Plus, there is a tight construction programme to meet

the rapidly increasing sewage flow from nearby new developments. Through the implementation of BIM in this project, we can plan ahead to avoid potential conflicts in the design and to have a clear picture of the upcoming construction programme to minimize impacts to existing plant's performance.”

There were several previous upgrade projects conducted in the existing SWHSTW, which meant the BIM model had to pull information from the three previous expansion projects and the current design in order to show the site in one single 3D model. The visualisation helped resolve the contradicting information and align the current project with previous construction phases. “This is one of the first large scale sewage treatment projects delivered globally that is using a BIM approach.” says Echo Leong, AECOM's Executive Director, Water & Urban Development. “We worked closely with DSD to help define how BIM could improve project delivery, reliability and safety.”

## From sketches to 3D visualisation

The design team began with simple sketches, then developed the design further using BIM models. AECOM's Water



Produce Detailed Utilities Elevation Drawings from 3D BIM Models to Ensure Constructability and Improve Visualisation  
Image courtesy of AECOM Asia Company Limited

and Urban Development engineering team brought together design models from each discipline including that of the surrounding topography using latest laser point cloud technology. The highly detailed master model provided an excellent 3D visualization for the client and other stakeholders, which eliminated the need for extensive coordination meetings - as would have been required in a traditional process in 2D.

AECOM set up a BIM enabled collaboration platform as a common data environment that allows all project stakeholders and our client to access and interact with the most up-to-date project information, which is in turn federated out to the master BIM model.

Using 3D model was an advantage in helping show where the different services connected including at what depths and along which angles they connect. "With BIM, we could visualise whether the design was buildable" explains Ms. Can Leung, Senior BIM Manager, AECOM. "It makes it easy to visualise complicated aspects of the design with our client and the project team."

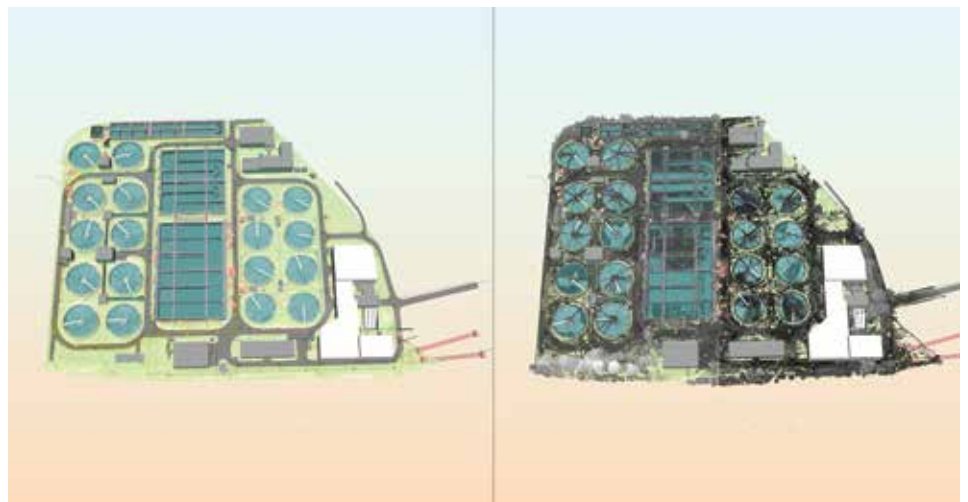
Using BIM also helped save a lot of time that would have otherwise been required for creating 2D drawings. For instance, changing a simple pipe inlet of a treatment building structure could affect a whole series of drawings - yet Ms. Leung notes that the BIM models allowed the automatic creation of a batch of drawings with accurate coordinates.

### Critical site locations

The team anticipated that BIM would especially help the coordination between civil, structural, process and mechanical disciplines for construction near the

existing inlet works facilities, where multiple underground utility diversion would be required, and the on-going operation of the overall facility could not be affected. The model allows identification of critical site locations through illustrating the construction sequences step-by-step, and identifying areas to improve safety during construction, operation and maintenance.

"We needed to visualise where the pipes would go", says Ms. Leong. "Determining their arrangement is much clearer in 3D - otherwise, it would require piles of design drawings." By using the as-built drawings from previous upgrades incorporated into a set of federated Revit models, engineers were able to review conditions for rerouting existing pipes and laying new pipes along critical paths, without affecting the sewage treatment works' performance.



Cross-Reference Design Model with Existing Site Conditions to Ensure Consistency  
Image courtesy of AECOM Asia Company Limited

The improved centralisation of project information in a common data environment server allowed each discipline to instantly gather synchronised, up-to-date design information. This greatly optimised the decision making process.

### Modelling equipment and informing the public

Working from scratch, the design team also created a library of equipment models for sewage / water treatment works. This enabled the engineering team to size up or size down an item of equipment with minimal input.

Another use of the BIM models is as a major tool for public outreach to gain support for the project. The visual element of the model makes it easier to communicate as the public could participate in a virtual flythrough of the sewage treatment works, which allows the other project stakeholders to better



Digital Catalogue of Re-usable Parametric STW Equipment Revit Model Family Allowing Easy Model Adjustment for Specific Applications  
Image courtesy of AECOM Asia Company Limited

understand the proposed design - it was easier to convey the innovations and benefits brought by this project, and showcase the finished plant facilities.

**Towards a virtual model of the upgraded plant**

The information from the BIM models will be incorporated into DSD’s Facility Management system, including scans of existing facility and equipment. It will require careful planning, partly to identify the configuration requirements for the model attribute fields to best suit the plant operators’ needs during the operation and maintenance stage.

After being painstakingly verified, the BIM model will work as a virtual model of the upgraded plant, much like a set of as-built drawings but with much greater ease of use for the operators to locate a specific item of equipment and extract the relevant information within a virtual 3D environment.

It is also proposed to include QR code in as-built models, so operators can use mobile devices to swiftly obtain information on equipment while on site. “DSD looks forward to the benefits of the incorporation of BIM technologies in our asset management system that will return a more reliable and secure sewage treatment services to the community,” says Mr. Lau.

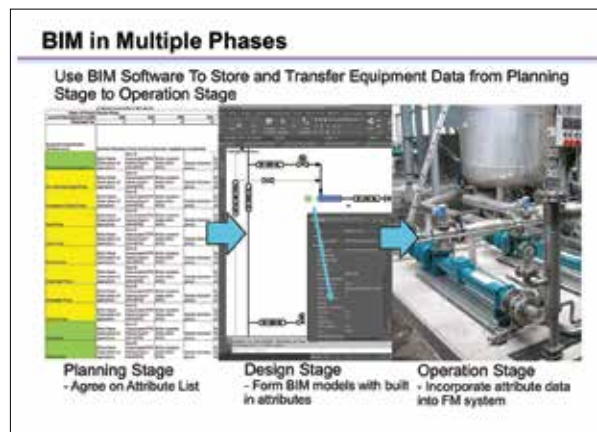
**BIM for error free sewage treatment works and more**

“We are working towards implementing BIM in other sewage treatment works worldwide, and the best practices developed here will be shared with other teams,” says Mr. Makwana. DSD would also like to have this showcase project as an example of best practices for their upcoming projects.

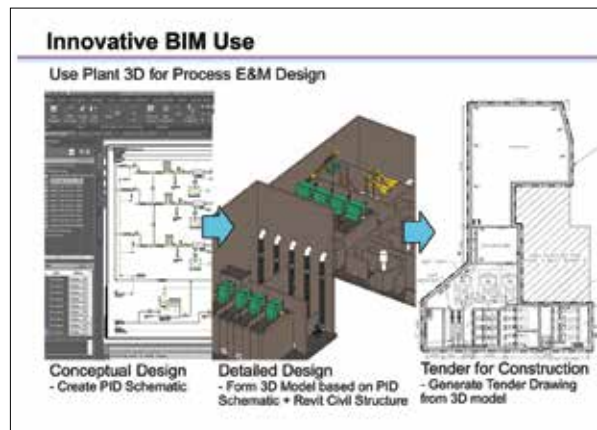
Though AECOM now wants to use BIM in all projects and would like to promote BIM practices in the industry, Mr. Makwana says the entire civil engineering and construction industry has a steep learning curve ahead, especially as clients currently may require delivery of 2D drawings following traditional processes as well as BIM information models.

“Generally, clients expect zero clashes when BIM models are used,” says Ms. Leung, “But it would be more beneficial

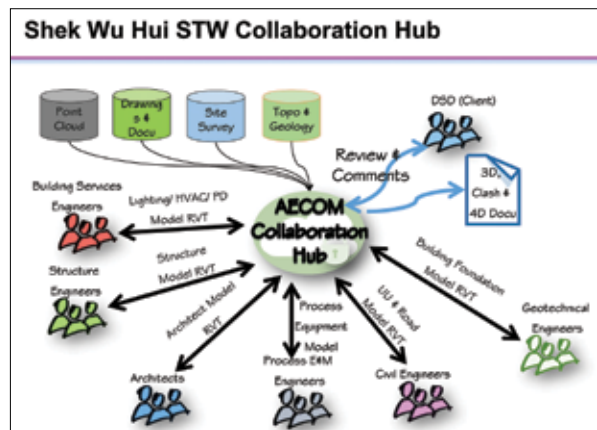
to employ the concept of error free BIM, with defined tolerances, sufficient clearance and sufficient maintenance space. BIM is an excellent tool for public engagement - as the models are visual, clear and easy to understand and can be used through future operation and maintenance cycles.”



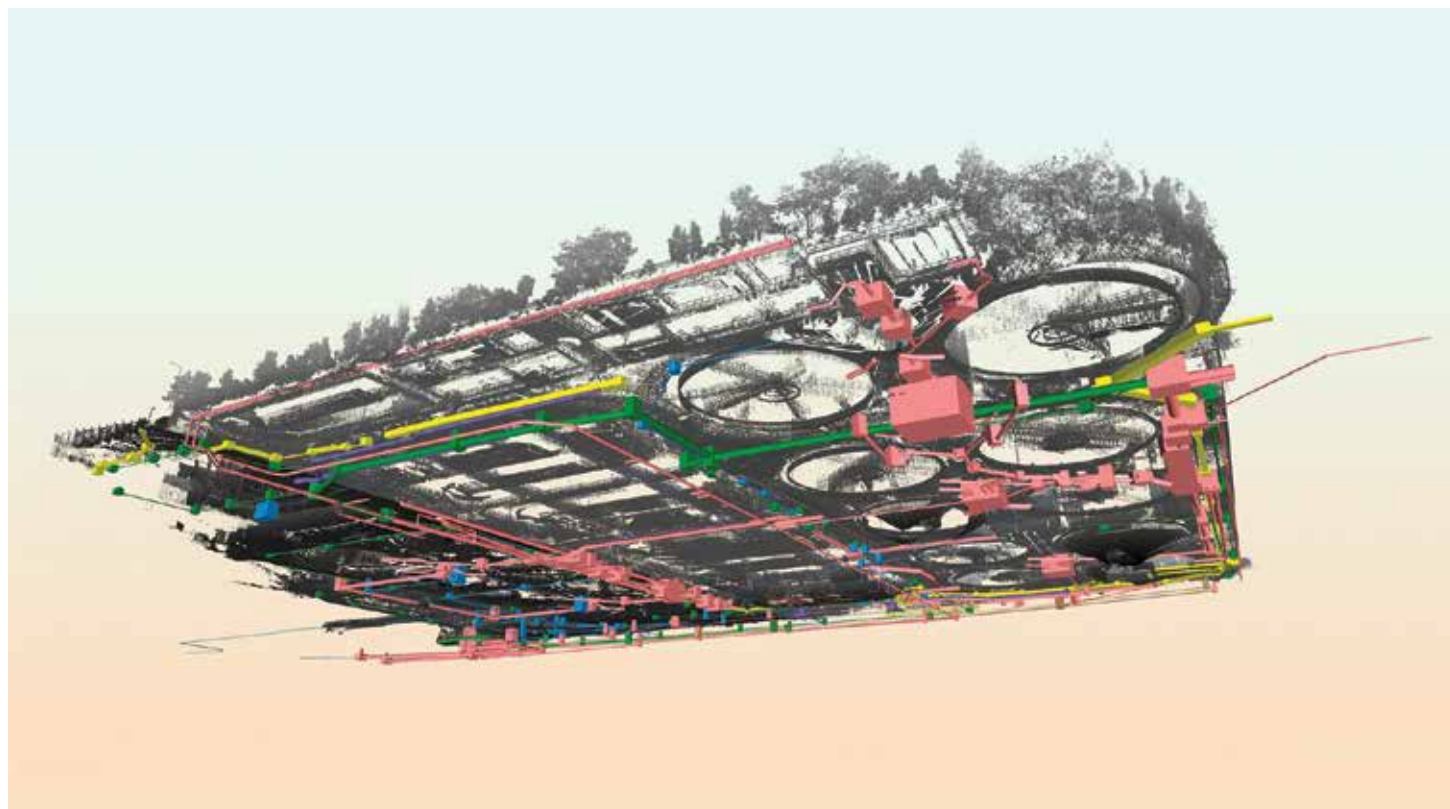
Use BIM Software To Store and Effectively Transfer Equipment Data from Designers to Contractors to Operators  
 Image courtesy of AECOM Asia Company Limited



Use Plant 3D for Streamlined Process Electrical and Mechanical Equipment Schematic and 3D Design and Tender Drawing Production  
 Image courtesy of AECOM Asia Company Limited



Common Data Environment Server for Efficient Data Management  
 Image courtesy of AECOM Asia Company Limited



Precision Point Cloud Scans Combined with Revit Model to Virtually Recreate Existing Plant Facilities  
Image courtesy of AECOM Asia Company Limited

## AECOM Background

AECOM is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately \$18 billion during fiscal year 2015. See how we deliver what others can only imagine at [aecom.com](http://aecom.com) and @AECOM.

## Drainage Services Department Background

Established in 1989, the Drainage Services Department (DSD) has been committed to providing Hong Kong with a world class wastewater treatment and stormwater drainage services. About 93% of the population are now served by the public sewerage system, which includes about 1,700 kilometers in total length and around 300 sewage pumping stations and treatment facilities collecting and treating 2.8 million cubic meters of sewage per day. Flooding risks have been greatly reduced and flooding black-spots have been reduced from 90 in 1995 to 8 in 2016.