Opti Design Overview

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DESIGN OVERVIEW

with Opti's CMAC Technology

INTRODUCTION

Opti is the leading provider of digital adaptive stormwater control solutions. Opti helps communities address the impacts of climate change, aging infrastructure, urbanization, and water pollution. We empower our customers and partners, enabling them to secure the sustainability of our communities and natural resources. With our commitment to innovation, we are driving a resilient and brighter future for all.

Opti provides a cloud-based platform that optimizes the collection, storage and treatment of stormwater runoff by transforming passive infrastructure with Continuous Monitoring and Adaptive Control (CMAC). CMAC integrates information directly from field deployed sensors with real-time weather forecast data to directly monitor performance and make automated and predictive control decisions to actively manage stormwater storage and flows across the watershed. The physical infrastructure that enables CMAC to function are three-fold:

- Water level sensor
- Control Panel with power source i.e. solar panels
- Outflow Control Device such as an actuated valve, slide gate or pump

With this onsite hardware, Opti's technology can be applied to meet one or many of the following objectives:

- Flood Mitigation
- Hydromodification Reduction
- Combined Sewer Overflow Mitigation
- Water Quality Improvement
- Water Conservation
- Maximize Asset Performance

Opti's technology continually ingests forecast data and adjusts the outlet controls to meet performance objectives, such as maximizing capture of forecasted runoff events. Over 90 software configuration settings are available to control the discharge rate from a facility and timing of flows.

Opti supports consultant partners in the design of CMAC systems. This document outlines how to design and seamlessly integrate Opti's software and hardware. The design process will include specification of the following aspects of the system:

1. Hydrology & Hydraulics
2. Hardware Placement & Specification

It is recommended to work closely with Opti throughout the design process, this ensures proper translation of site objectives to the Opti software configurations. The table below provides checkpoints between Opti and the design team to ensure performance objectives are met and the Opti package is specified properly.

Checkpoint 3 is required by Opti to ensure proper design and specification of Opti's integrated hardware and software. In the event that the final planset is not provided to Opti for review and comment, Opti reserves the right to deny proposal requests.

CHECK POINT	*AEC Design Team*	*Opti*
1 Feasibility Assessment	• Defines the performance and control objectives for the site • Provide as-built drawings and hydrology reports • Identify regulatory requirements or performance objectives to inform design with CMAC • Determine stage storage and critical elevation points for design	• Available for consultation throughout design requirement gathering • Assist with identifying regulatory requirements or maximizing benefit of design with CMAC • Provide supporting documentation relevant to Opti CMAC technology as needed
2 Solution Design	• Design the infrastructure and prepare detailed planset with specified locations for Opti hardware (valve, level sensor and control panel) • Draft design details and specification package in accordance with Opti's certified hardware standard details. • Develop H&H model to simulate Opti CMAC behavior	• Assist design team with completing a draft Software Configuration • Support partner on H&H model development and simulation

3 Final Design & Specification REQUIRED	• Complete construction planset, SWM report, and specification package
	• Provide final construction planset; stormwater management report; and specification package (components specific to Opti only) for Opti's approval
	• Review software configuration from checkpoint 2 with Opti with the
		• Provide:
		  ○ Submittal package
		  ○ DRAFT Opti software & hardware package scope of work (SOW), provided to bidding contractor
		  ○ Budgetary pricing for use in the Engineers Estimate

HYDROLOGY & HYDRAULICS

CMAC stormwater systems can be designed using common hydrologic and hydraulic modeling tools such as HydroCAD or EPASWMM, or incorporated in spreadsheet calculations. This section introduces concepts to aid in storage and valve sizing. Contact Opti for additional information about modeling a continuous time series with CMAC.

The "active control volume" in a CMAC system is the volume in a storage unit that can be actively controlled by Opti's technology. In the diagram below, the active control volume is in between the flow control point (invert of the actuated butterfly valve) and the passive overflow weir.

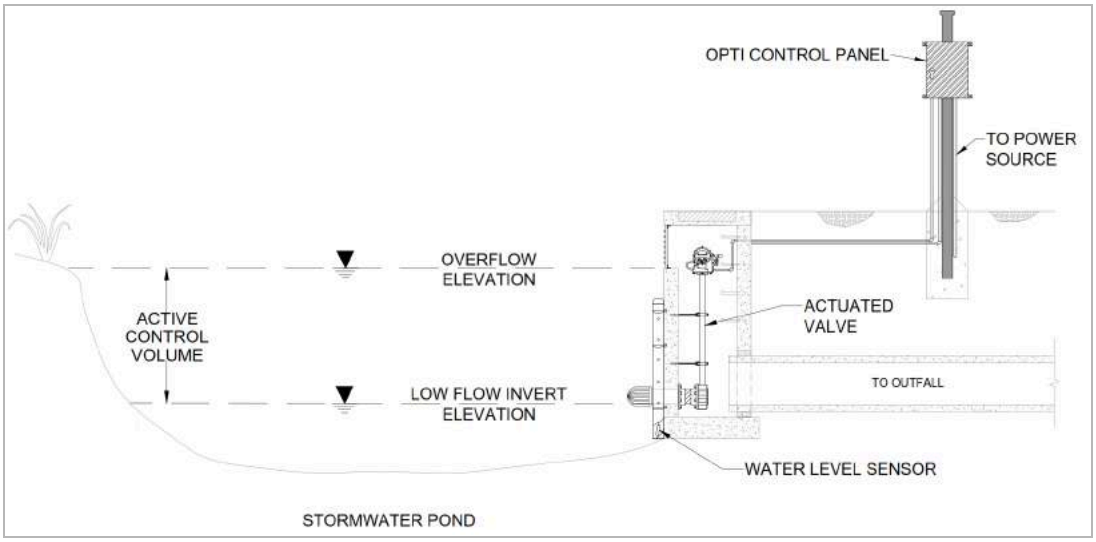

Figure 1: Active Control Volume in a CMAC Design

A permanent pool can be maintained using the software settings, therefore it is preferable to put the controlled outlet as low as possible in the water column to allow for greater flexibility in the controllable volume. Opti recommends discussing the performance objectives of the facility with the Opti project manager prior to proceeding with design.

As with any stormwater infrastructure design process, there are several possible known parameters prior to design and unknown parameters that the Engineer of Record will iteratively design:

Knowns:

1. Contributing drainage area to infrastructure and percent impervious area
2. Required design storms for routing
3. Regulatory compliance metrics
4. Performance objectives
5. Stage-storage curve
6. Existing outlet structure design (identify size and elevation of all passive openings)

CMAC Design:

1. Active control volume available
2. Design and permitting requirements
3. CMAC valve or gate size and placement
4. Outlet structure design or retrofit as needed

OPTI DESIGN GUIDANCE

Consider the following guidelines for a standard Opti CMAC design. *If at any point there are questions regarding Opti's software capabilities and configurations for a given site, please seek guidance from Opti's Customer Success Team at* support@optirtc.com.

Software Notes

The outlet control device (i.e. actuated valve) changes positions based on the outflow rate dictated by the software. Any storm event that can be statically captured by a detention system (total storm runoff volume is less than volume in a detention system under overflow height), is expected to have no wet-weather release with Opti's technology. All Opti systems have a failsafe position for power outages, loss of cellular connection or failed hardware.

Common Configurations:

- ➔ Modulate throughout storm events to avoid overflow and allow release of water at smaller rates during wet weather conditions. This configuration helps to minimize larger overflows and to maximize captured wet weather runoff.
- ➔ Fully open the control valve for large storms that are forecast to overtop the passive overflow, which will allow the system to resemble a passive system during the hydrograph peak.
- ➔ Baseflow target set for wet or dry weather that does not change based on storm size.
- ➔ Intermediate elevations in the water column used as targets for wet or dry weather, not related to passive overflow elevations.

Outlet Structure Design

- Establish a storage volume that fits minimum design storm runoff criteria from the site with an outlet control point.
- A typical design actively controls a low flow orifice in an outlet structure or weir wall at the bottom of the water column (to maximize controllable volume). The volume between the low flow orifice with actuated-valve and the next passive outflow point (mid-stage weir or orifice) is considered the controllable volume.
- For retrofits, an outlet structure or weir wall can be specified upstream of larger outlet points where control may otherwise be difficult (e.g. large diameter or odd shaped culverts).
- The minimum height of the overflow should be sized to capture the design storm dictating basin size.

Maximize Control Volume

The overflow or weir wall height is increased to attain a larger control volume while meeting local jurisdiction requirements such as discharge rate or water surface elevations. When routing larger storm events, the actuated-valve can throttle to increase the orifice size.

Hydraulic modeling guidelines for Maximum Control Volume:

- Model the weir wall with and without an underdrain orifice to represent a clogged valve scenario.
- The clogged valve scenario is used for safety purposes and represents a total mechanical and electrical failure of a system, coinciding with a large storm event.

For retrofit/enhancement of existing storage units, the actuated-valve may be installed on the existing low flow orifice at the outlet control structure. Clogged valve modeling should still be performed, specifically for larger storm events (10–, and 100–year) to ensure adequate routing.

Valve Sizing

Valve sizing is an iterative process linked to control volume as discussed in the previous section. For installations on existing systems, the valve size is typically equivalent to the existing low flow orifice diameter/dimensions. For example, it is likely that if an outlet control structure has an existing 6" low flow orifice, the specified actuated-valve used to control the outflow will also be 6".

Valve Sizing Guidelines:

- Determine a passive valve size required to discharge the full control volume in 6 to 24 hours. For existing systems, It is recommended to reference as-builts and/or existing hydrology reports.
- Model any jurisdiction-specific design storms with an equivalent actuated valve size to meet discharge rates.

The system control logic can be adjusted to limit the valve opening for any specified storm event (e.g. 2yr, 10yr, 25yr etc.). For example, if a 12" valve is required to meet discharge and water surface elevation requirements for a 100–year storm, the same valve size can mimic a smaller diameter valve (i.e. partially closed) to meet flow rate requirements for a 1– or 2–year rainfall event.

Send to Opti

- Stormwater management report (if prepared).
- Stage storage table in .xls/.xlsx format with the following columns: FT MSL, FT, CF
- Drainage area to the facility and total imperviousness or curve number associated with the drainage area.
- Elevations and dimensions of all outflow orifices, weirs and embankments.
- Valve sized used to meet design storm requirements.

HARDWARE PLACEMENT & SPECIFICATION

Hardware placement and specification is imperative to consider during design and is specific to each site. This section provides guidance for placement and specification of hardware procured through Opti, and of other system components related to flow control.

Hardware Procured through Opti (installation details provided)	System Components Specified by Consultant
➢ Pressure Transducer ➢ Opti Control Panel ➢ Solar Panel ➢ Outflow Control Device: Butterfly Valves and Slide Gates	➢ Outflow Control Device: Pumps, Tide Gates, etc. ➢ Conduit Layout and Connections ➢ Outlet Structure

Hardware Placement

The level sensor, control panel, and outflow control device must be clearly identified within the proposed plan layout of the site and section views. Refer to the Opti Certified Hardware Standard Details for additional installation requirements and specifications.

Level Sensor

Figure 2: Example level sensor stilling well and pressure transducer

- Placed the water level sensor in a location where **the full water column** in the facility can be measured.
- Installed in a stilling well upstream of the outlet control device as far away from the orifice as possible. Typically, a pressure transducer is the instrument of choice; however, other level sensors may be considered. Consult the Opti Certified Hardware Standard Detail for recommended sensors.
- For confined space installation, place stilling well near an access point (e.g. manhole, inspection port).
- Contact Opti for site specific or alternate level mounting:
    - Mounted to a pipe or basin bottom.
    - Within underground prefabricated circular or domed facilities.
    - If the design team prefers an ultrasonic or radar level sensor.

Opti Control Panel

Figure 3: Example control panel

- The control panel can run on 120VAC line power or as a 24VDC solar installation. An internal battery backup is provided for all actuated butterfly valves (see below) running on 120VAC.
- Locate the control panel on a pole or building wall (outdoors), or mounted to an interior wall (indoors).
- If there are concerns about 4G connectivity at the site, please notify Opti to determine the appropriate antenna type.
- For areas with poor cell reception, the control panel antenna will be mounted separately (up to 150 feet). For example, a control panel in the basement of a building will have an outdoor antenna that connects to the panel.
- For indoor installations, a minimum clearance of 10 feet shall be maintained between the control panel and any electrical box with voltage less than 240V. The control panel shall be installed in a separate room from any electrical box with voltage greater than 240V.
- If a backup generator will be permanently installed onsite, it is recommended that the control panel be incorporated in the powered circuit.

Solar Panels

Figure 4: Example solar panel installation

- Place solar panels:
    - in an unobstructed location facing South to ensure maximum sunlight. Notify Opti If tree canopy or building shadows are a concern.
    - a minimum of 4 feet above high flood level.
    - as close to the control point as possible to minimize cable and conduit runs.
- If theft is a concern, the hardware may be placed within fencing or on a higher pole. For solar powered sites, the batteries may be secured in a heavy-duty job box.

Outflow Control Device

- An actuated valve is typically mounted to the internal wall or weir wall in the stormwater facility's outlet structure, on the downstream side.
- The orifice on which the valve is mounted will typically match the valve size.
- Unless otherwise specified, the valve comes with an ⅛ inch rubber gasket to mount to a concrete wall.
- The flanges on the valve require additional clearance. See valve specifications for additional information.
- The valve ships with reinforcing brackets referred to as "valve stem mounts" that decrease vibration from the actuator.
- Additional support below the actuated valve shall be specified by the Engineer of Record to support a minimum of 600 lbs (or the final weight of the actuated valve, whichever is greater).
- The Engineer of Record or contractor is responsible for any trash rack specifications.

Conduit Connections

- Opti will provide a project-specific wiring diagram to be included in the project's electrical plans.
- Buried conduit is required from the actuated-valve and level sensor to the control panel. These components shall be clearly identified on the site plan
- The electrical diagram requires a junction box in between the control panel and valve/level sensor for conduit runs greater than 100 feet. The junction box can be installed above grade, or mounted inside the outlet structure.
- Plan sets with multiple onsite sensors and control panels will also include call outs in the Piping and Instrumentation Diagram (P&ID) and mechanical sheets.

Hardware Specification

- Opti certifies third party sensors, valves and actuators to be used with our platform, which are tested as an assembled unit prior to shipping.
- All CMAC hardware is procured through Opti, and then owned by the site owner or software subscription holder.
- An Operations and Maintenance (O&M) training is offered with all Opti deployments. For additional O&M plans and programs, please contact Opti directly.
- Specification sheets are available for all Opti Certified Hardware. Opti will assist with specification package language if needed to ensure the proper hardware is described.