

SMARTPOND ROTARY WEIR SPECIFICATION

AUTOMATED ROTARY WEIR DETENTION SYSTEM (ARWDS)

Components, Applications, and Function Specification

1. Introduction

The following specifications describe the components, general functions, and applications of an Automated Rotary Weir Detention System (ARWDS). The system functions as an electronically controlled stormwater management device, providing precision management capabilities and real-time in-field data. Using sensors, solar power, an electronic actuator, camera, and an internet-based control interface, the ARWDS connects to a drain pipe to enable managers to precisely control surface water retention and detention remotely. The 24" rotary valve allows precise water level management with 1" resolution and only releases water from the surface. The control panel can be configured for full automation, real-time remote control, or scheduling of future events. Detention times, dewatering rates, dewatering depths and more can all be managed with the ARWDS. Constructed of ¼" powder-coated steel, the ARWDS is built to last in harsh environments.

2. ARWDS Applications in Stormwater Management

The ARWDS is a device for active Stormwater management. As opposed to passive devices like a floating skimmer, active water management dramatically increases the efficiency and effectiveness of a detention pond. Where a passive skimmer or weir allows water to leave immediately upon collection, the ARWDS can detain newly caught Stormwater and allow it to settle for a period of 12 hours before automatically dewatering. By releasing water only from the surface, settling pond characteristics can be maintained during dewatering. The Automated Rotary Weir Detention System is comprised of the following components:

3. Components

3.1 Hardware and Configuration

The standard ARWDS features a 24" square-top rotary valve 30" tall. The back plate of the ARWDS where the drain pipe connects is a flat 30-inch square sheet of steel which can be cut to fit any size pipe up to 24" in diameter. Larger pipes can be retrofitted to this back plate. Pipes larger than 24" will result in flow capacity being restricted by the ARWDS's valve. Above the 30" valve mounts the pedestal. On top of the pedestal is mounted the control box. The pedestal contains a remote grease manifold with eight standard terminals connecting to the ARWDS's rotary flanges. Inside the steel hood of the control box is a battery, motor, cable winch, and solar charge controller. In front of the hood is the weatherproof electronics box

where all electronic boards and connections are housed. Above the electronics box is the 30-watt solar panel.

The standard ARWDS measures a 30" maximum valve height (meaning 30" maximum water depth), with the pedestal extending 33" above the top of the maximum valve height. The top of the solar panel sits 24" above the top of the pedestal, giving the standard ARWDS a total height of 87".

The maximum valve height of the ARWDS can be increased up to a total height of 70" tall by installing 4" or 12" spacers. Spacers are stackable and bolt on to the square top of the valve. It is recommended that the joints between spacers and the valve are sealed with silicone after installation. With the addition of spacers where valve heights exceed 42", pedestal spacers must be added in order to maintain a control box height at least 20" above the maximum valve height. When pedestal spacers are installed the user must also add cable extenders.

The swivel component of the ARWDS consists of five parts: the tab, two flanges, packing material, and a packing material clamp. A series of bolts connect the two flanges which pull against the internal tab. This holds the valve of the ARWDS to the frame and creates a rotary union between the two. ½" square packing material fits between the two flanges and against the 24" drum to provide lubrication and a water tight seal. This packing material is held in place with a steel band which clamps around the outside of the material and is tightened with a bolt. Eight grease fittings encircle the inner and outer flanges and connect with grease tubes to remote grease terminals on the pedestal.

The 3/16" galvanized cable is wound through the 2-direction winch spool and connected to a tab at the bottom of the ARWDS's valve by eye bolts. The cable is secured with two cable clamps per end.

The installer should always allow at least 12 inches of space between the maximum valve height, or fully closed position, and the top of the levee or embankment. Similarly, the control box should be at least 6" above the top of the levee or embankment in case of extreme flood or storm surge events.

3.2 Electronics and Software Specifications

- **Main board**

The main board of the ARWDS's electronics box is the large green board in the center. It serves as the main connection terminal for all sensors.

- **Motor Controller Board**

The motor controller board of the ARWDS regulates the connection between the battery and the motor, and receives inputs from the main board to control motor direction. It also powers the main board.

On the motor controller board are two small white buttons labeled “A” and “B”. These are [intermittent switches](#) which bypass all other controls to directly activate the motor. The “A” button moves the ARWDS’s valve in the closing direction and the “B” button moves the valve in the opening direction. It is important that the user not over-rotate the ARWDS’s valve when using the intermittent switches as this can damage the cable drive or valve.

- **Motor**

The ARWDS’s motor operates on 12-volts and has two wires connecting to the motor controller board. It is mounted on a bracket and connects with the square output shaft to the cable drive winch with a 5/8” socket.

- **Battery**

The ARWDS is powered by a 12-volt, 65 amp/hour deep cycle battery. two terminals at the top connect the power wires to the motor controller board and the solar charge controller to the battery.

- **Solar Panel**

The solar panel of the ARWDS is 12-volts with 30 watt charging capability. It connects to a solar charge controller which regulates the voltage and current before connecting with two wires to the positive and negative battery terminals.

- **Cell Data Modem**

The cell data modem is the small green board above the main board inside the electronics box. It handles all cellular communication and data transfer to the SmartPOND app. The cell data board plugs into the main board and only has one wire connecting to the exterior antenna. A SIM card plugs into the left side of the board.

- **Antenna**

The antenna connects to the cellular data board inside the electronics box and magnetically mounts between the ARWDS’s hood and electronics box bracket. If the ARWDS is installed in an area with low cellular reception, the user may have to mount the antenna higher above the unit, using the extra cable coiled inside the electronics box.

- **Camera**

The ARWDS's camera mounts beneath the control box and wires directly to the main board inside the electronics box. The view angle is 90° and the enclosure is fully weatherproof. The ARWDS is pre-programmed to take two photos—one in the morning and one in the afternoon—every day and upload them to its page on the SmartPOND app. This will ensure that the user is always looking at a current photo when logging in. The photo can also be updated on demand through the app.

- **Sensors**

- Water level sensor

The water level sensor is a pressure sensor capable of staying submerged in water indefinitely. It mounts on the side of the ARWDS's lower frame.

- Inclinometer

The ARWDS's valve position sensor is an inclinometer. This sensor measures the tilt of the valve and translates that angle to valve height.

- Temperature Sensor

The primary function of the temperature sensor is to provide warnings to the manager through the SmartPOND app in the event that ice may have formed in the detention pond and the ARWDS valve is attempting to move. It also relays current and historical on-site temperature data to the SmartPOND app.

- Rain Gauge

The Rain Gauge is a freestanding receptacle for measuring precipitation. Through an opening at the top of the device, rain is collected and then funneled to a mechanical device, called a tipping bucket. As water is collected, the tipping bucket fills to the point that it tips over, causing a momentary closure of a switch to incrementally measure rainfall accumulation. This action empties the bucket in preparation for additional measurement. Water discharged by the tipping bucket passes out of the rain gauge with no need for emptying.

4. In Case of Failure

There are several ways to bypass the ARWDS's normal electronic functions to control the valve position in case of failure.

4.1 Pre-determined fail positions

In the configuration page of the SmartPOND app (see SmartPOND App, section ii), a user can pre-determine the “fail position” for each ARWDS based on their needs for that particular site. The fail position refers to where the ARWDS’s valve should move immediately prior to a critically low battery. The options are:

- Fail open – move the valve to 0” prior to battery failure
- Fail closed – move the valve to the full-vertical position prior to battery failure
- Fail in place – allow the valve to stay in its current position prior to battery failure

4.2 Intermittent switches

Inside the electronics box on the black motor controller board there are two small white buttons labeled “A” and “B”. These buttons bypass all other systems to directly control the motor. The “A” button will move the ARWDS’s valve in the closing direction and the “B” button will move it in the opening direction. It is important that the user not over-rotate the valve when using the intermittent switches as rotating the valve too far can damage the cable drive or the valve of the ARWDS.

4.3 Removal of motor and manual direct winch control

In case of a total electronic failure or motor failure, the motor and motor bracket can be uninstalled together by removing the two bolts at the bottom of the motor bracket. With the motor and motor bracket removed, the 5/8” output shaft on the cable drive winch can be directly controlled with an electric hand drill, socket wrench, or any other tool that can grip the output shaft.

4.4 Disconnection of the cable and direct valve control

In case of total electronic failure and cable drive winch failure, the cable can be disconnected from the bottom of the ARWDS’s valve and the valve can be rotated using a lever. Insert the lever into the inside of the valve and lever against the inside of the open square top in order to rotate the valve.

5. smartPOND App

The smartPOND app is a simple and user-friendly interface that makes monitoring and controlling the ARWDS fast and easy. There are options for real-time direct control as well as fully automated operating modes.

To begin, a user must log in with a username and password. After logging in, the user will be directed to the home page where all of their ARWDS units will be displayed. On this home page the user may select which ARWDS they want to view or control by clicking on the button displaying the unit's name. The following sections will break down the different parts of the app and explain how each function works.

5.1 Unit Display Page

After logging in and selecting a specific ARWDS, the user will be taken to that unit's [Unit Display Page](#). This page displays current water level, valve position, and target valve position (if a move is being executed) for that unit as well as a current photo with a time stamp. The photo is updated every morning and every afternoon automatically, but by clicking the "Update Photo" button, the user may update the photo on demand at any time. By clicking the SmartPOND logo in the top left of the screen the user will be taken back to the home page where they can select between all of their ARWDS units. The "Send New Command" button and "Data" buttons are discussed in detail in the sections below.

5.2 Configuration Page

The first step after installing a new ARWDS is to log in to the SmartPOND app and access that unit's configuration page. To access this page, open that ARWDS's unit display page, click the "Data" button, and at the bottom of the first section labeled "[Latest Readings](#)" select the "[Edit Device Configuration](#)" button. In this section the user may enter a custom name for that unit, enter a water level calibration, configure the unit's height, select direct real-time control or Auto-Dewatering mode, and select the fail position.

The [Water Level Calibration](#) section is a useful feature for fine-tuning the water level reading. If the user notices that the water level and valve positions are not reading equally, or, in other words, the water level is even with the lip of the valve but they are displaying different numbers, the user can input a water level offset in the water level calibration box. This will offset the water level reading. For example, if the user notices that the water level is consistently reading 2" lower than the valve level, the user may input the number "2" in the water level calibration box and that will create a 2" offset. This will make the water level and valve levels display equivalent levels when the water is even with the lip of the valve. Likewise, if the water level is consistently reading 2" *higher* than the valve level, the user may input a "-2" in the water level calibration box to offset the water level reading two inches *lower*.

The [Riser Configuration](#) box is a very important setting. This box tells the ARWDS how tall it is, thus affecting its rotation arc and valve movements. Standard ARWDSs are 30" tall, but with the addition of SmartPOND's 4" and 12" spacers, this height can be increased up to a maximum of 70". It is critical that any time the height of an ARWDS is changed, the user updates the height of that riser on the configuration page. This will ensure that the ARWDS's valve rotates in accordance with its total height.

Below the Riser Configuration box is the [Control Method](#) option. Here, the user may choose between “[Real-Time Control](#)” or “[Auto-Dewater Mode](#)”. Real-time control enables the user to send commands to the ARWDS using the command page in the SmartPOND app (explained in part ii of the SmartPOND App section). Auto-dewater mode will enable the ARWDS to automatically control the holding and release of water without any input from the user.

If the user selects auto-dewater mode, they must also select a “[Target Dewatering Depth](#)” input. This input tells the ARWDS how low to drain the water before returning the valve to the fully closed, or vertical, position. Users may select any number down to 0”. Auto-dewater mode functions as follows: Assuming that the ARWDS is in the full closed position and the water level is at its target dewatering depth, the device will be standing by for a water level increase. When the next rain event occurs, the water level sensor on the ARWDS will recognize a water level increase. The device will stand by until the water level increase plateaus for a period of two hours. At that point the ARWDS will start a 12-hour detention timer to allow settling to occur. Once the 12-hour detention period has elapsed, the ARWDS will begin a drawdown from the surface—maintaining a valve position four-inches below the surface water level, continuously, until the Target Dewatering Depth is reached. Once dewatering is completed, the ARWDS’s valve will return to the full closed position and stand by for the next water collection event.

If the ARWDS is configured in auto-dewater mode, it is also recommended that a “[Fail Position](#)” is selected. The fail position tells the ARWDS where to move the valve immediately prior to a low battery failure. There are three options here:

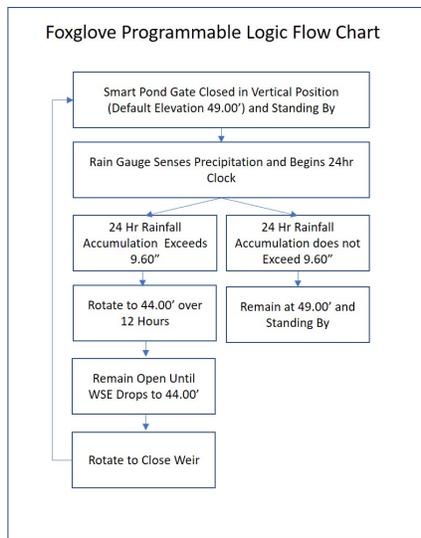
- Fail open – move the valve to 0” prior to battery failure
- Fail closed – move the valve to the full-vertical position prior to battery failure
- Fail in place – allow the valve to stay in its current position prior to battery failure

Any time a setting is updated in the configuration page the user must press the “Update Information” button to save that new setting.

5.3 Command Page

Automated Control

Select the preprogrammed control option in the dropdown labeled “FOXGLOVE”. Hit Send Command. Upon completing steps, the following command sequence will be performed with every rain event.



Direct Control

To directly control to the ARWDS through the SmartPOND app, the user should already be looking at that unit’s display page. From there, select the “[Send Command](#)” button. The command page requires three steps to complete a new command for the ARWDS:

Step 1. Select new target valve position

This functions as a drop-down menu where the user may select what height (in inches) the ARWDS’s valve will move to.

Step 2. Choose Rate

This determines the rate at which the ARWDS’s valve will move from its current position to the new target valve position selected in step 1. There are four options:

1. Standard – moves the valve ½” per hour
2. Drawdown—moves the valve 1” per 3-day period
3. Nonstop—moves immediately and all at once

4. Custom—user may enter number of hours for move to cover (must be entered as a whole number). This number will determine the rate at which the valve moves from its current position to the new desired valve position.

Step 3. When to Start

There are two options for this step:

1. Now – begin the move determined in steps one and two immediately
2. Date—user may select future date and time for move determined in steps one and two to begin

5.4 Data Page

By clicking on the Data button on the Unit Display Page, the user will be directed to that unit's data page. The data page is constantly refreshing itself with current in-field conditions and updating the information in the app. There is a lot of information available here.

The top section of the data page, "[Latest Readings](#)" displays current field conditions, much like the top of the unit display page. Current valve level, water level, target level, temperature, and battery voltage can be seen here. If the ARWDS is in the process of a move, the "rate" of the move will be displayed in this section as well. Keep in mind that the ARWDS operates on a 12-volt battery, so any battery voltage reading below 11.5 volts is considered a critically low battery while voltages up to 13.5 are considered fully charged. The "[Edit Device Configuration](#)" button is located in this section as well. This button will be addressed below in section ii.

Below the Latest Readings section is the "[Pending Commands](#)" section. This box will display the scheduled start time, new target valve level, and valve movement rate of any user-scheduled future commands. If the user has not scheduled any future commands, this section will be empty.

Below the Pending Commands section is a small box that allows the user to manipulate the timeframe displayed in the various charts and graphs below. The standard timeframe for the charts and graphs displayed on the data page is 14 days, but by clicking on this button the user may change this timeframe to 3, 7, 14, or 30 days. It is also possible to select a start and end date if the user would like to see a specific period of time displayed in the charts and graphs. If the timeframe is changed, the user must press the "Update Graph" button to see the updated data.

Below this box are the various charts and graphs. The first graph displays historical valve positions, water levels, and battery conditions from the selected time period. Below that graph are the same data lines broken into individual graphs for each respective category, including temperatures.

Below the graphs is the “[Recent Commands](#)” chart which displays details of the most recent commands received by the ARWDS including when the command was received, the target valve level of that command, and the valve movement rate.

The next section is the “[Recent Logs](#)” chart displaying the most recent data updates from the ARWDS. This section displays the time of the data log, as well as valve position, temperature, water level, and battery voltage at that time.

The final section at the bottom of the data page is “[Device Information](#)”. This information is used in identifying that specific ARWDS’s serial number, ICCID number, and current height configuration. This information will be needed in order to address any troubleshooting or customer service questions.

At the bottom of the data page is the “[Contact Us](#)” information for any customer service questions.

5.5 Warnings

The SmartPOND app will display warnings to the manager if any of the following circumstances occur:

5.6 Ice

If the temperature sensor of the ARWDS detects temperatures below freezing within the past 24 hours, an ice warning will display in the SmartPOND app. The manager should refer to the displayed photo on that unit’s display page before sending any commands to move the valve.

5.7 Leak

If the valve position remains constant and a water level decrease of more than 2” in 24 hours occurs, the ARWDS will display a warning in the SmartPOND app signaling that there may be a leak.

5.8 Blockage

If the water level remains 2” higher than the valve position for more than 24 hours, or if the valve attempts to drain the water and no water level decrease is recorded, the ARWDS will display a warning in the SmartPOND app signaling that a drain blockage may have occurred.

6. Spare Parts List

6.1 Spacers

The standard ARWDS is 30" tall, meaning a maximum water depth of 30" can be detained. To increase this depth, 4" and 12" spacers are available which bolt to the top of the valve. Spacers are stackable and easy to install. It is recommended that installers use silicone to help seal the joints between spacers and the ARWDS valve to ensure they stay watertight.

6.2 Trash Guard

The trash guard mounts on top of the ARWDS's valve or on top of a spacer to protect against large debris clogging the ARWDS's valve or drain pipe. The Trash guard mounts with four bolts.

6.3 Pedestal Spacer and Cable Extensions

If more than 20" of spacers are added to the ARWDS, it is recommended that the installer add a pedestal spacer to raise the control box higher above the maximum riser height. This will help ensure that the control box will not become submerged during extreme flood or storm surge events. If pedestal spacers are installed, cable extensions will be needed as well.

7. Maintenance

7.1 Grease

The ARWDS features a remote grease terminal on the pedestal. There are eight terminals that connect with grease tubes to the inner and outer flanges of the rotary valve. SmartPOND recommends the ARWDS be greased at least twice per year. It is also recommended that a thick, mildly heat-resistant grease be used to avoid grease melting through lines during the summer months.

To grease the ARWDS's flanges, use a standard grease gun to pump grease through the fittings. By either logging into the SmartPOND app and using the command page (see SmartPOND App, section ii), or by pressing the intermittent switches (see In Case of Failure, section 2), cycle the ARWDS from the full closed position to the full open position. While the ARWDS's valve rotates, alternate greasing between all eight grease fittings. When the ARWDS completes the movement, cycle it again from the full open position to the full closed position and repeat the greasing process.

Besides the eight grease terminals on the pedestal, the only other location where grease is needed is the worm gear on the cable drive winch. To access the winch, loosen the four jam screws on the control box hood. It is not necessary to completely remove the jam screws. With the screws loose, remove the hood. Apply grease to the vertically oriented worm gear.

7.1 Flange Bolts

There are 10 bolts connecting the two flanges which encircle the ARWDS's 24" swivel. These bolts should be evenly tightened, allowing for a 1/16" gap between the flanges and the

stainless steel packing band inside. Do not over-tighten the flange bolts, as this will pinch the steel packing band and cause the swivel to bind.

7.2 Packing Band

The stainless steel packing band between the two flanges of the ARWDS swivel tightens with an Allen-head bolt to secure the packing material beneath in place. This band should be snug at all times but not over-tightened. Over time, the rotation of the ARWDS's valve will wear on the packing material, so the packing band will need to be re-tightened on occasion to ensure that the material is well seated against the swivel surface.

7.3 Digging around Valve

Depending on the installation location of the ARWDS it is possible that silt, sediment, and debris can build up around the unit. An annual inspection of the unit is necessary to ensure that excess debris and sediment has not limited the rotation arc of the valve. If the ARWDS's valve cannot rotate to the 0" or fully opened level, it will not be able to fully drain the impoundment area.

7.4 Solar Panel

The solar panel is commonly utilized by birds and insects. It is important to keep the surface clean of bird litter, insect nests and debris in order to maintain optimal performance.

7.5 Cable Slack

The drive cable of the ARWDS routes from the cable drive winch inside the control box to a tab at the bottom at the ARWDS's valve. To test cable slack, move the valve of the ARWDS in either the closing or opening direction using the intermittent switches (see 'In Case of Failure', section 2). Moving the valve will cause one side of the cable to tighten and the other side to loosen. **The loose side should always have five inches of perpendicular slack.** For slight adjustments, tighten or loosen the nut of the eye bolt on the loose cable side as needed. For major adjustments, loosen the cable clamps at the bottom of the ARWDS's valve and adjust slack through the eye bolt. With the proper five inches of slack adjusted into the loose side cable, retighten the cable clamps. Clamps must be secured very tightly to avoid cable slippage.

7.6 Cable Connections

The drive cable of the ARWDS is connected at the bottom of the ARWDS's valve with eye bolts and cable clamps. Check annually for corrosion or broken parts. Make sure the cable clamps are secured tightly and the eye bolts are intact. Replace as needed.

7.7 Battery

Over time, battery terminals may corrode. Check annually for corrosion and clean as needed.

7.8 Camera

Check the lens glass annually for insect nests or debris and clean as needed. One nut connects the camera frame to the control box and two small set screws secure the camera to the camera frame. These can be loosened in order to adjust the camera's aim and then retightened to secure it in place.

7.9 Important Safety Information and Warnings

- Always keep hands clear of the ARWDS's valve, swivel, and cable drive system when unit is in operation.
- Turn the power switch off when doing any electrical work
- Do not enter the water when the ARWDS is actively draining water
- Do not stand inside or on top of the ARWDS's valve
- Always wear gloves when doing any work on the cable drive system

7.10 Storage

The ARWDS is shipped in a near-fully assembled configuration and should be stored likewise. The systems are transported and stored on pallets and must remain secured via straps or steel bands to said pallet at all times. The battery and solar panel are not installed at times of transport or storage. Solar panels may be stored inside the ARWDS's valve. Batteries must not be stored on concrete surfaces and must be kept with terminals upright.

8. Installation

The ARWDS can be installed in a near-completely assembled configuration. Only the battery and solar panel should be removed during the installation process. There are several ways to install the ARWDS but these key points must be met to ensure proper function:

8.1 Leveling

The ARWDS must be level when welded to the drain pipe, especially perpendicular to the levee or embankment.

8.2 Pipe Placement

To attach the drain pipe to the ARWDS, first position the back plate against the drain pipe in the position it will be installed. When positioning the ARWDS against the pipe, make sure that the bottom of the drain pipe aligns with the bottom of the ARWDS's 24" drum. Use soapstone to trace the pipe against the back plate so that the hole may be cut out with a torch. With the hole cut out, the ARWDS may be realigned with the pipe and welded.

8.3 Height Configuration

Depending on the site, the ARWDS may require spacers to achieve the desired detention depth. Always allow at least 12" of space between the maximum valve height and levee height. The control box of the ARWDS should never be configured less than 6" above the levee or embankment height.

8.4 Structure Support

If the ARWDS is being installed on a pipe measuring less than 16" in diameter, permanent structural support such as a concrete pad or steel frame must be installed beneath the base of the device. Pipes larger than 16" in diameter can support the weight of the ARWDS and therefore a permanent support structure beneath the device is optional. The standard fully assembled ARWDS weighs 600 pounds. This does not include spacers or trash guards.

9. PRODUCTS

A. Acceptable Automated Rotary Weir Detention Systems

"smartWeir" Automated Weir Detention System

B. Acceptable System Supplier

Convergent Water Technologies, Inc.

(800) 711-5428

www.convergentwater.com

C. Authorized Value Added Reseller

10. Quality Assurance and Performance Specifications

The quality of all system components and all other appurtenances and their assembly process shall be subject to inspection upon delivery of the system to the work site.

Installation is to be performed only by skilled work people with satisfactory record of performance on earthworks, pipe, welding, chamber, or pond/landfill construction projects of comparable size and quality.