

Emriver Em4

With Single-Axis Tilt Base

Use and Care Manual



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READ AND UNDERSTAND THESE WARNINGS BEFORE USING YOUR EMRIVER MODEL

The Emriver Em4 model is very heavy when filled with water and sediment. A collapse of the model could severely injure or kill a person. Be absolutely sure you understand how to use the model and its tilting base.

Use only the base provided with your model. Despite weight-bearing claims, no standard production sawhorse is strong enough to safely support the Em4 model. Sawhorses and folding tables can collapse under dynamic or side loading.

Never allow people to sit or stand on or in the box. Never get underneath the loaded box.

Use only the pump and power supply provided with the model. Be certain to connect it to a properly grounded outlet. Always use the Ground Fault Circuit Interrupter (GFCI) provided with your model.

The box should only be used for its intended purpose as stated herein.

If any part of the box or pumping system is damaged, if you have any doubts about the electrical or structural safety of the model, or if you do not understand these directions, do not use this model.

You must read, understand, and abide by all the instructions and warnings in this manual to avoid damage to the model or personal injury. Updates to this manual and other support for the Emriver Em4 can be found at <http://www.emriver.com>. Please contact us for additional support if your question cannot be answered online.



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Introduction

This manual describes the safe use and maintenance of your Emriver Em4. When filled with modeling media and water the model can weigh in excess of 1,200 lbs (544kg), and could be dangerous if not properly supported, assembled, and operated.

Read, understand, and abide by all the instructions and warnings in this manual to avoid damage to the model or personal injury. Updates to this manual and other support for Emriver models and instruments can be found at

<https://emriver.com/manuals-downloads/>

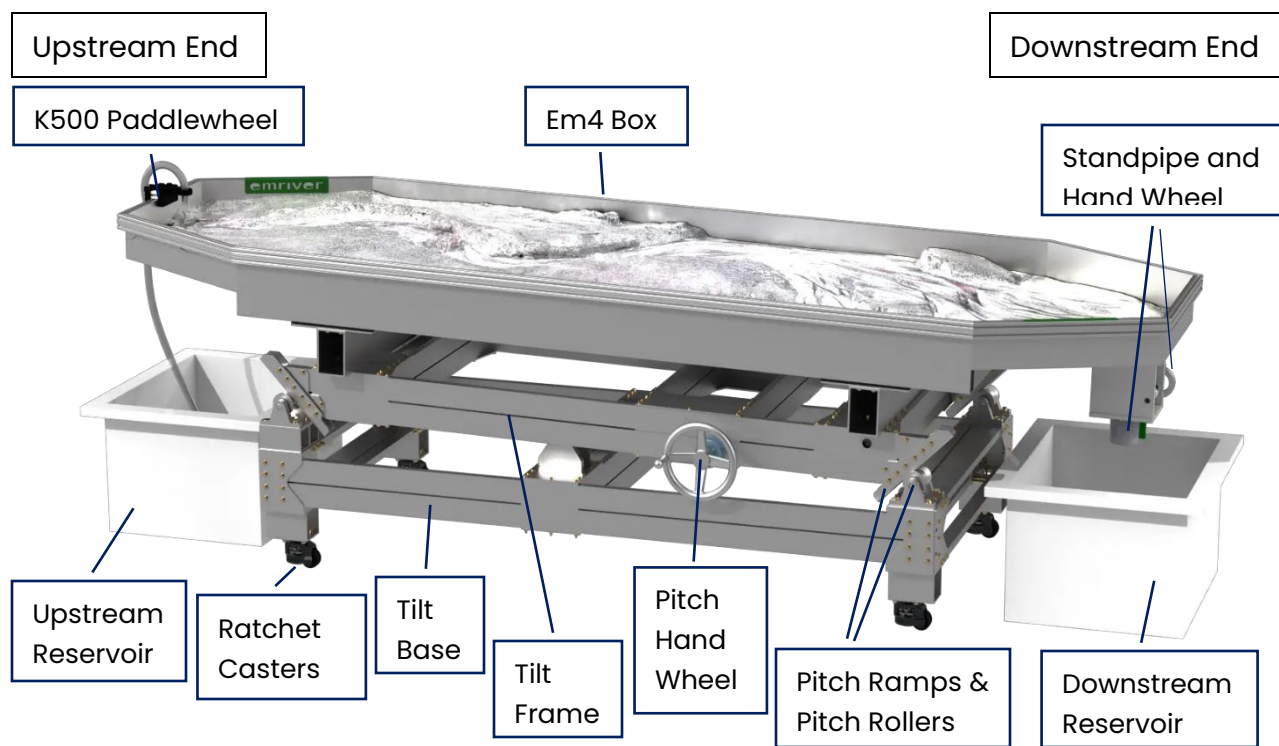


Figure 0.1 Parts of the Emriver Em4.



Parts and Accessories Checklist

Included with your model:	Other parts and supplies to have on hand:
• Emriver Em4 Box • Emriver Em4 Single Tilt Base • Color-coded modeling media in 12 buckets • Standpipe • Two reservoirs and hose • Sediment trap with inserts • Pump and filter with tubing • K28 Electronic Flow Controller • K500 Digital Flow Controller • Paddlewheel flow meter • Flow Outlet • Energy Dissipating Unit (EDU) • Power Supplies • GFCI Adapters • Culvert Tubes • Measuring Tape • 25ml graduated cylinder • Solid and Perforated scoops • Limestone and plastic riprap • Simulated riparian vegetation • Scrapers for moving media • Poly hand float • Squeegee • Blue and green dye • Dye Injector Bottles	• Water supply • Electric Outlet • Hand towels and mop • Hand level • Garden hose • Notebook • Household bleach • ½" mesh sieve



Assembly and Operation

Step 1 – Set Up the Tilt Base

Your model will ship assembled, with the Em4 box on the tilt base. The system is modular and made to easily disassemble into components. Each component (box, tilt frame, base) weighs 225–250 lbs (102–113kg) and will require at least 4 strong people to lift. If you need to disassemble the system in order to transport it, please watch the video at <https://vimeo.com/208926030>.

Remove all packing straps and padding, including the padding between the pitch rollers and ramps.

Use the standpipe handwheel to ensure the standpipe is fully raised. Lift the Em4 Box off the tilt base and place it somewhere out of the way. **Important:** Do not place the Em4 box flat on the ground supported by the standpipe. Lean it against a wall or place it on a sturdy table.

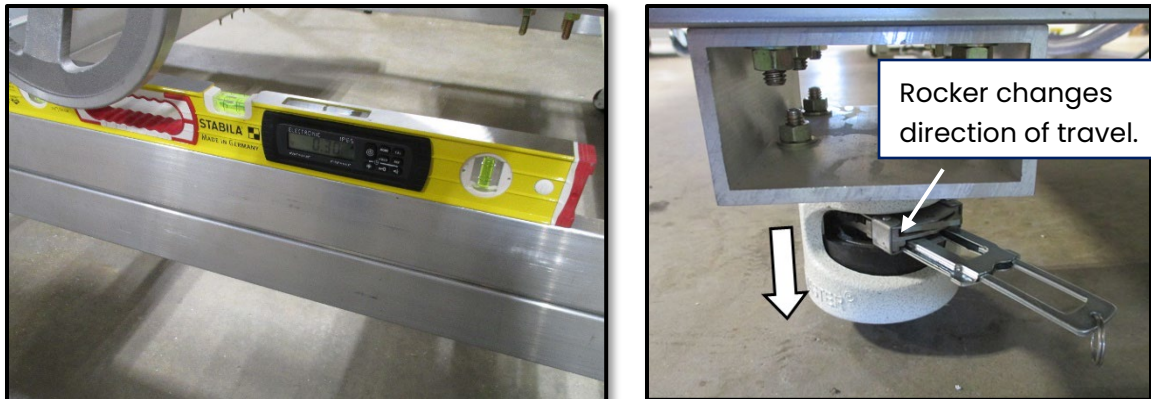


Figure 1.1 Level the Tilt Base with the ratchet casters.

Use the ratchet casters to lower the base on to its wheels. Roll the tilt base into place. When facing the side of the tilt base with the tilt hand wheel, the downstream end of the model will be to your right.

The box will extend 30" (76cm) beyond the tilt base on the upstream and downstream ends. The reservoirs will add an additional 12" (30cm). Leave plenty of room to move around your model. Once the box is loaded onto the base and filled with modeling media, and reservoirs are installed and filled with water, it will be much harder to move the base, so be sure to position it where you will use it before completing the setup.



Level the tilt base by extending the arms of the ratchet casters and lowering the rubber feet. The rocker on each caster changes the direction of travel. It is more important to level the base from left to right versus from upstream to downstream.

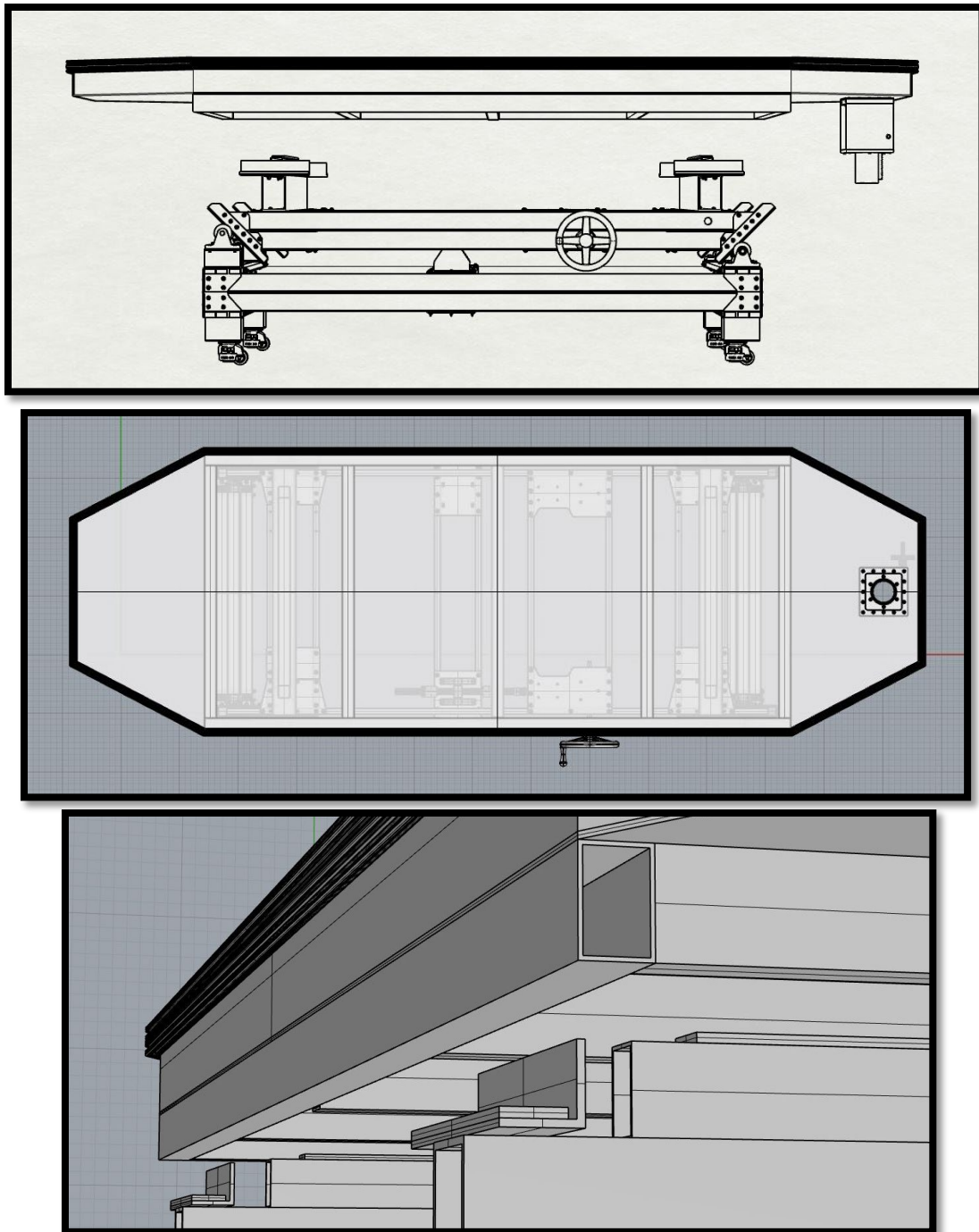


Figure 1.2 Placement of the Box on the Tilt Base.

Lift the box onto the tilt base, with the standpipe at the downstream end. Be sure the box is centered on the base, with an equal amount of overhang on each end.



Note: Do not remove the box from the base while it is full of media. Only move the box while it is empty.

To operate the tilt base, turn the pitch hand wheel. Turning the hand wheel clockwise increases the pitch, or slope of the box. Turning the hand wheel counterclockwise decreases the pitch. The box pitch is limited to a range of 0-3 degrees by stops on the acme screw and a torque-limiting clutch on the hand wheel.

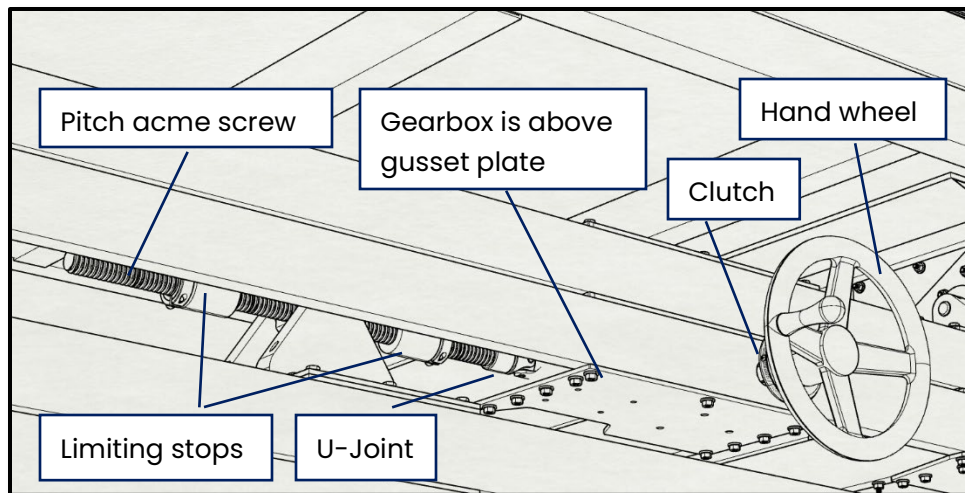


Figure 1.3 Parts of the tilt mechanism.

When operating the system, be sure to keep hands away from any moving parts and pinch points, the aluminum ramps and rollers, and the acme screws.

Raise and lower the standpipe by turning the standpipe handwheel. The standpipe has been lubricated with a film of non-toxic silicone grease. If the standpipe becomes difficult to adjust, apply a small amount of grease from the tube included in your tool box. The gear and rack do not need to be greased.

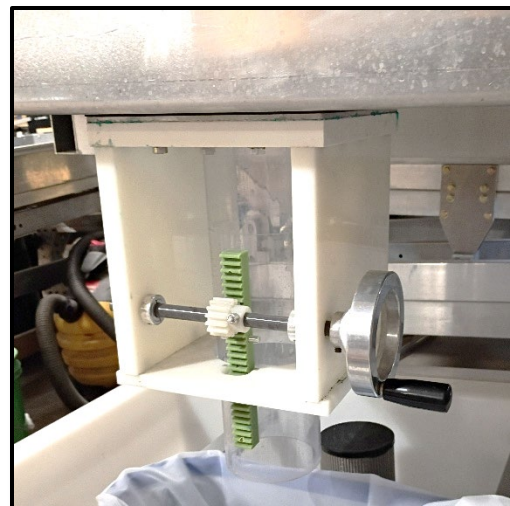


Figure 1.4 The standpipe and adjustment mechanism.



Step 2 – Position and Connect the Reservoirs

The Em4 uses two reservoirs: an upstream reservoir and a downstream reservoir. The upstream reservoir has a coupling for the reservoir hose, and a drain valve with an adapter to connect a garden hose. The downstream reservoir has a hose coupling, two filters inside and aluminum supports for the sediment trap.

Place the upstream reservoir beneath the upstream end of the box (without standpipe) so that the drain valve and hose coupling face downstream. Place the downstream reservoir beneath the downstream end of the box (with standpipe) so that the reservoir hose coupling faces upstream.

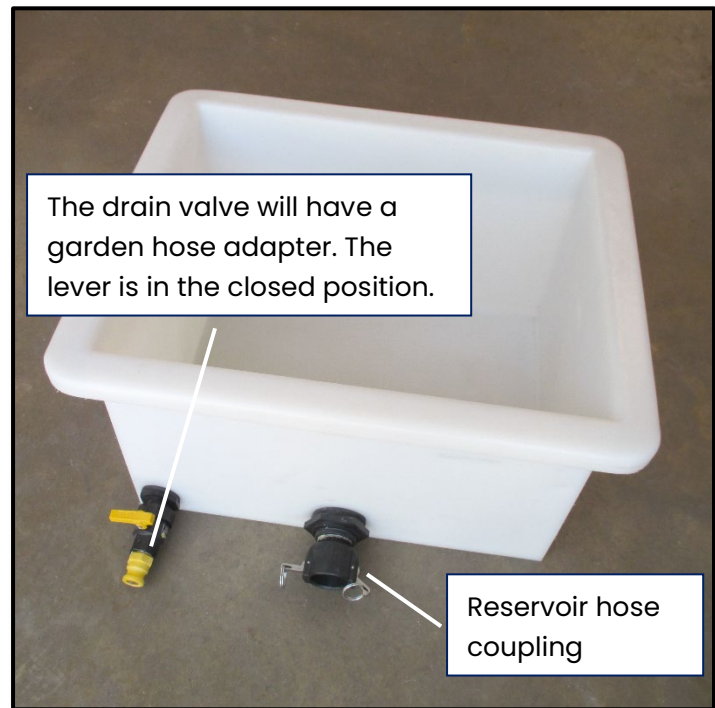


Figure 2.1 The upstream reservoir. The fitting on the valve will be different than in the picture.

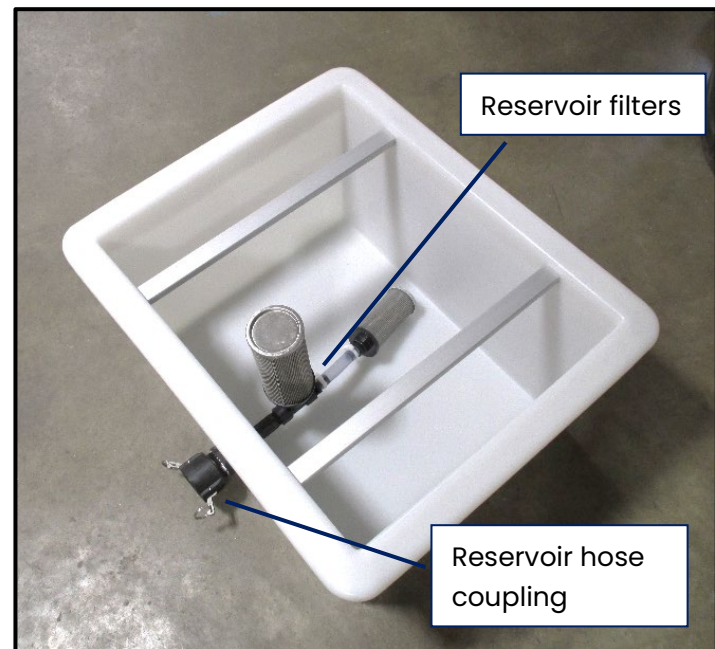


Figure 2.2 The downstream reservoir.



Be careful when tilting the Em4 that the standpipe does not hit the downstream reservoir or upright filter, which may cause damage.

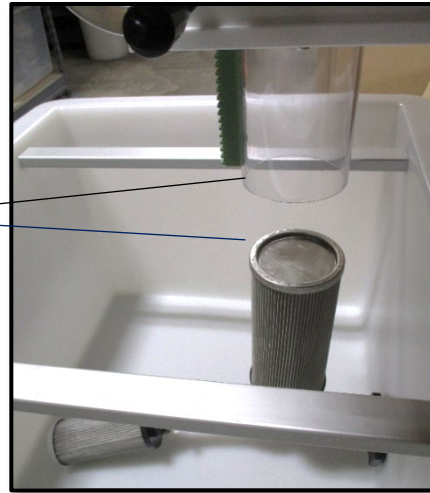


Figure 2.3 Standpipe and upright filter

Place the 2" diameter Reservoir Hose under the tilt base between the reservoirs. Pull the locking levers on the reservoir hose coupling out from the body. You may have to press the locking pins on the reservoir coupling to release the levers. Insert the Cam-and-Groove hose coupling on the hose ends into the sockets on the reservoirs and push the levers toward the reservoir to secure them. The levers may be difficult to press in.

Ensure that the drain valve on the upstream reservoir is in the closed position.

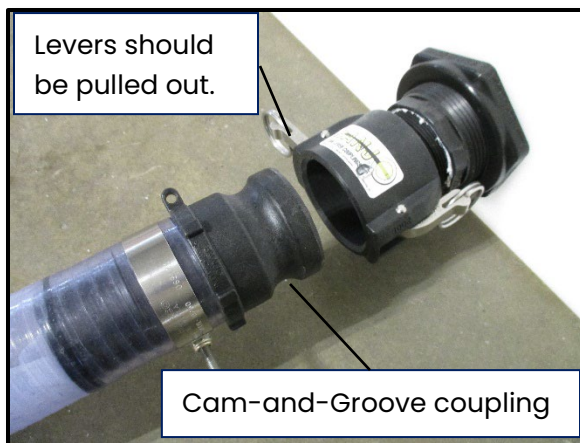


Figure 2.4 Insert the coupling into the socket.



Figure 2.5 Push the levers toward the reservoir.



Step 3 – Attach the K500 Controller and Paddlewheel

Your Emriver K500 digital flow controller can provide precise measurement of flow rates from 25 ml/sec to 210 ml/sec and automatically run hydrographs.

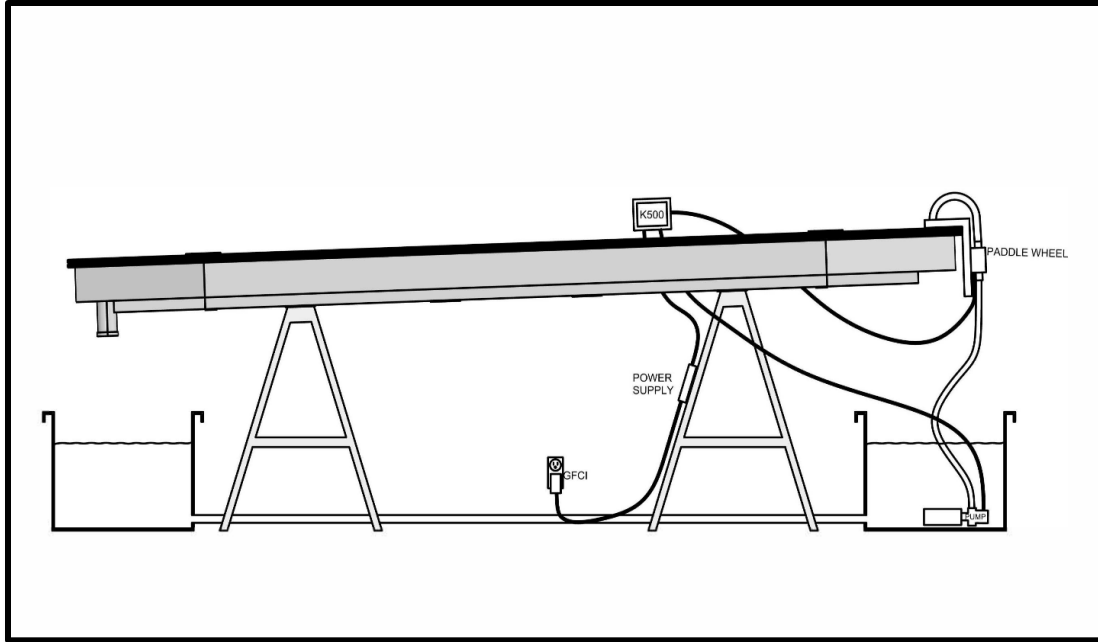


Figure 3.1 Schematic of the K500 on the Em4 with static supports.

Mount the K500 controller on the stream table box

Mount the K500 controller on the right-hand side of the box (as you are looking downstream), near the upstream end. Place the claw mount over the edge of the box and tighten Screw 1 so that the bracket is secure. Screw 2 can be used to adjust the viewing angle of the K500. If you need to remove the K500 from the mounting bracket, just loosen Screw 2 until the balls are removable from their sockets.

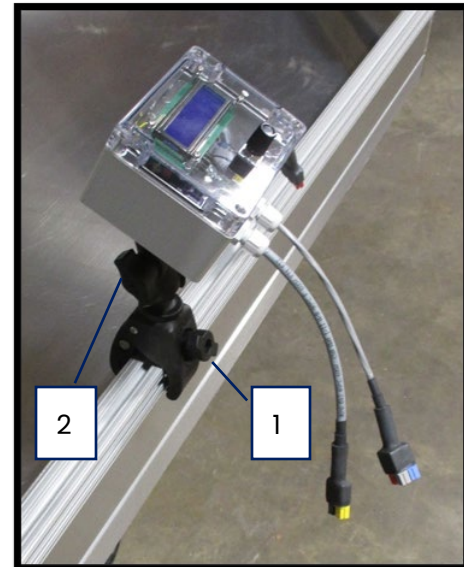


Figure 3.2 K500 mounted on gunwale



Mount the paddle wheel assembly

Hang the paddle wheel assembly in the center of the upstream end of the box. The position of the outlet hose end may be adjusted by loosening the thumb screws on the top bracket. Connect tubing to pump and paddle wheel.

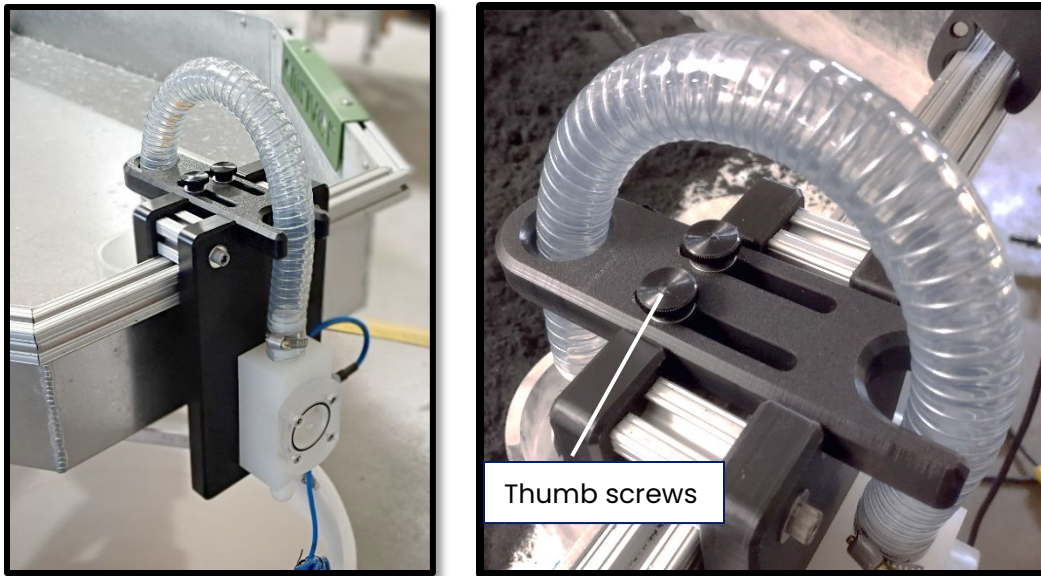


Figure 3.3 The paddlewheel mounts on the upstream end.

Connect tubing to pump and paddle wheel

Attach one end of the $\frac{3}{4}$ " diameter pump tubing to the barb connector on the bottom of the paddle wheel, and one end to the GRI pump using the enclosed hose clamps.

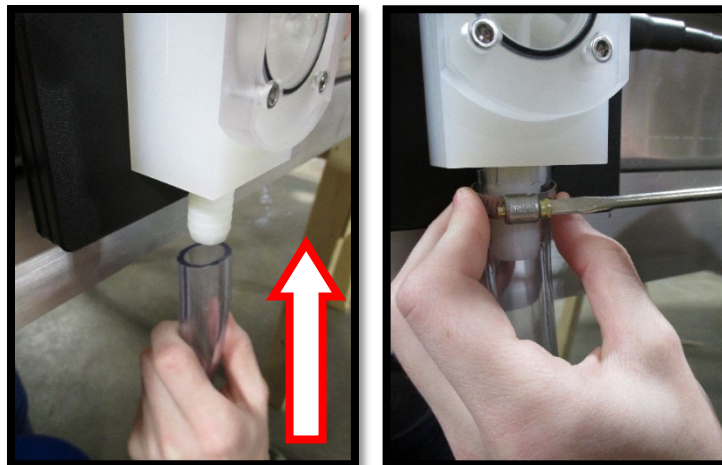


Figure 3.4 Connect the pump tubing to the paddlewheel.



Attach the filter to the pump and be sure to fill the reservoir with water before powering up the K500 controller. The pump *must* be fully submerged before being operated.

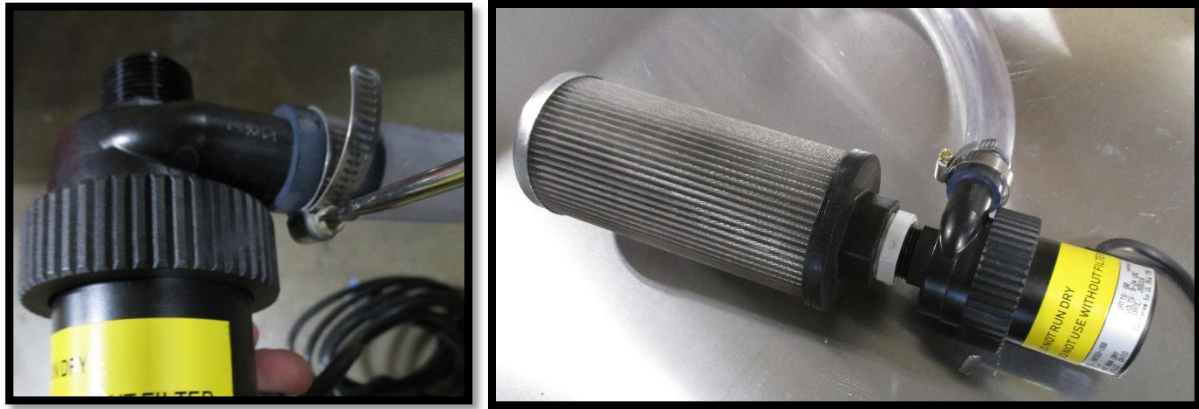


Figure 3.5 Connect the pump tubing to the pump and attach the filter if necessary.

Make electrical connections

The K500 controller has three electrical connectors. Make the power connection last, and always make sure there is water in the reservoir before you start the pump using the controller.

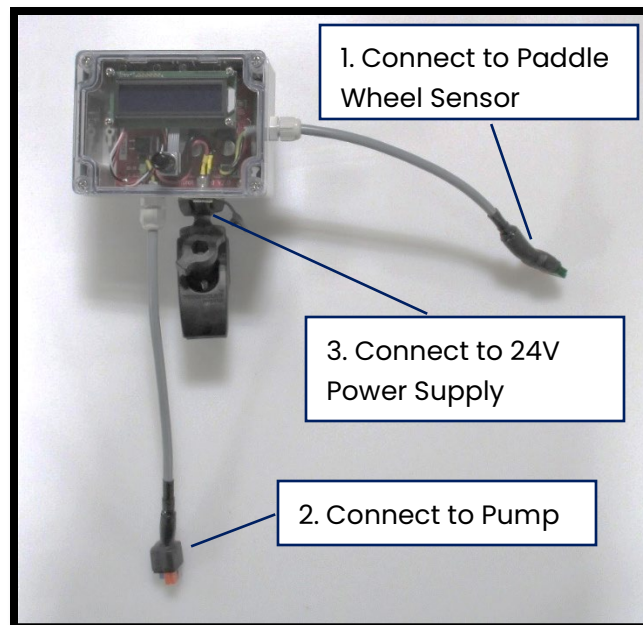


Figure 3.6 Electrical connections on the K500 Controller



The color-coded connectors on the K500 controller, the paddle wheel, and the pump can only be connected one way.

Connect the paddle wheel and pump before connecting the 24V power supply.

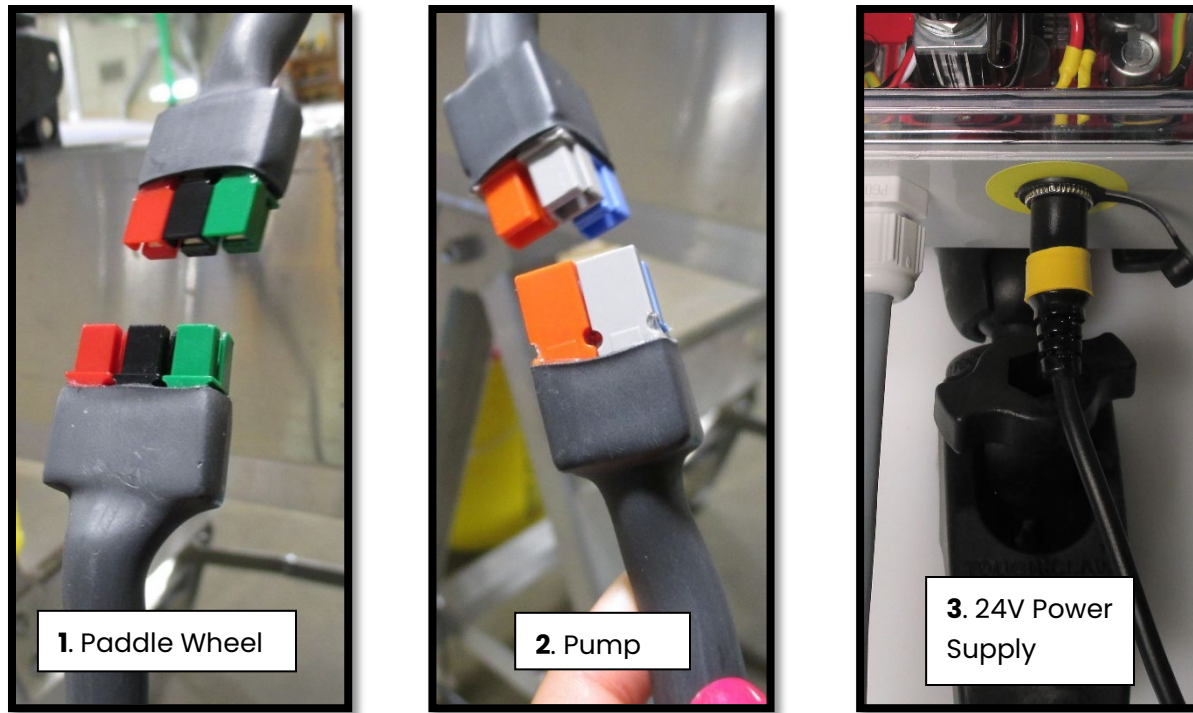


Figure 3.7 Color-coded connections on the K500 Controller

Step 4 – Place the Sediment Trap

Place the sediment trap on the aluminum struts in the downstream reservoir. Be sure the sediment trap sits directly below the standpipe to catch any media in the return water. The white mesh filter bag should be in the sediment trap and secured around the rim with the lace.



Figure 4.1 Be sure the sediment trap doesn't interfere with the standpipe.



Step 5 – Fill the box with Modeling Media

Your modeling media will arrive packed in twelve 5-gallon buckets. The colors are not pre-mixed to better show the proportions of each grain size. Pour the media into the box one bucket at a time. Spread the media using the scoops and scrapers included with your stream table to mix and distribute it evenly throughout the box. Running the model with water will accomplish the final mixing.



Figure 5.1 Unmixed media in the Em4 box.

Handling the media: During experiments and demonstrations, sediment leaving the box through the standpipe will accumulate in the sediment trap. The rate at which the trap fills is highly variable, depending on activity in the box. To return the sediment to the box, pause the flow by raising the standpipe, and pull the sediment trap out from under the standpipe. Dump the sediment back in the box and return the trap to the downstream reservoir.

Allowing sediment to accumulate in the reservoirs will **NOT** harm the system. The filters are sized to allow the system to function normally even when completely buried in sediment. However, fine debris such as dirt, lint and pollen can accumulate in the media over time and clog the filters. Just give them a rinse now and then.

Step 6 – Position the Energy Dissipating Unit (EDU)

Place the EDU in the model under the outlet hose on the K500 Paddlewheel. The 'mouse hole' in the side of the EDU should point downstream. **NOTE: Never allow the outlet hose to submerge below the water surface in the EDU; this can allow sediment to syphon into the paddlewheel and damage it.**

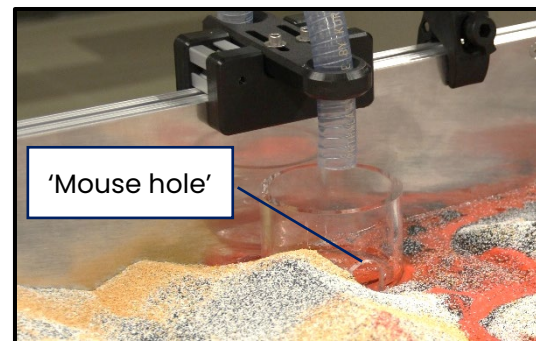


Figure 6.1 The EDU under the outlet hose at the upstream end of the EM4.



Step 7 – Fill the reservoirs

Position the reservoirs before filling them with water. **Do not move the reservoirs after they have been filled, as this will cause damage to the reservoirs.**

Check that the drain valve on the upstream reservoir is closed. (Figure 2.1) Fill both reservoirs to 5 inches (127 mm) below their rims. Allow the water to equalize between the two reservoirs. If water level is slow to equalize, make sure the filter in the downstream reservoir is clear and not full of air.

Using excess water could damage the box or cause it to collapse. Do not overfill the reservoirs.

Do not start the pump until you have filled the reservoirs.

Step 8 – Set up your instruments (Wavemaker, Groundwater, etc)

See the instruction manual provided with each instrument or visit our website www.emriver.com for instructions or call our office at 618-529-7423.

Step 9 – Start Water Flow with the K500 Controller

Power the Pump

Connect the cord from the power supply to the Ground Fault Circuit Interrupter (GFCI) and plug the GFCI into a 120V receptacle. If you are using an extension cord, connect the extension cord to the GFCI. Do not plug the model's power cord directly into a receptacle unless you are sure the receptacle is GFCI protected.

Users outside North America will need to supply an appropriate GFCI adapter if the electric outlet is not already protected.

The K500 does not have a power switch, it will start as soon as it has electricity. Shut the controller down by unplugging it.



Figure 9.1 A green light indicates the GFCI is working correctly.



Upon startup, the K500 will briefly display two splash screens and then go to the home display where the timer will immediately start.

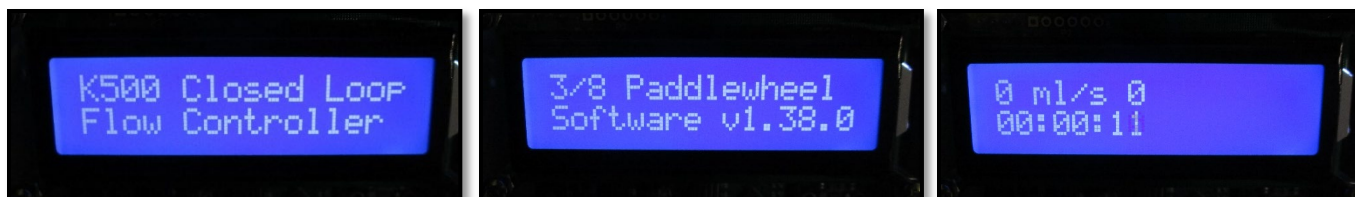


Figure 9.2 Startup screens and Home Screen on the K500 Controller

Home Screen

The home screen provides the user with five indicators.

While at the home screen, turn the knob clockwise to start flow. The lowest setting is 25 ml/sec. You may need to set a higher flow rate when you are first starting up the system to flush air from the tubing or filter. Agitating the filter with the pump assembly under water can help remove air.

After setting a target flow, it will take a little time for the pump to stabilize the flow around the target. The range of flow is from 25 ml/sec to 210 ml/sec.

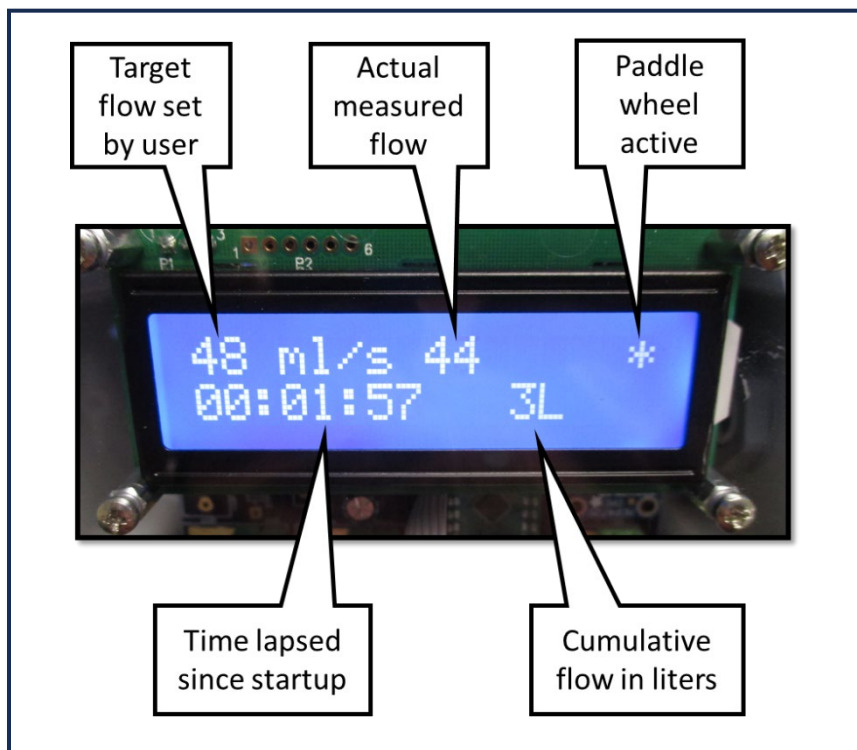


Figure 9.3 Home Screen on the K500 Controller



Error Statement

If the K500 does not detect input from the paddle wheel for 30 seconds, either because the sensor is disconnected or there is no flow from the pump, an error indicator will appear on the home screen.

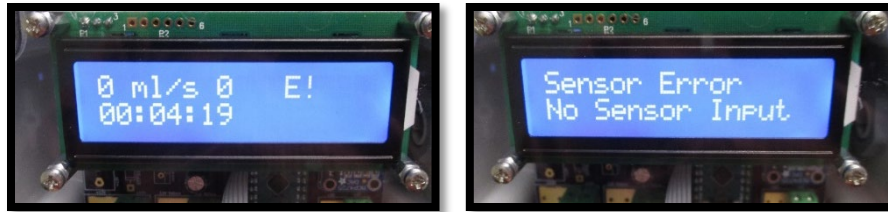
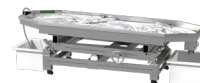


Figure 9.4 Error Screens on the K500 Controller

If you receive an error statement, first check the electrical connection from the paddle wheel to the K500. If the connection is OK, check to see whether there is air in the filter or tubing preventing the pump from priming or getting flow to the paddle wheel. Reset the K500 by disconnecting the power supply and reconnecting.

Note that if the sensor is disconnected, the pump will continue to run for 30 seconds before shutting off automatically. In some circumstances, particularly when the flow rate is above 100 ml/s, the pump speed will ramp up to its maximum rate until the connection is reestablished or the pump shuts off.



Navigating the Menu Screens

The K500 menus are navigated by turning the knob, and options are selected by pressing the knob.

Press the knob once to display the **Menu Selector** screen.



Turn the knob one 'click' to the right to get the **Zero Flow** screen. Here you can press the knob once to stop all flow.



Turn the knob again to get the **Maximize Flow** screen. Here you can **press** the knob once to set the flow to the maximum level, 210 ml/sec.



Turn the knob again to get the **Hydrograph Selector** screen.



Figure 9.5 Menu Screens on the K500 Controller



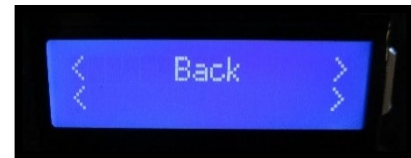
Navigating the Hydrograph Screens

At the Hydrograph Selector screen, you can **press** the knob once to enter the submenu of Hydrograph options. **Turn** the knob to cycle through the options. **Press** the knob to select and start a hydrograph. When the hydrograph is complete, flow will return to zero. **Press** the knob during a hydrograph to stop flow.



Figure 9.6 Hydrograph options in the K500 controller

Press the knob on the **Back** screen to go back to the main **Hydrograph Selector**.



Turn the knob to view the Controller Information screen. Here you can **press** the knob to view information.

Turn the knob again to return to the Main Screen.



Figure 9.7 Final screens on the K500 Controller



This chart shows the timing and flow rates of preprogrammed hydrographs on K500.

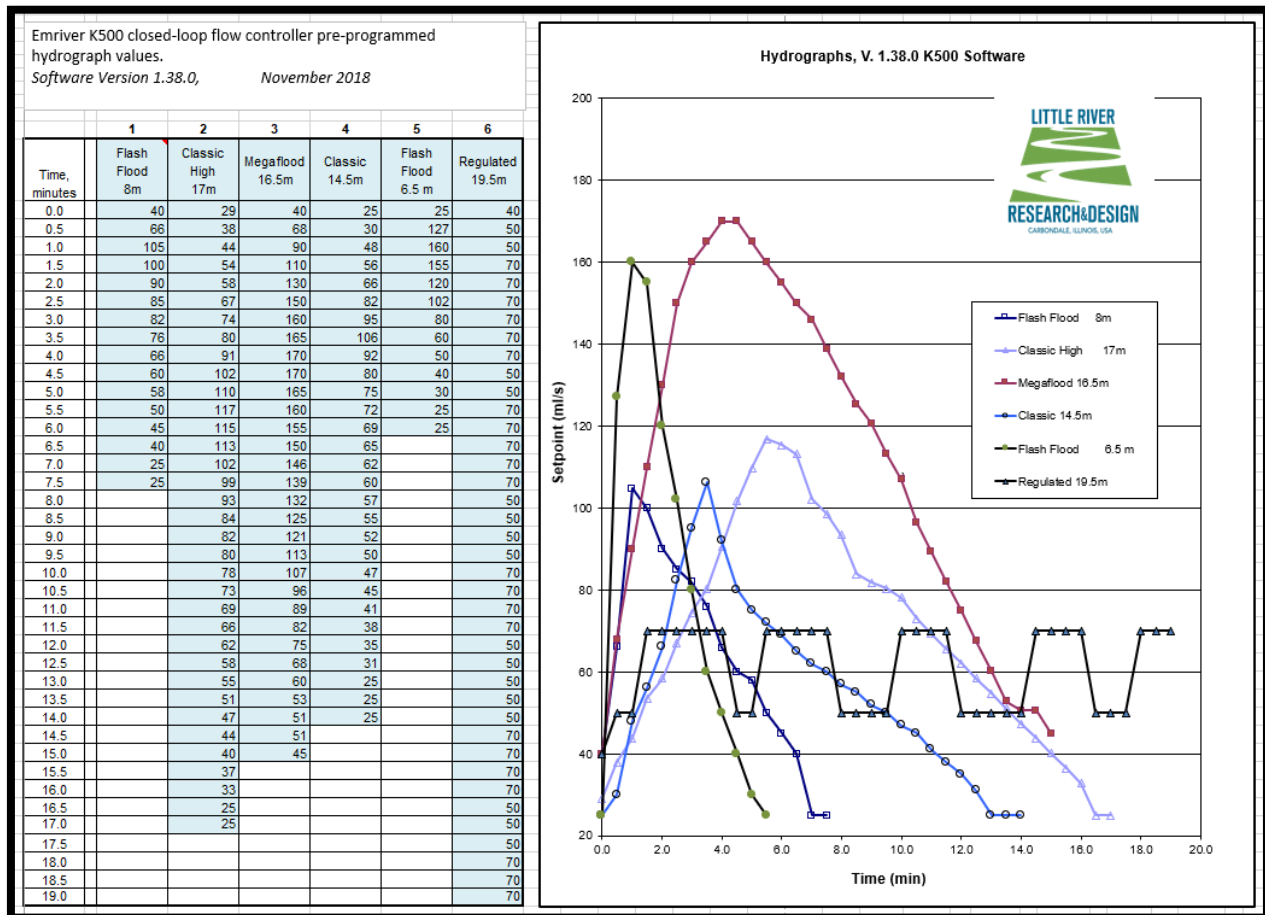


Figure 9.8 Pre-programmed hydrographs in the K500 Digital Flow Controller.



End-of-Day Procedure

After using your Em4 Stream Table, it is important to drain all water from the model. Water left standing in the box for long periods can cause corrosion of the aluminum.

Lower the standpipe to start draining water from the box. Be sure that the bottom end of the standpipe does not hit the filter or reservoir. Using the handwheel, tilt the box to its maximum slope.

Pile the media towards the upstream end of the box to aid drainage.

As much as 20 gal (76 L) of “groundwater” will remain in the media and box after the pump has been turned off and flow from the standpipe has slowed to a deceptive trickle. Before storage of the model, the remaining water must be drained from the sediment. This water can take several hours to drain.



Figure 10.1 Pile up the media to aid drainage.

Remember that the reservoirs cannot be moved while full of water.

The upstream reservoir is fitted with a drain valve and fitting for a garden hose for emptying the system into a floor drain. You may also use your K28 controller and extra pump to drain the reservoirs into buckets or directly into a proper drainage area.

Note: To prevent growth of mold and bacteria, add about 10 ml of household bleach to the upstream reservoir water and circulate the solution through the system.

Maintenance and Care

Drain the model and reservoirs after each use; do NOT leave water in the Emriver models.

To keep your model sanitary, change out the water every day and drain the table by lowering the standpipe all the way.

Add bleach to the reservoir only as necessary. Add about 10 ml of household bleach to the reservoir, and run the pump to distribute it through the system. This will prevent algae and bacteria from colonizing the model. You may also use widely



available home water filters to remove contaminants. **Adding too much bleach or chlorine can damage the aluminum parts.** Bleach breaks down into salts which can cause corrosion. If bleach is repeatedly added, rather than changing out the water, corrosion is likely.

Never use lithic materials (i.e., sand) in the Emriver tables.

Do not use metallic objects in the model.

Power down the pump and controller after each use by disconnecting the pump. from the controller, and disconnecting the controller from the power supply.

Do not use solvents, which may dissolve or weaken the plastic tubing. If the tubing is stored while wet, it may support algae growth and become cloudy. Routing a mild bleach solution through the system after use will minimize this problem. Removing all standing water in the lines will help as well. If tubing becomes cloudy you may purchase a replacement from us, or buy from your local hardware store, but that which is supplied with your model is a high-quality type and is longer lasting and more flexible

Clean the filter on the pump periodically by unscrewing the filter from the pump and thoroughly rinsing it inside and out.

Tilt Base Maintenance & Troubleshooting

Twice a year, inspect the acme rod. Add a small amount of general purpose grease and turn the handwheel to spread it over the travel between the two polyurethane stops. If there is grit on the acme rod, take time to remove the old grease with solvent, allow it to dry and fresh grease.

“Stuck” Tilt Base

Between the hand wheel and the tilt base, you will see a blue clutch. This is designed to prevent damage to the 90-degree gearbox. If you continue to turn the handwheel after the pitch meets it maximum or minimum slope, you will hear the clutch “clunk” as it prevents the gearbox from turning. If you reverse the rotation of the handwheel, but the clutch does not reengage the gearbox, here is how to fix it.

There's a U-Joint between the gearbox and the acme screw. You can put a screwdriver through the joint and turn the acme rod. It can be helpful to have someone turn the handle simultaneously. If the box is stuck at maximum slope, turn the u-joint clockwise (facing downstream). The handle rotation will also be clockwise. If the box is stuck at level, turn both the acme and the handle counter-clockwise.

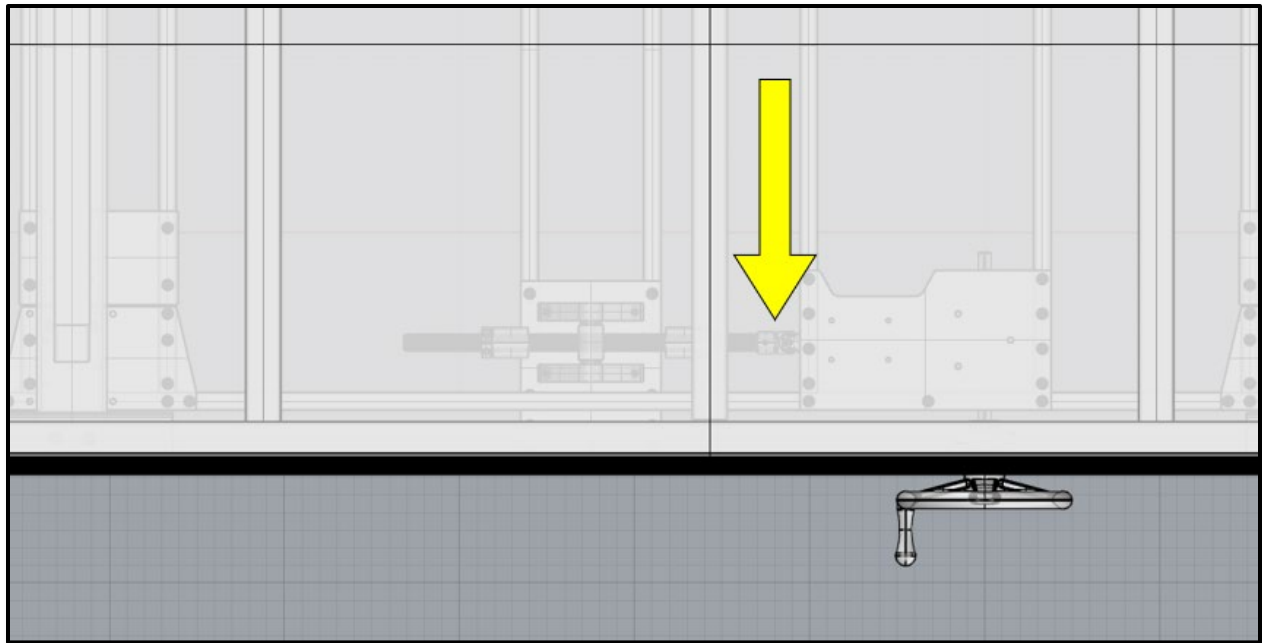


Figure 12.1 Location of the U-Joint as seen from above. Figure 1.2 shows the tilt mechanism from below the model.

To avoid getting the tilt mechanism stuck, we recommend that users approach the maximum/minimum slope gently with the handwheel, and back off just a hair before leaving the Em4.



Figure 12.2 Insert the screwdriver through the U-Joint.



Demonstrations and Experiments

The primary independent variables imposed on your experimental channels are channel slope and discharge. To gain familiarity with the capabilities of the model, it is best to begin by exploring both of these variables at relatively low values.

Slope of the system is controlled by the tilt of the box (which can range from 0–3%) and by the elevation of the standpipe. The slope of your channels is also dependent, of course, on their sinuosity. It is best to begin with lower slopes, around 1%. A small laser level can be used to explore the relative elevations of the upper end of the channel and the standpipe.

As you are learning to use the model, set your K500 to 35–50 ml/s. These flow rates may seem too low at first glance, but low flows often give the most interesting results. Higher flows will mobilize all sediment in the channel, which, in many demonstrations and experiments, will make it difficult to see specific processes. Try forming a channel with moderate flows (less than 75 ml/s), and then lowering the discharge to find the point at which sediment transport in the channel ceases. Work up from this point.

When forming experimental channels, mimic what you see in the field. For example, meandering gravel-bed rivers will have low point bars that slope gradually up to a floodplain, and relatively steep banks on the outsides of bends. Routing brief flood pulses (high flows of about 190 ml/sec) through your channels will give them more realistic characteristics. Remember that your modeled channels should be in a near-equilibrium condition in order to show the effects of disturbances. The guidelines and videos at the following places will help you begin.

<https://emriver.com/videos/>

<http://serc.carleton.edu/NAGTWorkshops/geomorph/emriver/index.html>

When you notice media being scoured from in front of the EDU, you may replenish it by pushing the banks closer together adjacent to the scour or by sprinkling media directly into the stream. If you pile the media excavated from your initial channel near the EDU, you will have a ready supply. Placing 8–10 pieces of limestone riprap directly under the outlet of the EDU will further calm the stream and reduce scouring.

A straight channel from the EDU to the standpipe in your river model will eventually form meanders, point bars, cutbanks, and other river features just as in nature, but it may take a couple of hours for these features to fully develop. Below are a couple of initial conditions that can produce features more quickly for teaching and demonstrating.



Meandering Channels

To form an initial channel with a meander, distribute the media evenly in the box. Use a triangular scraper to inscribe the desired curves in the media, and then sculpt gentle banks with a scoop and plastic float.

Delta Building

To explore delta building and alluvial fans, move most of the media to the upstream 2/3 of the box and distribute it evenly. The downstream third of the box can have the aluminum 'bedrock' exposed, or may have a thin layer of media in it. You may wish to remove one 5-gallon bucket of media from the model.

Cut a straight or meandering incision in the media from the EDU to the beach and sculpt a gentle slope in the media away from your initial channel with the plastic scraper or the corner of a scoop. You may have media above the edge of the box at the upstream end of your model.

Raise the standpipe to 7cm (2.75") and start the pump, adjusting the flow to about 100 ml/s. Sediment will immediately begin moving downstream, and will be deposited in the forming lake at the downstream end of the model. As the lake fills, you will begin to see all the classic delta formation phenomena in the model. Periodically raising and lowering the standpipe will mimic rising and falling tides or sea level change and introduce layers of complexity to the delta. Raising and lowering the flow rate of the pump will further add to the dynamic qualities of the model.

Stratigraphy

Examining the stratigraphy can give fascinating insight into the depositional history of your experiments. As in nature, the most complex stratigraphy is often the result of long-term deposition under dynamic conditions. Flood sequences, meandering channels, delta building, and other fluvial processes all leave different marks on the stratigraphic record.

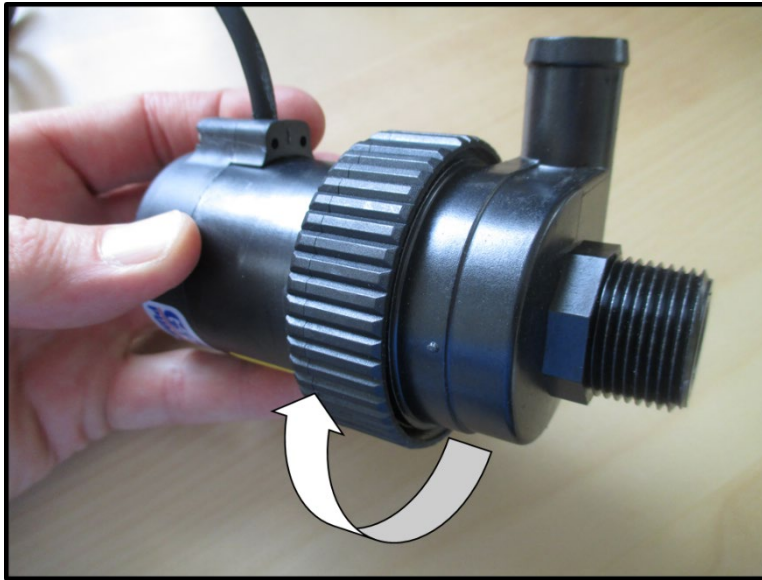
The best way to examine the stratigraphy in your model is to drain it overnight so the media can pack down. (Saturated media has lower cohesion than damp media.) Use the corner of a large scoop to cut V-shaped incisions laterally across the media bed. Cutting into the media this way magnifies the thickness of the layers and keeps the cut wall from collapsing.



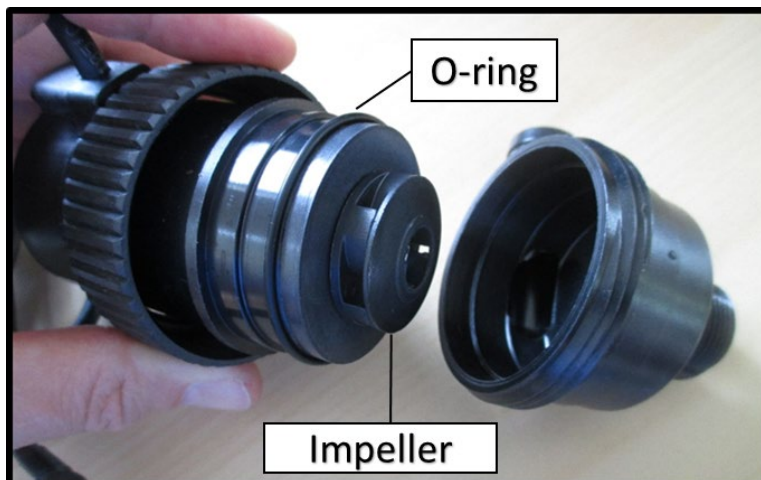
Instructions for cleaning the GRI pump

Your GRI pump should be checked monthly as part of routine maintenance. If you notice flow reduction or a complete cease in flow, disassemble and clean the pump following the instructions below. If you have questions in the process, please call Little River at 618-529-7423.

1. Disconnect GRI pump from controller and power supply.
2. Unscrew retaining ring.

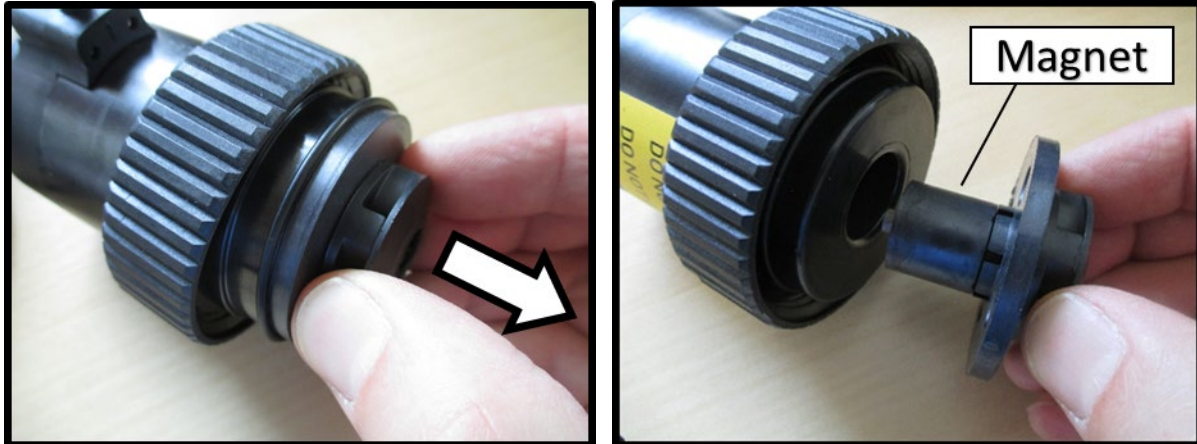


3. Pull threaded portion of pump housing to remove. Be careful not to remove the O-ring.

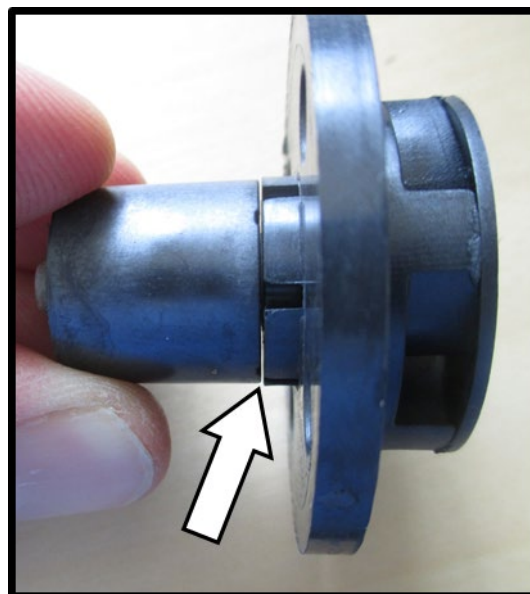
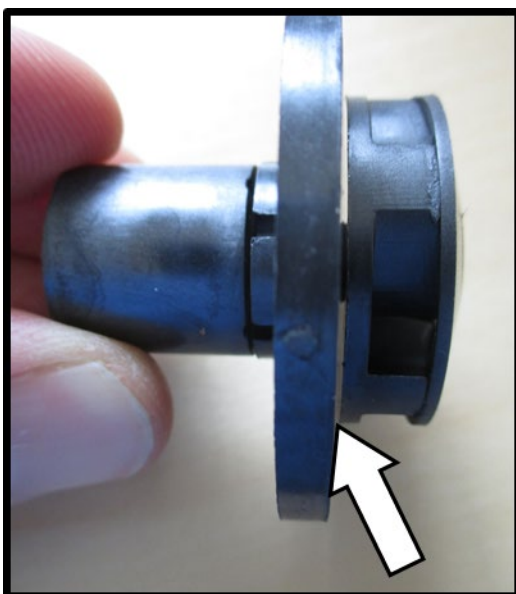




4. Remove the impeller by pulling it from the pump housing.



5. Clean all parts by rinsing with water. Make sure the narrow gaps around the impeller are clear of debris.





6. Moisten the whole unit to lubricate the O-ring and reassemble the pump by inserting the magnet and impeller into the housing. Make sure O-ring is in place and then press the threaded portion of the housing firmly onto the pump body. Tighten the retaining ring. When properly tightened, there should be no thread showing past the edge of the ring.



7. Attach filter and tubing. Submerge pump fully before restarting. Agitating the assembly lightly in the water will help clear air from the filter and pump.



Emriver Em4 Specifications

<i>Emriver Component</i>	<i>Specifications</i>
Modeling media	modeling media material Color-coded-by-size particulate thermoset plastic
	modeling media (sediment) dry wt. 360 lb (163 kg)
	sediment specific gravity 1.55
	sediment particle size 0.01 – 0.05 in. (0.25 – 1.2 mm)
Box	box weight approx. 275 lb (125 kg)
	box dimensions 12 ft x 3.9 ft (3.7 m x 1.2 m)
Reservoirs	water capacity 70 gal (265 L)
Pump	pump capacity 24V DC pump, rated 6.7 GPM at 60 Watts.
	Output ranges from 25 to 120 mL/sec
Entire system	wt. of entire system (dry) approx. 910 lbs (414 kg)
	wt. of entire system (wet, @25 gal) approx. 1720 lbs (668 kg)
	min. floor space required for demonstration with 12 people 12 x 15 ft (3.6 x 4.6 m)