Emriver Em3

Use and Care Manual



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YOU MUST READ AND UNDERSTAND THESE WARNINGS BEFORE USING THE EMRIVER MODEL

- The Emriver model is very heavy when filled with water and sediment. A collapse of the model's supports could severely injure or kill a person. Be absolutely sure you understand how to use the supports.
- Use only the supports provided with the Emriver model. Despite weight-bearing claims, no standard production sawhorse is strong enough to safely support the model. Sawhorses and folding tables can collapse under dynamic or side loading.
- Check all fittings on the aluminum supports before each use to be sure they are secure.
- When setting up the box, the supports must be laterally level and aligned. They must also be aligned with the proper support point underneath the box. Otherwise the box could warp or collapse when loaded. Make sure spreader bars are fully engaged.
- Never use more than 40 gal (151 L) of water in the model. Using more than the maximum amount of water and sediment could cause the box or supports to collapse.
- Never use more than the provided 240 lb (109 kg) of sediment in the box, and do not place any heavy objects in the box.
- 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 Emriver Em3. Be certain to connect the power supply to a properly grounded outlet. Always use the Ground Fault Circuit Interrupter (GFCI) provided with the Emriver model (see Figure 18), and be sure to read the manual that accompanies the GFCI.
- When using a 12-volt battery to power the model, always use the Emriver Battery Adapter from Emriver, Inc. Never bypass the fuses.
- When powering the model with a 12-volt battery, be sure you understand the dangers associated with charging and using lead-acid batteries, and consider using safer spill-proof batteries.
- 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.

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Introduction

This manual describes the safe use and maintenance of your Emriver Em3 river process simulator. It is very heavy when filled with modeling media and water, and could be dangerous if not properly supported, assembled, and operated.

It is important that you 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 model may be found at www.emriver.com.

Please take a moment to familiarize yourself with the parts of your Em3.

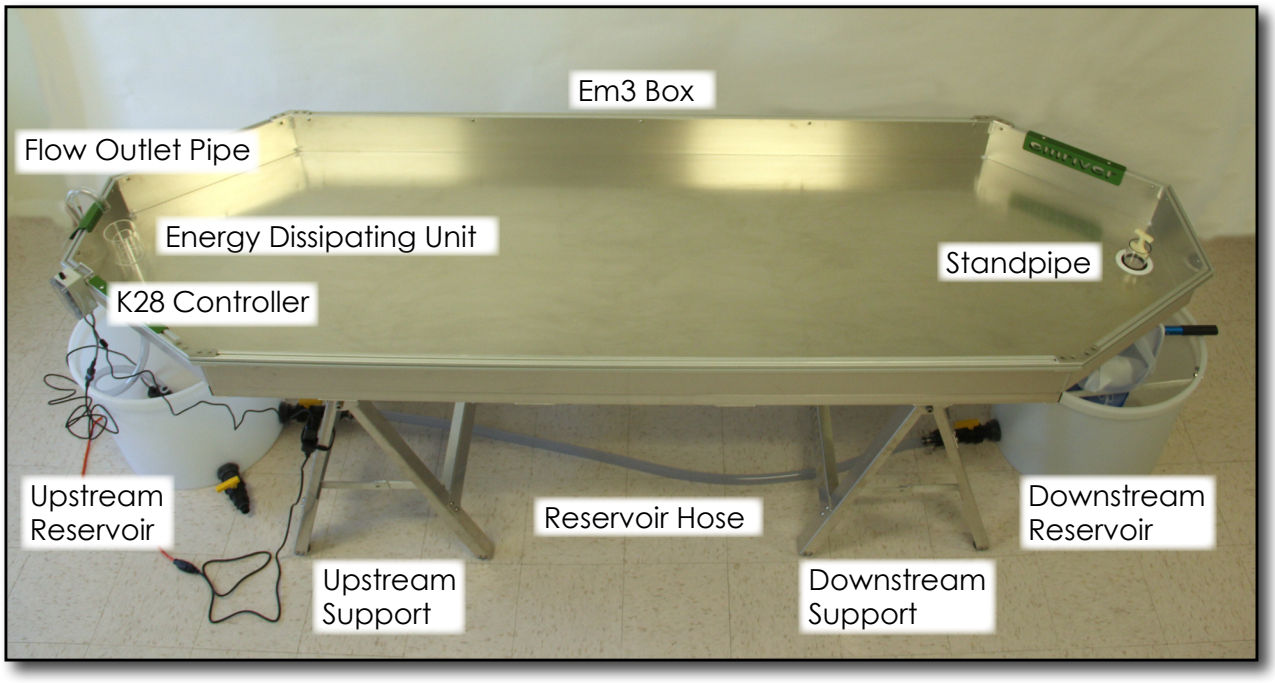


Figure 1. Parts of the Emriver Em3 stream table

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Parts and Accessories Checklist

Included with your model:

- Emriver Em3 Box
- Modeling media in 8 buckets
- Standpipe
- Emriver supports
- Reservoirs and connecting hose
- Sediment trap
- Pump and filter
- ¾" diameter pump tubing
- 1" diameter reservoir tubing
- K28 Electronic Flow Controller
- Energy Dissipating Unit (EDU)
- Flow outlet
- Power supply
- GFCI adapter
- Culvert tubes
- Measuring tape
- Solid scoop
- Perforated Scoop
- Marble and plastic riprap
- Simulated riparian vegetation
- Scrapers for moving media
- Plastic hand float
- Squeegee
- Blue and green dye

Other parts and supplies to have on hand:

- Water supply
- Electric outlet
- Tarp or groundcloth, 12 x 15 feet
- Paper towels and mop
- Shim materials
- Hand level
- Garden hose
- Notebook
- Household bleach
- Small towels for drying hands
- Sieve

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Assembly and Operation

STEP 1 - Set up the supports

It is best to set up your Emriver model on smooth and level ground.

The downstream support is shorter than the upstream support and has one brace positioned near the top to make room for the reservoir. Keep in mind how you would like the model oriented as you set up the supports. The supports should be set up so that the crossbars are 58 in. (1.5 m) apart and aligned as shown in Figure 2 to prevent damage to the box.

If the supports are not properly aligned, the box can twist when fully loaded, which may damage the box. Check alignment with a measuring tape and a bubble level. The supports must be both level with each other and parallel.

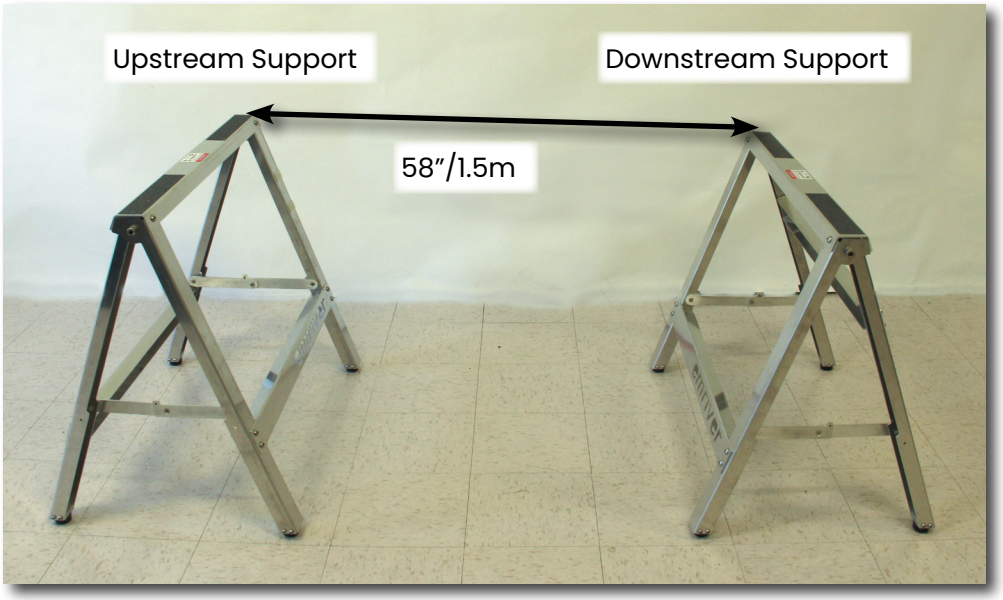


Figure 2. Labels on the supports indicate proper orientation, with the shorter support at the downstream end

WARNING: When fully loaded with water, the model can weigh in excess of 1,200 lb (544 kg). Dynamic loading during use, caused by someone leaning on the model, for example, can greatly increase this load. A collapse of the model's supports could be dangerous and seriously damage the model. You must be certain the model is adequately supported and that you have read and understand all warnings.

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On uneven ground, use shims made from ¾-inch plywood or 2-by-4 scraps under the support feet as necessary. Be sure all four feet of each support are in contact with the ground or a shim.

The Emriver supports have a difference in height of 3 in (76.2 mm), yielding a box slope of 5%, (50 mm/m or 0.61"/ft).

Note: Labels on the supports display arrows that indicate proper placement and orientation, with the shorter support at the model's downstream end. See Figure 3**.**

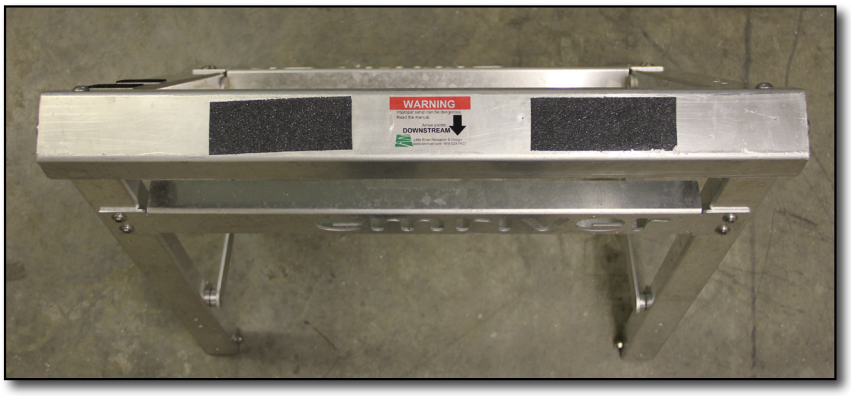


Figure 3. Labels on the supports indicate proper orientation, with the shorter support at the downstream end

STEP 2 - Place the box on the supports

Placing the box requires at least two people, as it weighs 95 lbs (43 kg). When the supports are level and aligned, place the box on them. The box MUST be supported at the end two reinforced ribs, and nowhere else. See Figures 4&5



Figure 4. Reinforced ribs on the underside of the box (indicated with arrows) must rest on the supports

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Gaps of more than 0.25 in (6 mm) between the box's support ribs and the support crossbars indicate that the supports are **NOT** properly aligned. The supports must be properly aligned with the support ribs on the box before any weight is added to the box. See Figure 6.



Figure 5. Place the box so that the ribs rest on the box supports.



Figure 6. The box placed correctly on the support

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STEP 3 - Install the standpipe in the drain assembly

The standpipe has been lubricated with a silicone grease to allow smooth action against the rubber seal. This lubricant is waterproof, nontoxic, and should last for many uses.

Install the standpipe by sliding it into the drain assembly from the underside of the box. Insert the handle first. For initial setup, the standpipe should extend into the box approximately 2 inches (50 mm). The standpipe will move much easier when the seal is wet. Never attempt to install the standpipe from the top of the box.

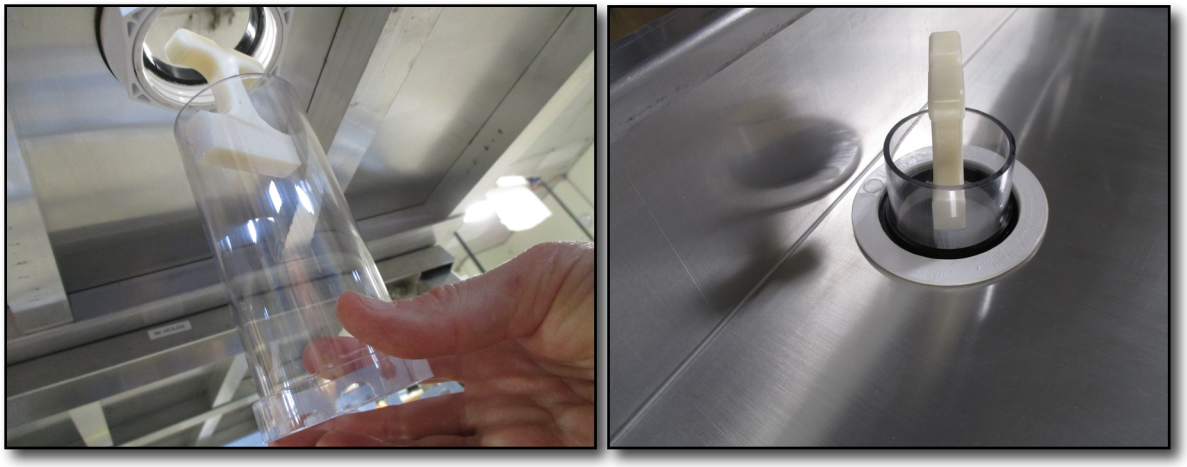


Figure 7. Insert the standpipe from the underside of the box.

As needed, apply a small amount of silicone grease to restore smooth movement. An extra tube of silicone grease has been provided with your model and can be found inside the tool box. Extra silicone grease may be found at most hardware stores and is typically used for waterproofing electronics and O-rings. **Keep the standpipe coated with a thin film of silicone grease** to ensure years of trouble-free operation.

If the drain assembly nut becomes loose, simply screw it back down by hand.

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STEP 4 - Position the reservoirs

The Em3 uses two reservoirs: an upstream reservoir and a downstream reservoir. The upstream reservoir has two valves. The downstream reservoir has a filter plus aluminum struts to support the sediment trap. Place the downstream reservoir beneath the box, directly below the standpipe, so that the valve faces toward the upstream end of the box. Note that the downstream box support has an opening for the reservoir. Place the upstream reservoir beneath the other end of the box so that the main valve faces toward the downstream end of the box. The drain valve has a fitting for a garden hose.



Figure 8. The downstream reservoir has a filter and struts for the sediment trap.

STEP 5 – Connect the reservoirs

Place the 1"x72" reservoir tubing under the box and supports. The cam-and-groove sockets on the hose ends have locking levers. To connect, insert the plug on the reservoir into the socket and pull the levers back. To disconnect, lift both levers and pull out the plug.

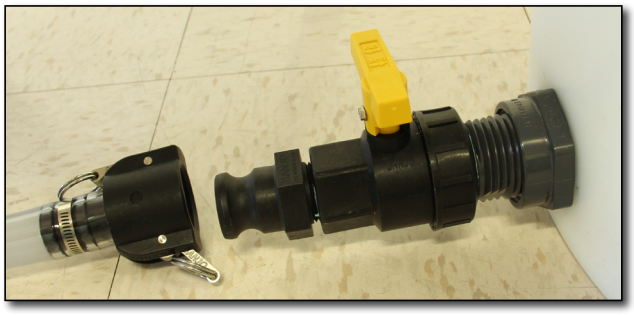


Figure 9. The front lever on the clamp fitting is in the open position. The far lever is locked. The yellow lever on the reservoir valve is in the closed position.



Figure 10. The Em3 box on the supports with upstream (L) and downstream (R) reservoirs positioned and the reservoir tubing connected

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STEP 6 - Pump and Flow Outlet Assembly for K28 Owners

If you own a K500 digital flow controller, skip this step and see the separate instructions at the end of this manual.

The pump and filter are screwed together, but do not need to be very tight. Attach one end of the 0.75"x42" pump tubing onto the outlet barb of the pump and secure it with a plastic clip. Place the pump, lying on its side, in the bottom of the upstream reservoir, keeping the wire connectors outside of the reservoir. See figure 11.



Figure 11. The upstream reservoir with the pump and filter

Turn the metal bracket on the flow outlet so the word 'emriver' faces the pipe outlet. Fit the hose from the pump onto the longer leg of the flow outlet and secure with the plastic hose clamp as shown in Figure 12. Hang the bracket and outlet at the center of the upstream end of the box. If the flexible tubing is turning the outlet, loosen the plastic hose clamp and twist the flow outlet so the it is perpendicular to the upstream end of the box. See Figure 13.



Figure 12. Pump tubing connected to the flow outlet



Figure 13. The flow outlet bracket on the center of the upstream end of the box

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STEP 7 - Position 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. The white mesh filter bag should be in the sediment trap and secured around the rim with the lace.



Figure 14. Place the sediment trap on the aluminum struts in the reservoir.

STEP 8 - Fill the reservoirs

Confirm the position of 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. Do not fill the system with more than 40 gal of water.

The reservoirs are graduated in US gallons and each reservoir has a 27-gallon capacity. Before filling the reservoirs, be sure the main valves are open to allow water to flow between the two reservoirs. Check that the reservoir hose is securely connected to both valves. Keep the drain valve closed.

Observing the graduations on the reservoirs, fill one reservoir with 20 gallons of water. Wait for the water to equalize between the two reservoirs. This may take a few minutes. Continue to fill the reservoirs until each reservoir contains 20 gallons for a total of 40 gallons in the system.

> WARNING: Using more than 40 gallons (151 L) of water could damage the box or cause it to collapse. Do not exceed this volume. When full of water, each reservoir weighs over 175 lb (79 kg). It may be damaged or destroyed if moved when full.
>
> DO NOT START THE PUMP until you have filled the reservoirs.

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STEP 9 - Position the Energy Dissipating Unit

Place the Energy Dissipating Unit (EDU) beneath the flow outlet. The flow outlet opening should line up with the innermost cylinder of the EDU. The EDU's Y-shaped opening should face downstream.



Figure 15. The EDU sits under the flow outlet with the V-notch pointing toward the downstream end of the box.

STEP 10 - Fill the box with modeling media (sediment)

Pour the media into the box one bucket at a time. Spread the media using the scrapers or float included with your Emriver model to distribute it evenly throughout the box.



Figure 16. Pour the media into the box

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STEP 11 - Connect the power supply

Connect the power cord to the DC power supply. Attach the DC power supply to the leg of the upstream support using the snap-together mushroom fasteners on the support and the power supply. Wrap the Velcro® strap around the support leg and the power supply to fasten securely**.**

Plug the Ground Fault Circuit Interrupter (GFCI) into a wall receptacle. If the green indicator light on the GFCI is on, it is ready for use. If the green light does not come on, press the top Reset button on the GFCI. If the reset button immediately pops back out, call an electrician to find the source of the ground fault in your electrical circuit.

Connect the power cord to the GFCI (Figure 18, US outlet shown). 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 wall outlet. **Always use the GFCI.**



Figure 17. The DC power supply secured to the leg of the upstream support

STEP 12 – Attach the K28 Flow Controller

Attach the flow controller to the upstream right-hand side of the box using the hook. The controller should be near the power supply. See Figure 19.



Figure 18. The green light on the GFCI indicates the circuit is protected.

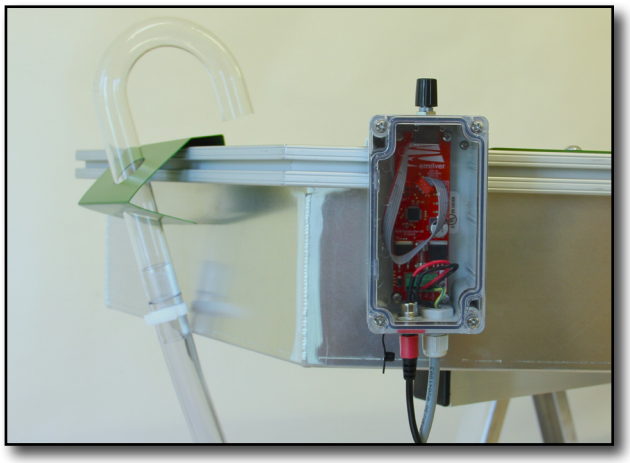


Figure 19. K28 Flow Controller hangs on the box at the upstream end

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STEP 13 - Connect the Pump

Connect the pump to the K28 controller using the gray, blue, and orange connector plug (note there is one red tab that is not a connector). Then, connect the controller to the power supply using the barrel jack with the red sleeve. See Figure 20 a, b, &c. *Make sure the power brick is secured to the support so there is no weight pulling on the power connection at the controller.*

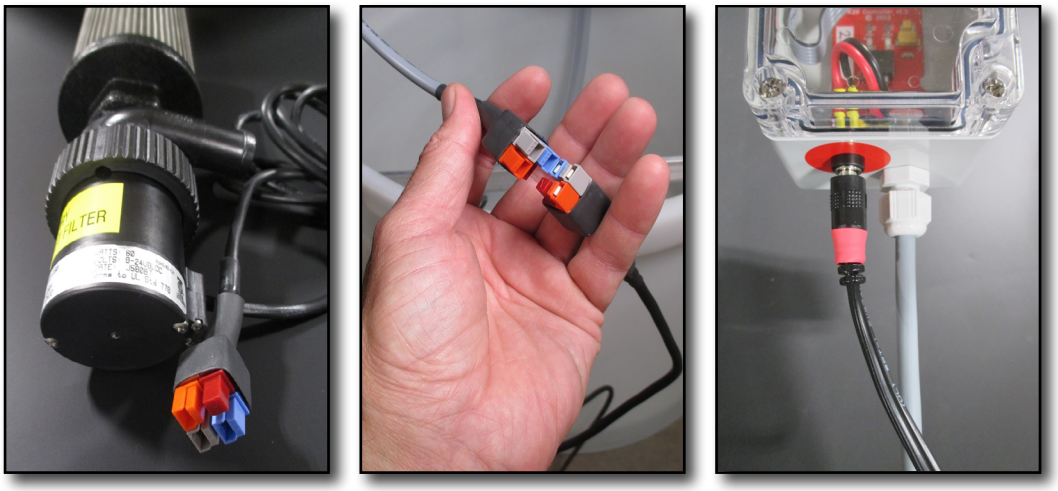


Figure 20 a, b, & c. The pump, above left, connects to the flow controller. The flow controller, right, connects to the power supply. The color-coded connectors on each component will match up.

A green LED in the controller glows when the power is on. Start water flow by turning the knob on the controller clockwise. A blue LED will start to glow to indicate flow is not set to zero. Pressing the knob resets the flow to zero. See Figure 17.

Troubleshooting: It often takes several turns of the knob to start water flowing up the hose. After water starts flowing out of the outlet pipe, turn the knob back down to achieve the desired flow rate.

If the controller does not produce flow, and there are no lights on the circuit board, check the power supply to ensure that the cord is fully connected and that there is a light on the power brick.

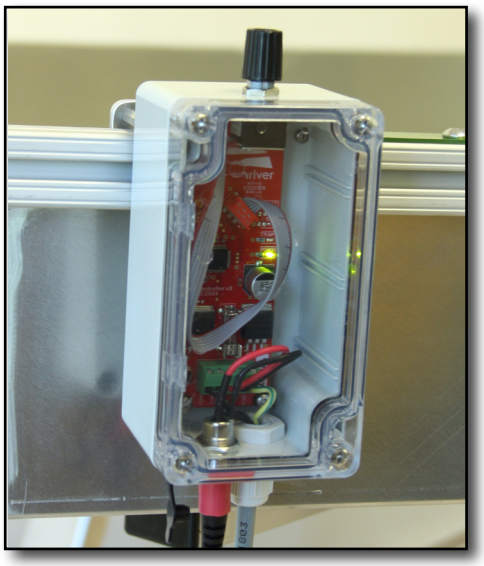


Figure 21. The green LED indicates the controller has power.

If the power light is on, but there is no flow, check to see that the blue flow indicator LED is lit on the circuit board. If it is lit, check the connection between the controller and the pump. Also check for any obstructions or clogged filters. Expel all air from pump and filter by shaking the pump and filter under water.

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If the flow indicator LED is not lit, turn the knob clockwise until the LED is lit and there is flow.

***Note*:** The knob does not turn the pump off completely; it merely stops flow. The pump is on as long as the power is connected. To completely turn off the pump, the power must be disconnected.

***Note*:** If the pump is reluctant to prime when started, reorient or shake it a bit (while underwater) to remove air trapped in its intake. If necessary, clean any debris from the filter by unscrewing it from the pump and flushing it with water.

Disassembly, Transport, and Storage

When breaking down the model, remember that **the reservoirs cannot be moved while full of water.**

The upstream reservoir has a drain valve with a fitting to attach a garden hose which can lead to a floor drain or outside.

You may also use the pump and hose to drain the reservoirs: Remove the pump hose from the outlet fitting at the upstream end of the box. Place the tubing into a media bucket (or any container that can be carried while full of water) or directly into a proper drainage area.

Turn on the pump to move water from the reservoirs to a smaller container or to a drain. Repeat until all of the water is removed from the reservoirs. (See Figure 22)

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, most of this remaining water must be drained from the sediment. This water can take several hours to drain.

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



Figure 22. The controller and pump can be used to empty the reservoirs into media buckets.

Note: To prevent growth of mold and bacteria, add about 6 ml of household bleach to the buckets if you must to store them wet.

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Maintenance and Care

- Drain the model and reservoirs after each use; do NOT leave water in the Emriver model.
- 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 12 ml of household bleach to the upstream 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.
- 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 left in the sun while wet, it may support algae growth and become cloudy. Routing a mild bleach solution through the tubing 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.
- All bolts on the supports should be periodically checked for tightness. Loose or missing bolts will affect the strength of the supports. The bolts should be as tight as possible while still allowing the supports to fold.
- Clean the filter on the pump periodically by unscrewing the filter from the pump and thoroughly rinsing it inside and out.

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Quick Start Guide for the Emriver Em3

Some basic guidelines for using the Emriver are included here. Further instructions and exercises can be found in the Emriver Lab Manual. In addition, the guidelines and videos at the following places will help you begin.

www.emriver.com

http://serc.carleton.edu/NAGTWorkshops/geomoph/emriver/index.html

Instructional videos are available as a Playlist on our YouTube channel. The link is also available from our website.

General Tips

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 is controlled by the slope of the box (which is 5% when you use the support horses on a level surface) and by the elevation of the standpipe. A 5% slope makes for a fast-moving stream when the standpipe is lowered. Raising the standpipe to 2 inches will reduce the effective slope to 3%, and raising it fully will reduce the slope to less than zero (-0.95%). This is the easiest way to control the slope of your model.

Slope of your channels is also dependent, of course, on their sinuosity. It is best to begin with lower slopes. A small laser level can be used to explore the relative elevations of the upper end of the channel and the standpipe.

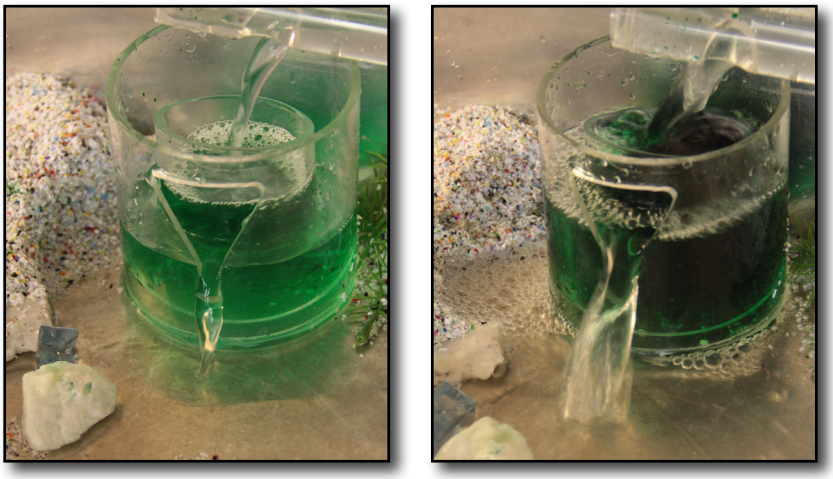


Figure 23. Low flow (left) and high flow (right) as it appears when looking at the EDU.

As you are learning to use the model, begin with low flows (about 25 ml/s, as seen in Figure 23, left side). These flows may seem too low at first glance, but low flows often give the most interesting results. Higher flows (about 125 ml/sec, shown in Figure 23, right side) 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 flow to find the point at which sediment transport in the channel ceases. Work up from this point.

When you notice media being scoured from in front of the EDU, you may replenish it

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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

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, see Figure 23, right side) 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.

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. The EDU will be about half-filled with water. 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.

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Stratigraphy

If you have color-coded media in your model, examining its stratification can give fascinating insight into the depositional history of your experiments. As in nature, the most complex strata are often the result of long-term deposition under dynamic conditions. Flood sequences, meandering channels, delta building, and other fluvial and lacustrine processes all leave different marks on the stratigraphic record.

The best way to examine the stratifcation 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.

Cleanup

When you are ready to put your Em3 away, dry the media as much as possible by fully draining the model and piling the media in the middle of the box for a day or so if possible. Scoop as much media as you can back into the buckets. If the reservoir is still full of water, remove the standpipe, pull the inlet tube from the end of the hose, and use the pump to wash all remaining media out of the box and into the sediment trap. The included squeegee is ideal for coaxing the last bits of media to the hole.

Handling the Media

During experiments and demonstrations, sediment leaving the box will accumulate in the sediment trap. The rate at which the sediment trap fills is highly variable, depending on activity in the box.

When the sediment trap becomes full, use the perforated scoop included with the Emriver model to return sediment to the box.

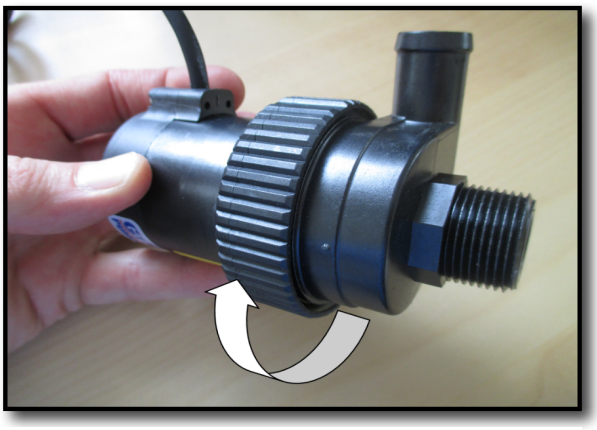
Allowing sediment to accumulate in the reservoir will **NOT** harm the pump. The filter is sized to allow the pump to function normally even when completely buried in sediment. However, fine debris such as dirt, lint and pollen can accumulate in the media over time and clog this filter. Just give it a rinse now and then.

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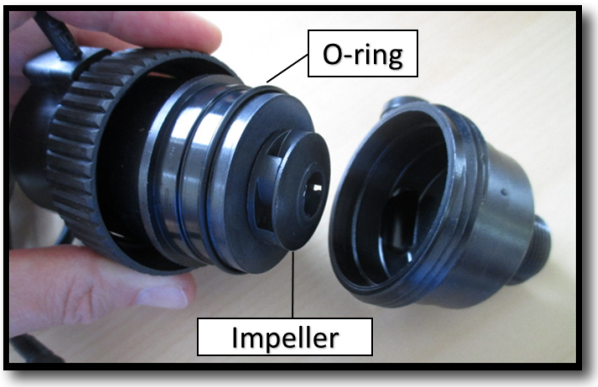
Instructions for Cleaning the GRI Pump

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 about the process, please call Emriver at 618-529-7423.

1. Disconnect GRI pump from controller and power supply.

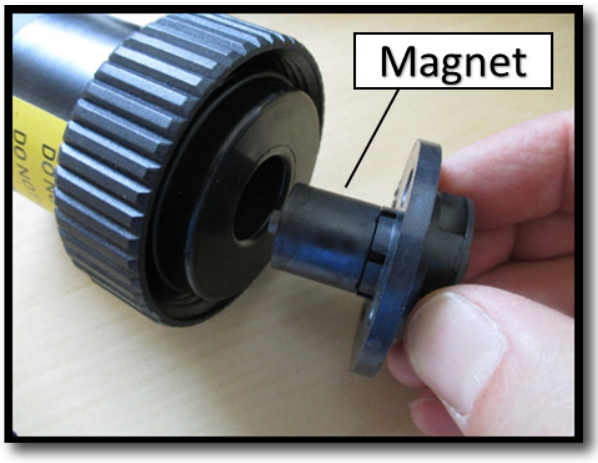


2. Unsrew the retaining ring.



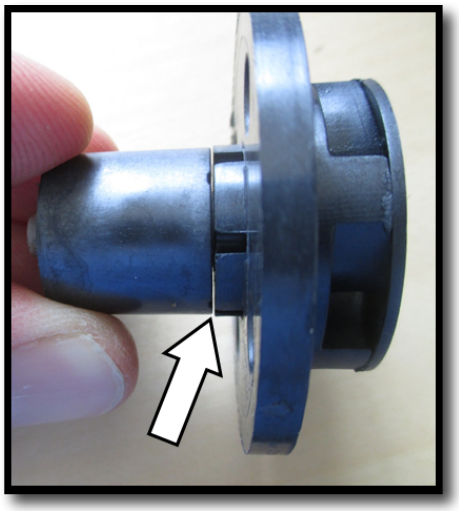
3. Pull the threaded portion of the pump to remove. Be careful not to remove the O-ring.

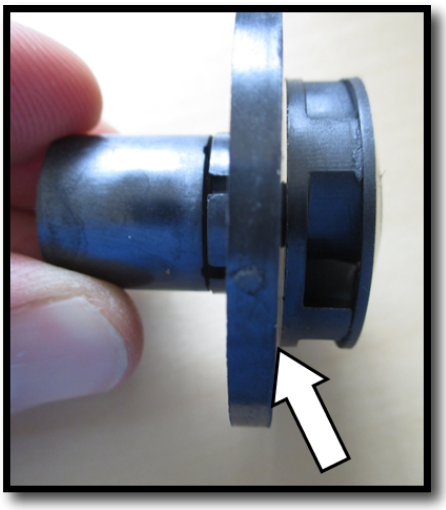




4. Remove the impeller by pulling it from the pump housing.

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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.

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Specifications

Emriver Item		Specifications
Modeling Media	Composition	Particulate thermoset plastic (melamine)
	Weight	240 lb. (109 kg)
	Specific gravity	1.55
	Particle size	0.02 - 0.09 in. (0.5 - 2.1 mm) Alpha & Carbondale Mix 0.01 - 0.05 in. (0.25 - 1.2 mm) Memphis Mix
Box	Weight	95 lb. (43 kg)
	Dimensions	120 x 39 x 5.5 in. (3 x 1 x 0.14 M)
Reservoir	Water Capacity each Total System Capacity	27 gal. (102 L) 40 gal (151 L)
Pump	Capacity	120 gph (450 Lph) maximum Output range 0 - 250 mL/ sec
Entire System	Dry weight	approx. 400 lbs (181 kg)
	Wet weight	approx. 720 lbs. (327 kg)
	Floor space required for demonstration with 12 people	9 x 16 ft. (3 x 5 m)

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