

## The Ideal Self Regulating Tide Gate (SRT):

- Is always open, allowing as much tidal exchange as possible – except when necessary to prevent flooding upstream from the SRT
- Is wide open when allowing backflow
- Is wide open when allowing outflow
- Does not slam shut when closing
- Can be temporarily disabled
- Can easily be adjusted to close earlier on a rising tide
- Can easily be adjusted to stay open longer on a rising tide
- Is reliable and operates consistently
- Operates unattended
- Does not require power to open or close
- Is not overly complicated
- Requires minimal maintenance
- Is durable
- Is fail safe
- Is relatively vandal-proof
- Is not expensive

## And here is why:

**The ideal hypothetical SRT is always open allowing as much water movement as possible – except when needed to prevent flooding upstream from the SRT.**

If the SRT is closed when it could have been open, the volume of tidal exchange is reduced and the amount of time when fish passage could occur is diminished. If the SRT is only partially open, the flow velocity at the opening will be higher than otherwise necessary. At some point, the increased velocity will deter fish passage at the SRT. The pertinent velocity will vary with the fish species.

Obviously, the SRT should not allow so much water to pass upstream that flooding occurs.

**The ideal hypothetical SRT is wide open when allowing backflow.**

A wide open flap gate is more amenable for fish passage. A wide open flap gate increases the volume of water that can pass through the gate during a tide cycle. More water means more tidal flushing. More tidal flushing generally means more dilution of contaminants, reduced water temperatures, and improved water quality.

A partially open SRT is more likely to have floating debris hang up on it. This can interfere with the operation of the SRT and result in flooding. Debris caught on the SRT can also reduce the conveyance of the SRT.

**The ideal hypothetical SRT is wide open when allowing outflow.**

A wide open flap gate is more amenable for fish passage. A wide open flap gate also passes high flow with minimal head loss. Reduced head loss means more water can pass through the culvert during high runoff events without causing flooding upstream from the SRT.

**The ideal hypothetical SRT does not slam shut when closing.**

If the culvert is flowing pipe-full and the SRT closes suddenly, the energy associated with momentum of the moving water in the culvert going to zero will result in water hammer. The negative pressure in the culvert may be damaging to the culvert and/or the flap gate.

If the flap gate closes gradually, the flow will be reduced before the flap gate closes completely. This will dramatically reduce the water hammer pressure effect. The culvert can also be vented to relieve water hammer pressures.

If the flap gate slams shut and the culvert is vented or the culvert is not flowing pipe full, there will be momentum effects – or surges – that may be undesirable. If the flap gate closes gradually these momentum effects are less severe.

**The ideal SRT can be temporarily disabled.**

If a hurricane, an extreme tide, and/or a high runoff event is forecast, temporarily disabling the SRT in advance of the event will maximize the available storage volume upstream from the closed SRT. This will reduce the extreme water level that develops upstream from the flap gate while it is closed during the high water.

After the event has passed, it should be simple to return the flap gate to its normal operation.

**The ideal SRT can easily be adjusted to close earlier on a rising tide.**

It would be ideal if the SRT can be set to close earlier on a rising tide during the wet season and/or when tides are not favorable. This will preserve more of the channel prism for storing runoff while the SRT is closed and this will reduce the high water level upstream from the SRT.

Adaptive management may suggest that the flap gate should close earlier. This adjustment should be simple to perform.

**The ideal SRT can easily be adjusted to close later on a rising tide.**

It is likely that the SRT can close later on a rising tide during the dry season. When high runoff events are unlikely, minimal storage is needed to contain runoff while the SRT is closed.

Adaptive management may suggest that the flap gate close later. This will allow more inundation of the upstream wetland. Making this adjustment should be simple to perform.

**The ideal SRT is reliable and operates consistently.**

The SRT should routinely open and close as required to allow tidal flushing while preventing flooding.

**The ideal SRT operates unattended.**

No one should have to be at the SRT or take any action to cause the SRT to open or close at the appropriate time. It should work without anyone's intervention.

**The ideal SRT is not overly complicated**

A relatively simple mechanism is easier to operate, maintain, troubleshoot, and adjust compared to a more complicated mechanism.

**The ideal SRT does not require power to open and close.**

If power is required for the SRT to operate, it must be as reliable as possible. During a power outage, the gate could remain open when it needs to be closed – or vice-versa. Under the wrong tide and runoff conditions, the consequences could be consequential.

A SRT that does not require power to operate has reduced operating expenses and is more fail-safe. Lastly, there is no monthly utility bill to process.

**The ideal SRT requires minimal maintenance.**

It is obvious that less maintenance is better than more maintenance.

**The ideal SRT is durable.**

The SRT should have sufficient strength to withstand debris impacts, wracking forces when the SRT closes on debris, and should be able to withstand general wear and tear.

**The ideal SRT is fail-safe.**

If something breaks – nothing catastrophic should happen.

**The ideal SRT is relatively vandal-proof.**

Nothing is absolutely vandal-proof, but it should be difficult for a vandal to change the SRT control mechanism's settings. It should be impossible to vandalize the SRT in a way that results in flooding. It should be difficult for a vandal to do damage that is expensive to repair.

**The ideal SRT is not expensive.**

The SRT should be less expensive than other alternatives.

## **A Side-Hinged Tide Gate Controlled Using the VBFG™ system by Juel Tide Gates is the Perfect SRT!**



At the presently time, there are four side-hinged flap gates using the VBFG™ System that have been in operation for one year or more. All of the characteristics listed above apply to my patent pending design at all of the sites.

They all open wide. They remain wide open through the rising tide until the desired water level upstream is reached. On the falling tide, they open fully when the seating head is near zero. To date, none of them have had any problems with floating debris. It passes easily through the large opening.

All four of the SRTs close on a rising tide before the culverts are flowing pipe-full. Therefore they can close fairly rapidly without causing a problem. The tension regulators can be tuned to cause the SRTs to close more slowly – but it is not necessary at any of these sites. For future SRT projects, a pneumatic cylinder could be added to the control system to assure that the SRT does not slam shut.

Adjusting the control mechanism is as simple as operating a manual boat winch. To temporarily disable the SRT and make it operate like a normal flap gate (allowing no back flow), simply back off on the winch such that there is no tension in the tension regulator when the flap gate is fully closed.



The SRTs are all extremely reliable. All four have been operating completely unattended without failure. The modified Edison Slough SRT has been scrutinized very closely by the upstream resident. Prior to the retrofitting of this SRT, he was very critical of the two attempts at self regulating SRTs at Edison Slough. With the successful retrofit by Juel Tide Gates, he is now something of an SRT enthusiast.

The SRTs utilizing the VBFG™ control mechanism do not require external power. Technically, they are powered by the tide. The tension regulator stores energy when the tide gate closes on a rising tide and later uses the stored energy to open the tide gate when the seating head goes to zero on the falling tide. The system is simple yet remarkably reliable and dependable.

My Aberdeen tide gate design with the improved VBFG™ control mechanism requires virtually no maintenance. I have a letter from the City of Aberdeen in which they state that the side-hinged tide gates have required minimal maintenance and still look like new after 12 years. The design uses heavy duty 316 stainless steel and a copolymer gate leaf. There are no sacrificial anodes to monitor and replace. The tension regulator for the new and improved control mechanism will probably have to be replaced periodically. To date they show little if any wear. The tension regulator may last for five years or more. Replacing the tension regulator takes less than an hour and the material cost is on the order of \$25.

If any component of the control mechanism fails, the tide gate becomes a free-swinging flap gate that continues to prevent flooding but does not allow any backflow. It is completely fail-safe.

At Edison Slough, there was a concern about vandalism. To address this concern, the VBFG™ control mechanism of the retrofitted SRT was entirely enclosed. A tamper-resistant machine screw must be removed to make adjustments to the control mechanism. A vandal can do nothing of consequence to this SRT. Any installation of my SRT design can be made to be virtually vandal-proof.

A side-hinged tide gate controlled using the patent pending VBFG™ system by Juel Tide Gates is vastly superior to other self-regulating tide gate designs (including my Aberdeen tide gate design) and it is less expensive than many inferior SRT designs.

I do not sell SRTs that do not operate properly. If Juel Tide Gates ever provides a SRT and it doesn't work right, I will make every effort to correct the problem. If I cannot get the SRT to work you do not have to pay me. It is easy for me to make this pledge since my SRT design will work at any site.