

## **Culvert/Tide Gate Infrastructure Description**

The primary purpose of the culvert/tide gate structure and the associated interior infrastructure (canals, ditches, berms, etc.) is to protect the winter lake area from daily high tide cycles and provide for the management of interior water levels on a daily basis throughout the year. Traditional top hinged, heavy, wooden gates are default closed and a barrier to fish passage. This type of tide gates prevent tidal exchange during low flow periods of the year and prevent fish ingress and egress during high water events. Full reconnection or restoration is not possible due to development and infrastructure as well as competing interests of multiple landowners and stakeholders.

Replacement of this culvert tide gate infrastructure is dependent on meeting current fish passage criteria as well as satisfying the Endangered Salmon Habitat (ESH) requirements of the Endangered Species Act (ESA) with regard to the listed Oregon Coast Coho Salmon. Compatible restoration that embraces the working landscapes concept (enhancing ecological function while retaining agricultural and natural resource production) is the key to replacing and maintaining the necessary culvert/tide gate infrastructure in tidal influenced estuary areas for the benefit of all landowners and stakeholders. This project addresses access for juvenile endangered Oregon Coast Coho Salmon to over winter habitat, providing slow water refugia, protection from predators, and improved feeding opportunities, which the lack thereof is the number one limiting factor for their recovery in the Coquille River Basin.

The District is responsible for the administration of the District Water Management Plan (DWMP) which is the road map for the water management operations within the District. The DWMP provides process for input from all landowners and stakeholders, within the parameters of the applicable permits and funding entities, allowing all landowners to meet their management objectives on their individual properties.

The evolution of tide gate design and technology in the past ten years has resulted in advanced tide gate components such as lightweight aluminum doors, side hinged tide gates, auxiliary doors, and mitigator devices, culminating in the development of the muted tidal regulator (MTR), (US Patent #6988853B1 & Canadian Patent #2525176) by Nehalem Marine Mfg. The MTR technology is unique because tide gate control and action is triggered by the inside water level, allowing for maximum tidal interchange and time open for fish passage. See Figure 1. The district has worked with Leo Kuntz, owner of Nehalem Marine Mfg. to develop the design of the concrete box culvert/tide gate infrastructure. North West Hydraulic Consultants, Inc. (NHC), Vaughn Collins, P.E., Associate Engineer has done extensive hydraulic modeling of the project infrastructure to ensure that capacity, velocity, and open time parameters are met, necessary to meet fish passage and operational requirements. Additionally, a Geo-Tec Study has been made by PBS Engineering and Environmental to document soil conditions necessary to support the concrete box culvert design by Precision Structural Engineering, Inc. Watch Technologies, with great experience in irrigation/dam water control equipment and electronic management/monitoring technology has also assisted in the design process.

The proposed tide gate structure will be comprised of a of a concrete box culvert (CBC) array with seven 10' X 8' openings, with two in Unit1, four in Unit 2, and one in Unit 3, increasing the total culvert capacity by a factor of three times. A Nehalem Marine Mfg., NSRG10X8RC side hinged tide gate will be mounted on a vertical slide frame (SHTG/VSF Assembly) with the muted tidal regulator system mechanically operating the SHTG/VSF Assembly with direction from appropriate software located in an onsite controller/base station. See Figure 2 (Preliminary Tide Gate Drawings). Incorporation of the vertical slide frame into the tide gate apparatus resolves the issue of fish access during winter high water events.

A typical tide cycle would see the side hinge gates open as the water level in the Coquille River drops below

the interior water level during an outgoing tide. As the interior water level drops, the Muted Tidal Regulator (MTR) is engaged to raise the slide gate frame, allowing the full culvert capacity to be utilized. As the tide changes at low tide the incoming water will begin to flow from the Coquille River back into the District. At this time the side hinge gates can easily close with no significant head or impact on the structure. Water continues to flow in through the entire culvert width as the slide gate frame is in a raised position until the interior set point is reached. At the set point the slide gate frame, with the side hinge tide gates already closed, slides down, closing the culvert opening and stopping the inflow of water. The gates will remain closed through the remainder of the high tide cycle until the Coquille River water level again drops below the interior water level, allowing the side hinged gates to open again.

During a high water event the slide gates can be raised using supplemental power to allow the culverts to be open through the entire high water event until it is possible to return to working water levels. Please note that tide levels and times change each tide.

In addition to the benefits of improved access to over winter habitat for the endangered Oregon Coast Coho salmon many other benefits from the C3P and WLRP projects will accrue to the Winter Lake area including:

- Restoration of tidal influence, habitat enhancement, and improved ecological values to the 400 plus acres in Unit 2.
- Water quality improvements for all management units.
- Improved drainage and irrigation capabilities for agricultural production.
- Improved habitat for migrating water fowl and shore birds
- The opportunity for silt to accrue over the entire flood plain, mitigating subsidence.
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This innovative culvert/tide gate system takes proven equipment and control technology to the next level in meeting project goals and objectives for landowners and stakeholders.