Flood Irrigation Tailwater in Jackson County: Summary of Case Studies 2009-2016

The purpose of the tailwater monitoring effort by Jackson Soil and Water Conservation District (JSWCD) was to establish a baseline of pollutant concentrations (*e. Coli*, temperature and turbidity) that flood irrigation water picks up as it moves across cattle pastures or hay fields. The summary includes monitoring done on 5 separate irrigation efficiency projects before best management practice (BMP) implementation. Post completion monitoring was not necessary because tailwater was at trace levels or non-existent as a result of the BMP implementation and the pollutants were therefore removed from the impacted waterways. BMP's implemented were conversion from flood irrigation to pressurized sprinkler irrigation and irrigation water management.

Typical Flood-Irrigated Pasture/Hay Ranch in Jackson County.

Tailwater is the water that runs off the end of a flood-irrigated field during irrigation and is typically of lower quality (more polluted) at the end of the field than at the beginning of the field. This low quality water can enter waterways and contribute to the poor water quality in many creeks and rivers in Jackson County; especially Little Butte Creek. In most areas in Jackson County, tailwater is not captured or reused in the initial field but instead flows off into the next downstream waterway where it can ultimately effect natural drainages. Eliminating or reducing tailwater from irrigated fields is a tool that is widely used across the nation as a way to improve water quality in the associated waterbody.

Our monitoring effort makes one specific case in this unique region to continue, and expand on, the irrigation BMP work that been happening for the last 20 to 30 years.

In 1993 the Oregon legislature passed the Agriculture Water Quality Management Act. The Act allowed Oregon Department of Agriculture (ODA) to begin working with Soil and Water Conservation Districts (including JSWCD) to implement area plans to improve agricultural related water quality. Additionally, JSWCD saw a need for implementing local monitoring efforts to quantify the benefits of using BMPs to improve irrigation efficiency in a region that historically used 'wild flood' irrigation. JSWCD believes that quantifying project results leads to more cost effective solutions.

Flood irrigation water being applied from the main canal to the head ditch before spreading onto the field.

Data is summarized on the following pages for simplicity and detailed information regarding the study or results are available from JSWCD.

Paul DeMaggio, PE
Soil and Water Conservation Engineer
Paul.demaggio@jswcd.org

Jackson Soil and Water Conservation District
89 Alder Street
Central Point, OR 97502
541-423-6159 www.jswcd.org

Table 1: Water Quality Monitoring Description of Projects

The Project # corresponds to the Project # shown on the graphs in Figures 1-4. Each monitoring project was considered pre-project baseline monitoring in order to assess conditions prior to BMP implementation. Three of these projects (1, 2 & 4) are complete and have successfully converted from flood irrigation to pressurized sprinkler irrigation with trace tailwater. Project 5 is scheduled for completion. The soil type, slope and management all affect the water quality of the tailwater that is flowing into the impacted waterway. The baseline water quality of the tailwater are shown on the graphs in Figures 1-4.

Project #	Acres	Slope	Soil Texture	Management	Diversion	Impacted Waterway
1	125	0-7%	Clay Loam	Contour Ditch Flood Irrigated Hay/Pasture	North Fork Little Butte Creek	North Fork Little Butte Creek
2	75	3-12%	Clay Loam	Contour Ditch Flood Irrigated Pasture	North Fork Little Butte Creek	North Fork Little Butte Creek
3	126	1-20%	Carney Clay	Contour Ditch Flood Irrigated Hay/Pasture	North Fork Little Butte Creek	Wetland near North Fork Little Butte Creek
4	1	2-4%	Manita Loam	Flood Irrigated Hay	Talent Irrigation District West Canal	Anderson Creek
5	14	0-3%	Silty Clay Loam	Contour Ditch Flood Irrigated Pasture	Little Butte Creek	Little Butte Creek

Baseline Monitoring Details

- *e. coli* was sampled once or twice during each irrigation cycle to DEQ standards using the IDEXX method and analyzed by professional labs.
- Turbidity was measured once or twice during each irrigation cycle using a Hach 2100P Portable Turbidimeter in the field.
- Flow Rate inflow was measured intermittently by OWRD Staff using a FlowTracker 1 and tailwater was measured continuously by one of JSWCD's calibrated cutthroat flume, a sharp-crested rectangular weir or a sharp-crested triangular weir.
    - Water level sensors such as the HOBO U20L and Omega CP1000 were used to create detailed hydrographs.
- Temperature was measured continuously using the HOBO U20L and Omega CP1000 data loggers.

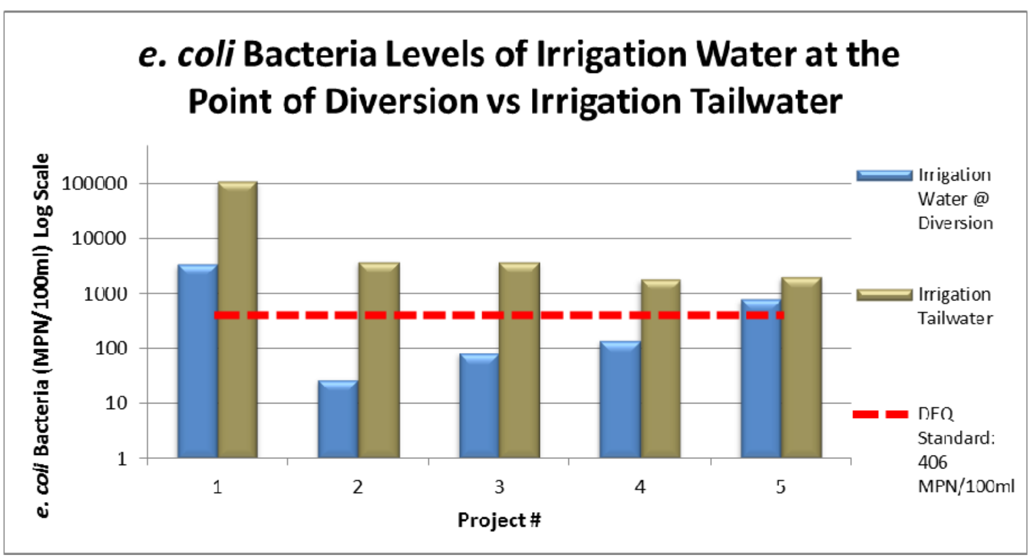

Figure 1: Average *e. coli* bacteria levels were all higher in flood irrigation tailwater than in the irrigation water at the diversion. Water was sampled at various times during irrigation cycles at the diversion and tailwater to quantify how much *e. coli* was contributed to the tailwater by the field. *e. coli* concentrations greater than the DEQ standard means that water is not safe for human contact.

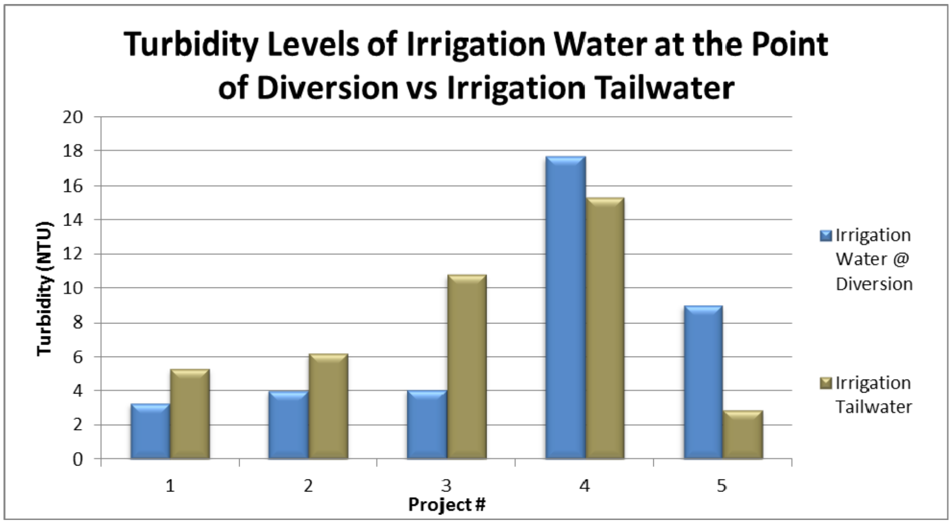

Figure 2: Turbidity is one way to measure the amount of erosion occurring in a field. Each project shows different amounts of erosion or filtering of the irrigation water as it flowed from the diversion to the tail end of the field.

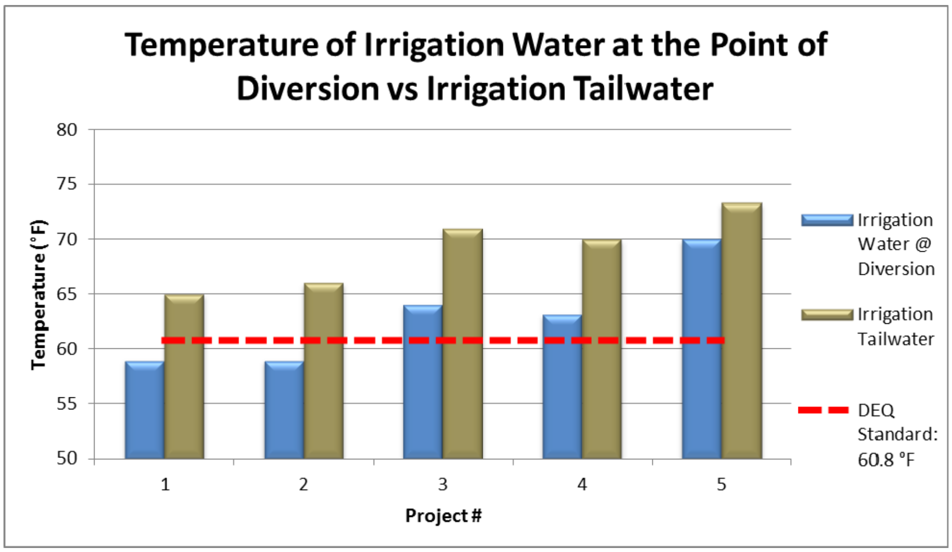

Figure 3: Average water temperature during the irrigation cycle increased in all cases of flood irrigation. Water is heated from the hot dry field, solar radiation, and ambient temperature.

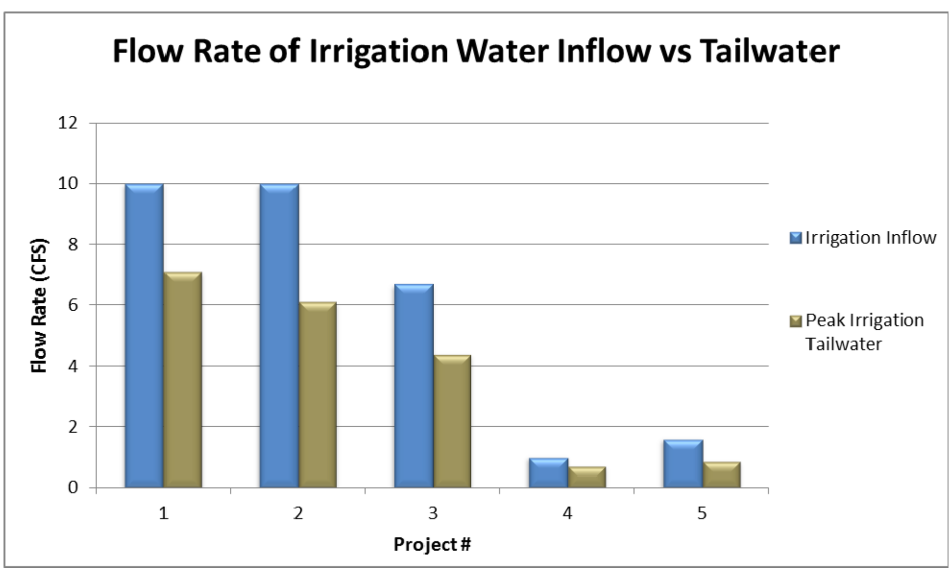

Figure 4: The difference between irrigation inflow and tailwater relates to the irrigation efficiency at that point in time. A substantial amount of flow rate is lost as tailwater off the end of the field and irrigation efficiency tends to be very low.

What does it all mean?

Results from 5 studies we conducted from 2009-2016 (Table 1 and Figures 1-4) show that flood irrigation tailwater is higher in temperature and contains higher concentration of bacteria compared with the irrigation source (point of diversion). *e. coli* bacteria, in all tailwater, was above the Oregon Department of Environmental Quality (DEQ) standard of 406 MPN/100ml. Tailwater temperature increased 5-13°F above the DEQ standard (60.8 °F) in all cases . Turbidity levels were higher in the tailwater than at the point of diversion in 3 cases, but in 2 cases, turbidity levels were reduced in the irrigation water during flood irrigation. Tailwater flow rate in all cases peaked at over 50% of the diversion flow rate onto the field which means that at a time during irrigation, over 50% of the irrigation water applied to field was lost off the end of the field.

Based on the monitoring JSWCD has accomplished since 2009, we can see how the BMPs applied to individual fields effect water quality. The next step is to determine how reducing or eliminating the known pollutants in tailwater is impacting associated waterways.

JSWCD is currently working with Rogue River Watershed Council (RRWC) on monitoring efforts to include entire watersheds such as Antelope Creek. Our monitoring efforts in Antelope Creek will look at the same parameters as above but will last 3 to 5 years, starting with the 2017 irrigation season. We will focus on instream water quality related to irrigation modernization BMP projects such as the Rogue River Valley Irrigation District (RRVID) Bradshaw Drop Project where hundreds of acres are scheduled to convert from flood irrigation to pressurized irrigation by year 2020.

Tailwater measured just before entering creek, Project 2

Trace tailwater after Project 2 conversion to sprinkler

Project Partners

Flood irrigation upgrades to sprinkler irrigation can be an expensive proposal. JSWCD provided the majority of the technical design improvements for each project, while the monitoring equipment and monitoring budget was supplied mainly from Oregon Department of Agriculture (ODA) Focus Area Funds. Funding for upgrading from flood to sprinkler came from a variety of sources including: Oregon Watershed Enhancement Board (OWEB), Natural Resource Conservation District (NRCS), Oregon Wildlife Heritage Foundation (OWHF), Department of Environmental Quality (DEQ), Medford Water Commission (MWC), Oregon Department of Fish and Wildlife (ODFW).

Southern Oregon University (SOU) was able to use the monitoring associated with project 2 as a capstone project for one of their students. Oregon Water Resources Department (OWRD) provided staff time for flow rate monitoring and Rogue Valley Council of Governments (RVCOG) was contracted for sampling and analysis. The ranch staff provided a large amount of in-kind match through installation labor and equipment use.

ROGUE RIVER WATERSHED COUNCIL RVCOG USDA Natural Resource Conservation Service DEQ SOU OWEB WRD OREGON Fish & Wildlife Oregon Wildlife MEDFORD WATER COMMISSION Oregon Department of Agriculture