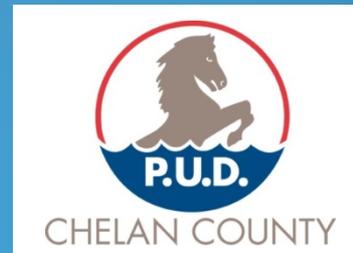


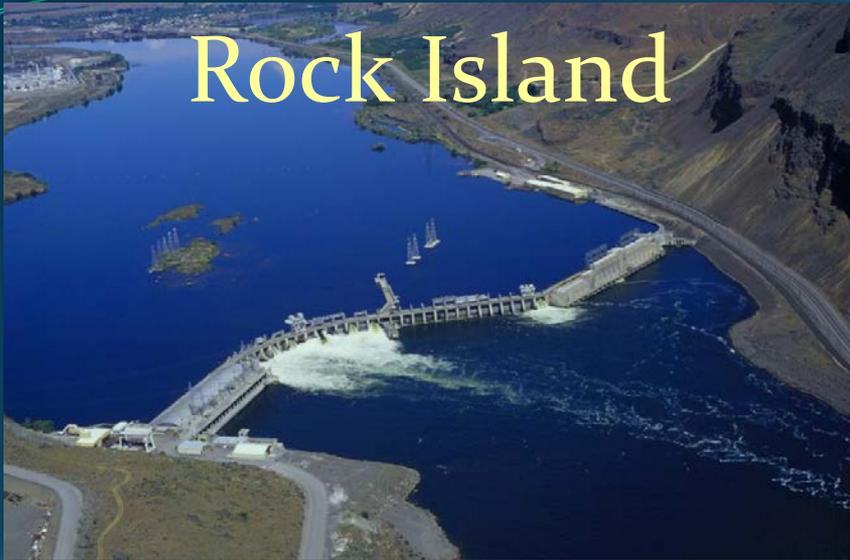
Partial Water Reuse Systems Operation & Maintenance

Presented by Ian Adams
Chelan County Public Utility District No. 1

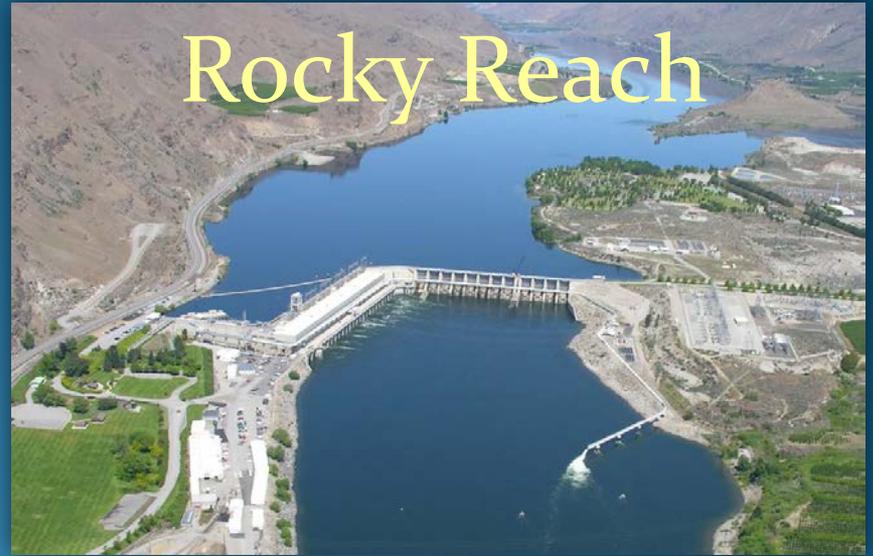


Chelan PUD operates three hydro projects in the mid-Columbia river that deliver clean, renewable, low-cost energy to local residents and to other utilities serving millions of Pacific Northwest residents.

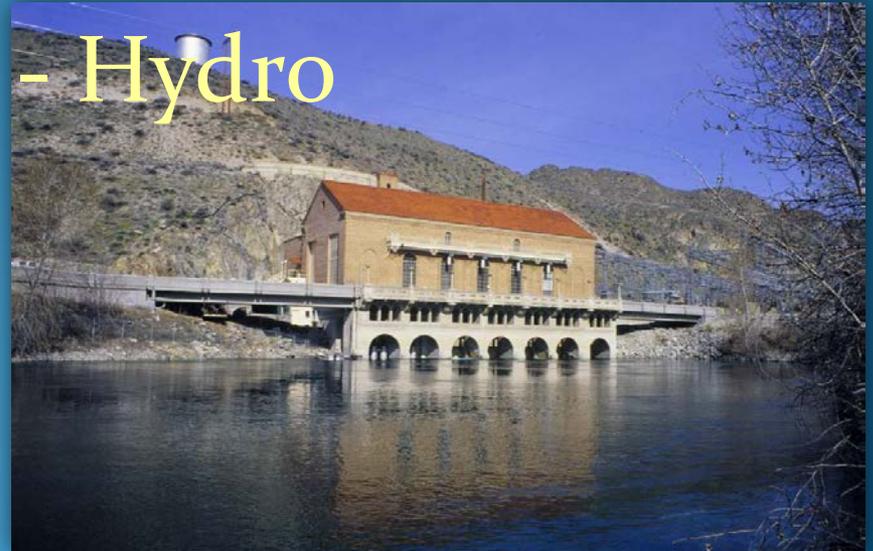
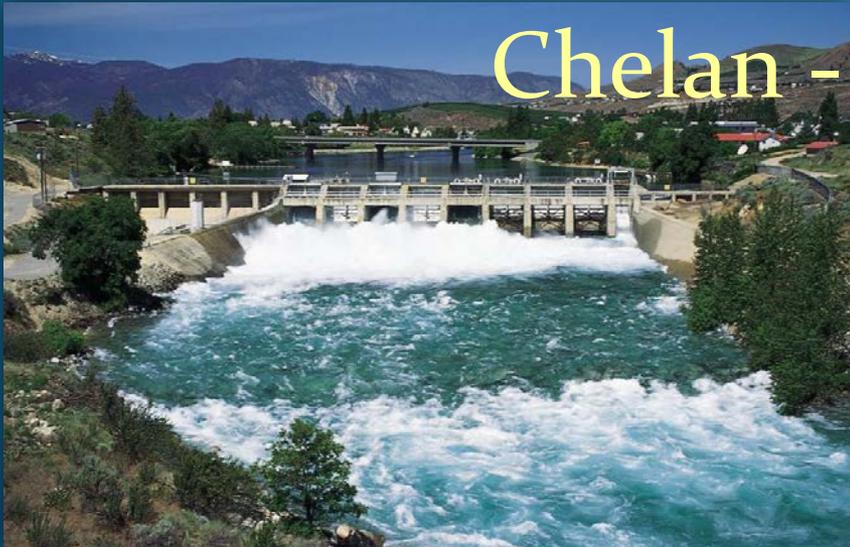
Rock Island



Rocky Reach



Chelan - - Hydro



Hydro operating requirements stipulate that Chelan PUD mitigate for hydroelectric impacts on anadromous fish by species supplementation.

Chelan PUD annually releases
 ≥ 1.5 million juvenile fish

Annual hatchery O&M budget is
 $> \$10,000,000.00$

Collaborative Effort

Chelan County PUD
(CCPUD)



Washington
Department of Fish &
Wildlife (WDFW)

CCPUD Hatchery and Acclimation Facilities

Blackbird Island Pond Acclimation Facility - Steelhead

Carlton Acclimation Facility - Chinook

Chelan Hatchery - ESA Steelhead, Resident Stocks & White Sturgeon

Chelan Falls Acclimation Facility - Chinook

Chiwawa Acclimation Facility – ESA Chinook & Steelhead

Dryden Acclimation Facility - Chinook

Eastbank Hatchery – Chinook, & Steelhead

Similkameen Acclimation Facility – Chinook

Currently Reared with Partial Reuse:

- 25,000 Steelhead
(from 20 fpp through 6 fpp)
- 200,000 Summer Chinook
(from first ponding through 20 fpp)

Eastbank



Eastbank Partial Reuse Facility:

- (2) 30-foot diameter fiberglass tanks
- (2) radial flow clarifiers
- Gas management tower
- 60 micron drum filter
- Pump sump
- (3) 5hp pumps (2 lead, 1 lag)
 - Makeup flow rate = 324 gpm
 - Reuse flow rate = 971 gpm
 - Total flow rate = 1,295 gpm
- Liquid & high pressure reserve oxygen supply & monitoring
- Alarming & water quality monitoring



Chiwawa

Chiwawa Partial Reuse Facility:

- (3) 20-foot diameter fiberglass tanks
- Gas management tower
- 60 micron drum filter
- Solids handling waste clarifier and holding tank
- Pump sump
- (2) 5hp pumps (1 lead, 1 lag)
 - Makeup flow rate = 120 gpm
 - Reuse flow rate = 420 gpm
 - Total flow rate = 540 gpm
- Liquid & high pressure reserve oxygen supply & monitoring
- CLA valve modulating backup system (automatically switches from partial reuse to flow through in the event of a power outage)
- 60,000 $\mu\text{Ws}/\text{cm}^2$ UV system
- Alarming & water quality monitoring

Keys to Successfully Operating a Partial Water Reuse system

1. Trained personnel
2. Alarming & backup systems
3. Detailed documentation
4. Scheduled preventative maintenance

1. Trained Personnel

- Hatchery operators
 - ✓ Regularly perform daily routines
 - ✓ Recognize potential problems
 - ✓ Rectify or notify proper personnel about potential problem(s)
- Mechanics
 - ✓ Perform scheduled preventative maintenance
 - ✓ Document findings during scheduled inspections
 - ✓ Stock spare parts for critical infrastructure systems

Typical cleaning



Routine cleaning & inspection of DO probes



2. Alarming & Backup Systems

- Alarming (Minimum Requirements)
 - ✓ Flow meter(s)
 - ✓ Dissolved oxygen sensor(s)
 - ✓ pH sensor(s)
 - ✓ Water temperature sensor(s)
 - ✓ Pump(s) fail
- Backup Systems (Minimum Requirements)
 - ✓ Handheld water quality analyzer or test kit
 - Dissolved oxygen
 - Water temperature
 - pH
 - Un-ionized ammonia
 - ✓ Reserve oxygen supply
 - ✓ Motor starters & overloads



EASTBANK FISH HATCHERY - WATER REUSE SYSTEM

SYMBOL LEGEND

- ALARM
- NO ALARM
- NO DATA

ALARM ALARM PRESENT

Real Time
Alarm
Monitoring

POND 1 **POND 2**

DISOLVED OXYGEN DISOLVED OXYGEN

INFLUENT FLOW
RECIRC FLOW

GAS TRANSFER TOWER

RUN STATUS
PUMP 1 ●
PUMP 2 ●
PUMP 3 ●

DISOLVED OXYGEN
PH
TEMPERATURE

ALARM SETPOINTS

PH SETPOINTS
LOW PH SETPOINT

LOX SYSTEM SETPOINTS
HIGH HIGH SETPOINT
LOW LOW SETPOINT

PUMP CONFIGURATION

NUMBER OF PUMPS
PUMP CYCLE HRS

WATER REUSE SYSTEM DISABLE CONTROLS

WATER REUSE COMM FAIL ENABLED

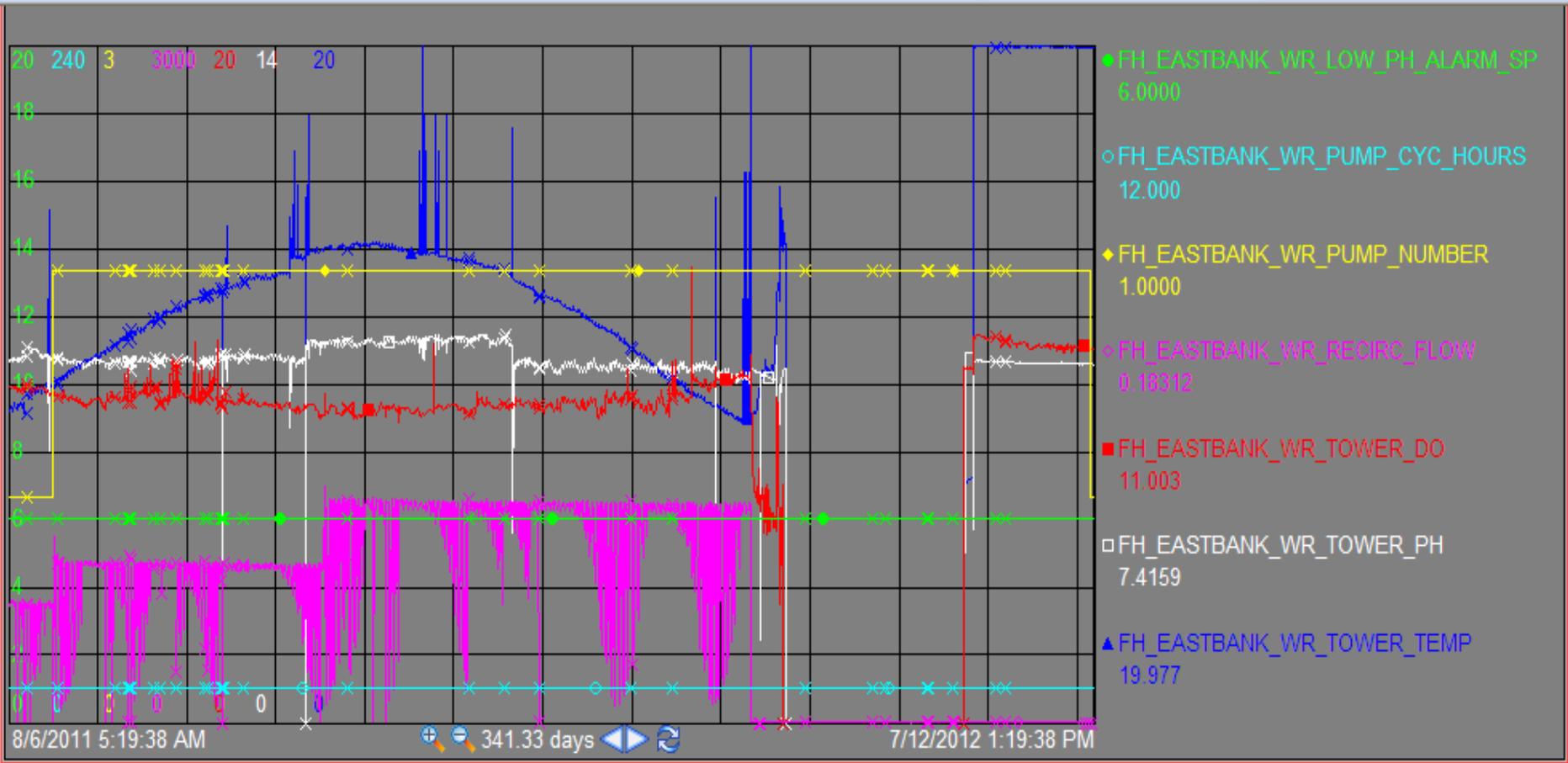
BLOWER 1 FAIL <input type="checkbox"/> ENABLED	POND 1 DO FAIL <input type="checkbox"/> ENABLED
BLOWER 2 FAIL <input type="checkbox"/> ENABLED	POND 1 HI HI DO <input type="checkbox"/> ENABLED
DRUM FILTER HIGH <input type="checkbox"/> ENABLED	POND 1 LOW DO <input type="checkbox"/> ENABLED
INFLUENT FLOW FAIL <input type="checkbox"/> ENABLED	POND 2 DO FAIL <input type="checkbox"/> ENABLED
LOW LOX PRESSURE <input type="checkbox"/> ENABLED	POND 2 HI HI DO <input type="checkbox"/> ENABLED
LOW WATER PH <input type="checkbox"/> ENABLED	POND 2 LOW DO <input type="checkbox"/> ENABLED
P1 CONTROL FAIL <input type="checkbox"/> ENABLED	RECIRC FLOW FAIL <input type="checkbox"/> ENABLED
P1 OVERLOAD <input type="checkbox"/> ENABLED	SUMP HIGH LEVEL <input type="checkbox"/> DISABLED
P2 CONTROL FAIL <input type="checkbox"/> ENABLED	SUMP LOW LEVEL <input type="checkbox"/> ENABLED
P2 OVERLOAD <input type="checkbox"/> ENABLED	TOWER DO FAIL <input type="checkbox"/> ENABLED
P3 CONTROL FAIL <input type="checkbox"/> ENABLED	TOWER PH FAIL <input type="checkbox"/> ENABLED
P3 OVERLOAD <input type="checkbox"/> ENABLED	TOWER TEMP FAIL <input type="checkbox"/> ENABLED

WATER REUSE SYSTEM ALARMS

WATER REUSE COMM FAIL ●

BLOWER 1 FAIL ●	POND 1 DO FAIL ●
BLOWER 2 FAIL ●	POND 1 HI HI DO ●
DRUM FILTER HIGH ●	POND 1 LOW DO ●
INFLUENT FLOW FAIL ●	POND 2 DO FAIL ●
LOW LOX PRESSURE ●	POND 2 HI HI DO ●
LOW WATER PH ●	POND 2 LOW DO ●
P1 CONTROL FAIL ●	RECIRC FLOW FAIL ●
P1 OVER LOAD ●	SUMP HIGH LEVEL ●
P2 CONTROL FAIL ●	SUMP LOW LEVEL ●
P2 OVER LOAD ●	TOWER DO FAIL ●
P3 CONTROL FAIL ●	TOWER PH FAIL ●
P3 OVER LOAD ●	TOWER TEMP FAIL ●

Trending



3. Detailed Documentation

- Daily logs
 - ✓ Hatchery operators
- Weekly logs
 - ✓ Hatchery operators
- Monthly logs
 - ✓ Hatchery operators
- Site record sheets (SRS)
 - ✓ Mechanics

Example daily inspection - monitor and record dissolved oxygen levels



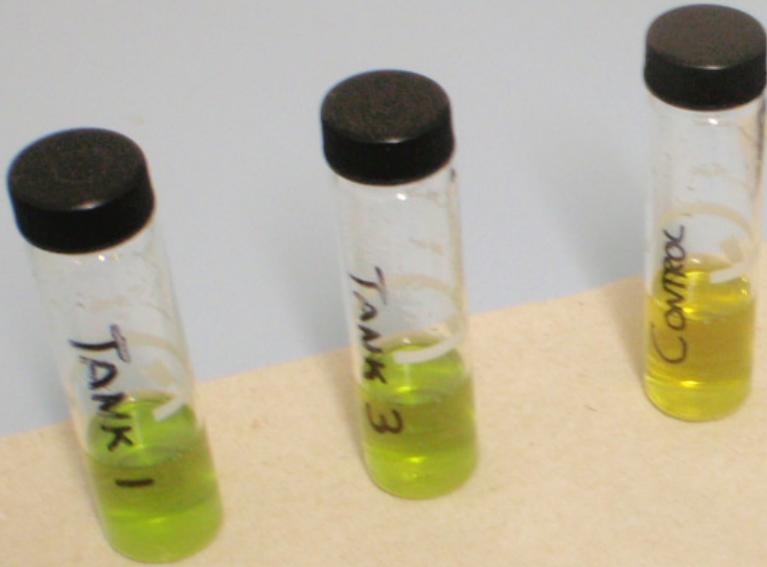
MANUAL O2
OFF ON



Example weekly inspection -
monitor & document pump
pressure



Example monthly inspection - lab work



4. Scheduled Preventative Maintenance

- O&M manuals

- ✓Engineering

- Create

- Contacts

- Process Overview

- Operating Procedures

- Maintenance Schedules

- Managing & Monitoring Water Quality

- Troubleshooting

- Drawings

- Product Manuals & Warranties

- Commissioning Reports

- Other

- ✓Distribute

- Hatchery operators & support staff

- Mechanics

4. Scheduled Preventative Maintenance

Cont.

- ✓ Maintain

- Engineering
- Mechanics

- Preventative maintenance plans

- ✓ Engineering

- Create

- Overview
- Maintenance interval
- Considerations
- General procedures
- Units specific information
- Suggested tool list
- Suggested drawings list
- Manufacturers list & product guide(s)
- SRS

4. Scheduled Preventative Maintenance

Cont.

- ✓ Distribute
 - Hatchery operators & support staff
 - Mechanics
- ✓ Maintain
 - Engineering
 - Mechanics
- Annual inspections
 - ✓ Mechanics
 - Annual
- Site record sheets (SRS)
 - ✓ Engineering
 - ✓ Mechanics

Create & Use O&M Manuals



Create & Use Preventative Maintenance Plans (PMs)

Chiwawa Rearing Facility PM Mechanical - Drum Filter

The Chiwawa Rearing Facility's Water Reuse System (WRS) has a rotary drum filter that removes sediment, and other suspended solid matter from both fresh (make-up) and reuse water. All water entering and cycling through the WRS pass through the drum filter.

Standard operation of the HydroTech micro-screen filter is as follows: Untreated process water enters the interior of the rotating drum and disperses radially through the micro-screen panels on the drum surface, to the outside of the drum. The screened water flows out of the filter through an effluent level control weir that is used to maintain the water level surrounding the drum at a minimum of 34% submergence. For initial clean screen operation, the influent (inside the drum) water levels should be very close to the set effluent water level.

As particulate matter is screened from the flow and collects on the screen panels, the head-loss across the micro-screen filter increases until a "High Level" set point is reached. When this set point is reached, the control system on the micro-screen filter will initiate drum rotation, via the motor on the micro-screen filter, open the normally closed solenoid on the backwash supply header, and begin operation of the high-pressure backwash pump.

Clean water is supplied by the high-pressure backwash pump to the spray header located adjacent to the drum. The flow from this spray header washes off the inner surface of the screen panels into a backwash trough located inside the drum, near the top.

As the micro-screen filter is backwashed, the head-loss through the micro-screen filter is reduced, thus reducing the water level in the influent channel. The backwash continues until either a field adjustable time interval has elapsed, or the "Normal Level" set point is reached in the influent channel. Once both of these control conditions are reached, the backwash solenoid is closed, high-pressure backwash pump operation ceases, and drum rotation is to automatically stop. The filter then continues normal operation until the next backwash cycle begins.

Maintenance Frequency:

- Annual (during annual overhaul period, June through September)
- As needed

Considerations:

- Hatchery operations
- Hatchery representative availability
- Acquire operations manuals for the drum filter (available on PUD share point site or from a planner)
- Acquire facility OMI
- Acquire prints of the facility's Water Reuse System
- Incorporate the work into an annual overhaul period (June through September) when the hatchery's water supply is shut down

Chiwawa Rearing Facility Drum Filter Maintenance SRS

Drum Filter

Inspection results:

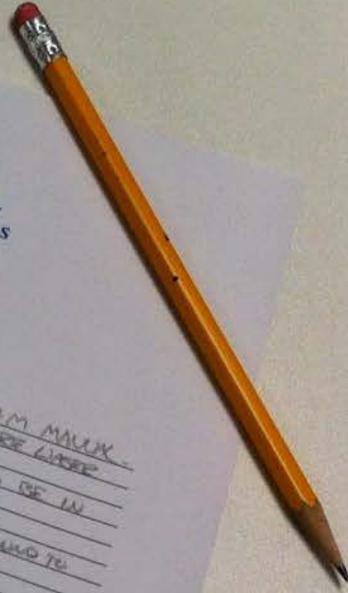
Action required

Yes OK Failed
No

Notes: (Suggested repair or replacement etc.)

- CLEARED FILTER AS DIRECTED IN O&M MANUAL
- USED TOILET BOWL CLEANER AND PRESSURE WASHER
- INSPECTED PUMPERS. PUMPERS WERE FOUND TO BE IN
GOOD CONDITION
- VERIFIED FLUID LEVEL IN GEAR BOX. LEVEL FOUND TO
BE OK

both
ugh
e and
ice



Example Unit Specific Information from PM

Unit No.	CWRF-DF-1
Quantity	1
Manufacturer	HydroTech
Model Number	HDF802-1H
Serial Number	5869
Type	Rotary Drum w/60 micron screen
Warranty Expiration Date	Expired
Cut Sheet(s)	<p>http://www.hydrotech.se</p>  <p>HydroTech - HDF800 Drum Filter.pdf</p>
Location	Inside the southwest corner of the Water Reuse System control building
Purpose	The drum filter removes sediment, and other suspended solid matter from both fresh (make-up) water and reuse water. All water entering and cycling through the WRS pass through the drum filter.
Periodic Maintenance	<p>Hatchery staff take care of the numerous weekly and bi-weekly maintenance and inspection items required</p> <p>Annual requirements: Refer to the manufacturer's Operation and Maintenance manual for specific details.</p> <ul style="list-style-type: none"> ● Inspect the rubber sealing between the filter frame and the drum for wear and damage. ● Replace the drum support wheels ● Check if the spray bar nozzles are worn; change nozzles if necessary ● Check oil level in the gearbox <ul style="list-style-type: none"> ○ Oil type: ISO Viscosity VG 680 e.g. <u>Omala</u> oil 680 (Shell) or equivalent. ● Depending on season, prime or drain spray bar pump ● Clean filter screen material. Refer to pages 20, 21 of the manufacturer's manual for cleaning methods.



Document all maintenance using
Site Record Sheet (SRS)

Example Site Record Sheet (SRS)

Chiwawa Rearing Facility- Drum Filter Maintenance SRS

Drum Filter

Inspection results

OK

Failed

Action required

Yes

No

Notes: (Suggested repair or replacement etc.)

- CLEANED FILTER AS DIRECTED IN O&M MANUAL.
USED TOILET BOWL CLEANER AND PRESSURE WASHER
- INSPECTED ROLLERS. ROLLERS WERE FOUND TO BE IN GOOD CONDITION.
- VERIFIED FLUID LEVEL IN GEAR BOX. LEVEL FOUND TO BE OK.

What all this effort supports is...



...what's really most important...



...adult returns!

