UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

Klamath River Renewal Corporation	**Project Nos. 14803-001;**
PacifiCorp	**2082-063**

AMENDED APPLICATION FOR SURRENDER OF LICENSE FOR MAJOR PROJECT AND REMOVAL OF PROJECT WORKS

EXHIBIT R
100% Design Report
(Part 3 of 12)

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Klamath River Renewal Corporation **PacifiCorp**	**Project Nos. 14803-001; 2082-063**

AMENDED APPLICATION FOR SURRENDER OF LICENSE FOR MAJOR PROJECT AND REMOVAL OF PROJECT WORKS

EXHIBIT R-5
Fall Creek Hatchery
(continued)

Fall Creek Design Report
(continued)

Calculation Cover Sheet

Project: Fall Creek Hatchery

Client: Klamath River Renewal Corporation **Proj. No.** 20-024

Title: Mechanical Calculations - IFC

Prepared By, Name: Sean Ellenson, P.E.

Prepared By, Signature: **Date:** 10/19/2020

Peer Reviewed By, Name: Kyle DeSomber, P.E.

Peer Reviewed, Signature: **Date:** 10/19/2020

SUBJECT:	Klamath River Renewal Corporation	**BY:** S. Ellenson	**CHK'D BY:** K.DeSomber
	Fall Creek Hatchery	**DATE:** 10/19/2020	
	Mechanical Calculations - IFC	**PROJECT NO.:** 20-024	

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SUBJECT:	Klamath River Renewal Corporation	**BY:** S. Ellenson	**CHK'D BY:** K. DeSomber
	Fall Creek Hatchery	**DATE:** 10/19/2020	
	Coho Building Drainage Piping Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to size the drainage piping within the Coho Building.

References

- *Lindeburg, Michael R. 2014. Civil Engineering Reference Manual, Fourteenth Edition. Professional Publications, Inc. Belmont, CA.*

Method

Raceway, working vessels, and building drains discharge raw water to the adult holding ponds after interconnecting with the primary drain piping outdoors. Open channel flow calculations followed the equations below (Lindeburg, 2014), and were calculated iteratively using a Newton-Raphson iterating scheme:

$$\theta_{deg} = 2\cos^{-1}\left(\frac{\frac{D}{2} - d}{\frac{D}{2}}\right)$$

$$A = \left(\frac{D}{2}\right)^2 \frac{\theta_{rad} - \sin\theta_{deg}}{2}$$

$$P = \frac{D\theta_{rad}}{2}$$

$$R_h = \frac{A}{P}$$

$$V = \left(\frac{1.486}{n}\right) R_h^{2/3} S^{1/2}$$

$$Q = AV$$

$$\frac{n}{n_{full}} = 1 + \left(\frac{d}{D}\right)^{0.54} - \left(\frac{d}{D}\right)^{1.2}$$

where:

$\theta =$ Internal angle of water surface
$D =$ Pipe inner diameter, ft
$d =$ Flow depth, ft
$A =$ Flow area, ft^2
$P =$ Wetted perimeter, ft
$R_h =$ Hydraulic radius, ft
$V =$ Average flow velocity, ft/s
$n =$ Manning's roughness coefficient
$S =$ Pipe bed slope, ft/ft
$Q =$ Discharge, cfs
$n_{full} =$ Pipe-full roughness coefficient

The following assumptions are made in these calculations:

(1) In order to allow for sufficient airflow, and to prevent periodic pressurization of the pipe where unintended, the pipe size is designed to convey the flow in an open-channel condition with the depth less than 70% of the inner diameter of the pipe.

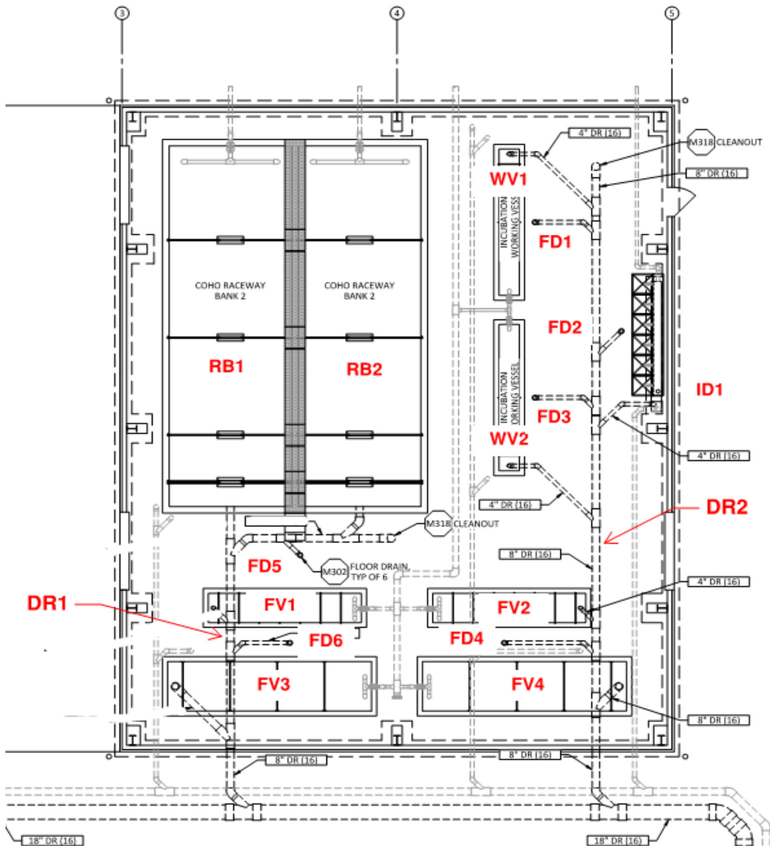
(2) The pipe is assumed to be plastic or some other smooth interior pipe, and non-profile wall pipe. Accordingly, a conservative roughness coefficient of 0.015 was applied (note: C900 pipe manufacturers report roughness values of 0.009). If the pipe varies from this assumption, these hydraulics will need to be reconsidered.

(3) Based on standard sewer design, the pipe is considered self-cleaning if the velocity is greater than 2.0 ft/s. Above 1.5 ft/s is acceptable if occasional flushing flows are expected. The pipes were designed to meet this criterion.

Inputs

General Parameters

Gravitational constant, g	32.2	ft/s^2	
Kinematic Viscosity, ν	1.41E-05	ft^2/s	[@ 50 F]



Location I.D.	Description	Discharge, Q gpm	Comments
WV1	Working Vessel #1	15	
WV2	Working Vessel #2	15	
FV1	Feeding Vessel #1	37.5	
FV2	Feeding Vessel #2	37.5	
FV3	Feeding Vessel #3	37.5	
FV4	Feeding Vessel #4	37.5	
ID1	Incubation Stack Drain	40	6 Stacks @ 5 gpm + 10 gpm standpipe waste
FD1	Floor Drain #1	10	Estimated
FD2	Floor Drain #2	10	Estimated
FD3	Floor Drain #3	10	Estimated
FD4	Floor Drain #4	10	Estimated
FD5	Floor Drain #5	10	Estimated
FD6	Floor Drain #6	10	Estimated
RB1	Coho Raceway Bank #1	181	
RB2	Coho Raceway Bank #2	181	
DR1	Drainage Header #1	457	RB1+RB2+FV1+FV3+FD5+FD6
DR2	Drainage Header #2	185	WV1+WV2+FV2+FV4+ID1+FD1+FD2+FD3+FD4

Calculations

Gravity Pipeline

Location I.D.	Description	Discharge, Q gpm	Pipe Nom. Diameter in	Pipe Inner Diameter ft	Slope ft/ft	Roughness Coeff, *n*	Flow Depth, d ft	<70% Full?
WV1	Working Vessel #1	15	4	0.316	0.015	0.015	0.11	34%
WV2	Working Vessel #2	15	4	0.316	0.015	0.015	0.11	34%
FV1	Feeding Vessel #1	37.5	4	0.316	0.015	0.015	0.17	55%
FV2	Feeding Vessel #2	37.5	4	0.316	0.015	0.015	0.17	55%
FV3	Feeding Vessel #3	37.5	4	0.316	0.015	0.015	0.17	55%
FV4	Feeding Vessel #4	37.5	4	0.316	0.015	0.015	0.17	55%
ID1	Incubation Stack Drain	40	4	0.316	0.015	0.015	0.18	57%
FD1	Floor Drain #1	10	4	0.316	0.015	0.015	0.09	27%
FD2	Floor Drain #2	10	4	0.316	0.015	0.015	0.09	27%
FD3	Floor Drain #3	10	4	0.316	0.015	0.015	0.09	27%
FD4	Floor Drain #4	10	4	0.316	0.015	0.015	0.09	27%
FD5	Floor Drain #5	10	4	0.316	0.015	0.015	0.09	27%
FD6	Floor Drain #6	10	4	0.316	0.015	0.015	0.09	27%
RB1	Coho Raceway Bank #1	181	12	0.941	0.005	0.015	0.34	36%
RB2	Coho Raceway Bank #2	181	12	0.941	0.005	0.015	0.34	36%
DR1	Drainage Header #1	457	12	0.941	0.005	0.015	0.56	60%
DR2	Drainage Header #2	185	8	0.630	0.015	0.015	0.30	48%

Location I.D.	Description	Internal Angle, θ deg	Flow Area, A ft^2	Flow Velocity, V ft/s	Self-Cleaning?
WV1	Working Vessel #1	142	0.02	1.44	N/A
WV2	Working Vessel #2	142	0.02	1.44	N/A
FV1	Feeding Vessel #1	192	0.04	1.88	N/A
FV2	Feeding Vessel #2	192	0.04	1.88	N/A
FV3	Feeding Vessel #3	192	0.04	1.88	N/A
FV4	Feeding Vessel #4	192	0.04	1.88	N/A
ID1	Incubation Stack Drain	197	0.05	1.92	N/A
FD1	Floor Drain #1	126	0.02	1.28	N/A
FD2	Floor Drain #2	126	0.02	1.28	N/A
FD3	Floor Drain #3	126	0.02	1.28	N/A
FD4	Floor Drain #4	126	0.02	1.28	N/A
FD5	Floor Drain #5	126	0.02	1.28	N/A
FD6	Floor Drain #6	126	0.02	1.28	N/A
RB1	Coho Raceway Bank #1	148	0.23	1.78	N/A
RB2	Coho Raceway Bank #2	148	0.23	1.78	N/A
DR1	Drainage Header #1	203	0.43	2.35	OK
DR2	Drainage Header #2	176	0.15	2.77	OK

Conclusions

The above calculations provide a set of flow, slope, and pipe size conditions that will maintain gravity flow in the drain pipes within the Coho Building.

SUBJECT:	Klamath River Renewal Corporation	**BY:** S. Ellenson	**CHK'D BY:** K. DeSomber
	Fall Creek Hatchery	**DATE:** 10/19/2020	
	Coho Building Waste Drainage Piping Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to size the waste drainage piping within the Coho Building.

References

- *Lindeburg, Michael R. 2014. Civil Engineering Reference Manual, Fourteenth Edition. Professional Publications, Inc. Belmont, CA.*

Method

Waste Drain Cleaning Stations discharge water to the settling ponds after interconnecting with the primary drain piping outdoors. Open channel flow calculations followed the equations below (Lindeburg, 2014), and were calculated iteratively using a Newton-Raphson iterating scheme:

$$\theta_{deg} = 2\cos^{-1}\left(\frac{\frac{D}{2} - d}{\frac{D}{2}}\right)$$

$$A = \left(\frac{D}{2}\right)^2 \frac{\theta_{rad} - \sin\theta_{deg}}{2}$$

$$P = \frac{D\theta_{rad}}{2}$$

$$R_h = \frac{A}{P}$$

$$V = \left(\frac{1.486}{n}\right) R_h^{2/3} S^{1/2}$$

$$Q = AV$$

$$\frac{n}{n_{full}} = 1 + \left(\frac{d}{D}\right)^{0.54} - \left(\frac{d}{D}\right)^{1.2}$$

where:

- $\theta =$ Internal angle of water surface
- $D =$ Pipe inner diameter, ft
- $d =$ Flow depth, ft
- $A =$ Flow area, ft^2
- $P =$ Wetted perimeter, ft
- $R_h =$ Hydraulic radius, ft
- $V =$ Average flow velocity, ft/s
- $n =$ Manning's roughness coefficient
- $S =$ Pipe bed slope, ft/ft
- $Q =$ Discharge, cfs
- $n_{full} =$ Pipe-full roughness coefficient

The following assumptions are made in these calculations:

(1) In order to allow for sufficient airflow, and to prevent periodic pressurization of the pipe where unintended, the pipe size is designed to convey the flow in an open-channel condition with the depth less than 70% of the inner diameter of the pipe.

(2) The pipe is assumed to be plastic or some other smooth interior pipe, and non-profile wall pipe. Accordingly, a conservative roughness coefficient of 0.015 was applied (note: C900 pipe manufacturers report roughness values of 0.009). If the pipe varies from this assumption, these hydraulics will need to be reconsidered.

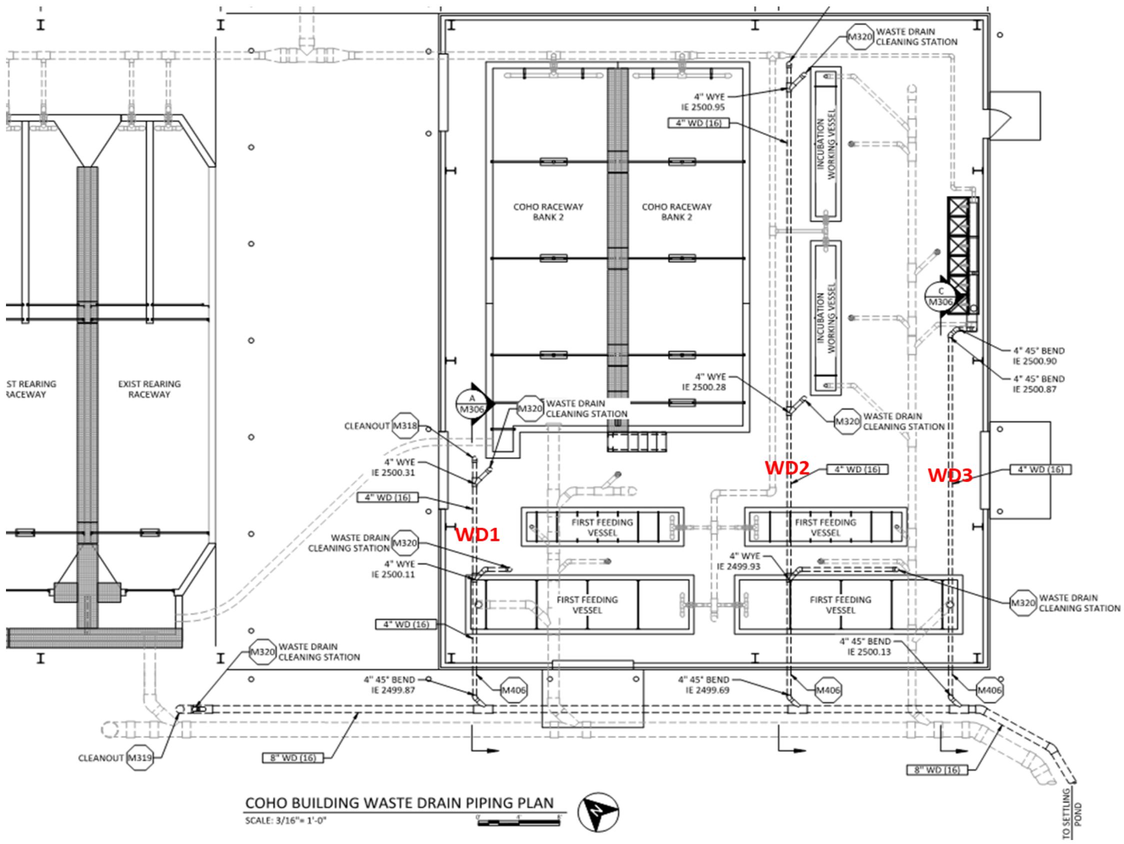
(3) Based on standard sewer design, the pipe is considered self-cleaning if the velocity is greater than 2.0 ft/s. Above 1.5 ft/s is acceptable if occasional flushing flows are expected. The pipes were designed to meet this criterion.

McMILLEN JACOBS ASSOCIATES

Inputs

General Parameters

Gravitational constant, g	32.2	ft/s^2	
Kinematic Viscosity, ν	1.41E-05	ft^2/s	[@ 50 F]



Location I.D.	Description	Discharge, Q gpm	Comments
WD1	Waste Drain #1	50	Capacity of one Vacuum Pump
WD2	Waste Drain #2	50	Capacity of one Vacuum Pump
WD3	Waste Drain #3	40	Capacity of Incubation Stacks

Calculations

Gravity Pipeline

Location I.D.	Description	Discharge, Q gpm	Pipe Nom. Diameter in	Pipe Inner Diameter ft	Slope ft/ft	Roughness Coeff, *n*	Flow Depth, d ft	<70% Full?
WD1	Waste Drain #1	50	4	0.316	0.020	0.015	0.19	60%
WD2	Waste Drain #2	50	4	0.316	0.020	0.015	0.19	60%
WD3	Waste Drain #3	40	4	0.316	0.020	0.015	0.17	53%

Location I.D.	Description	Internal Angle, θ deg	Flow Area, A ft^2	Flow Velocity, V ft/s	Self-Cleaning?
WD1	Waste Drain #1	203	0.05	2.27	OK
WD2	Waste Drain #2	203	0.05	2.27	OK
WD3	Waste Drain #3	187	0.04	2.12	OK

Conclusions

The above calculations provide a set of flow, slope, and pipe size conditions that will maintain gravity flow in the waste drain pipes within the Coho Building.

SUBJECT:	Klamath River Renewal Corporation	**BY:** S. Ellenson	**CHK'D BY:** K. DeSomber
	Fall Creek Hatchery	**DATE:** 10/19/2020	
	Chinook Building Drainage Trench Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to size the drainage piping within the Chinook Building.

References

- *Lindeburg, Michael R. 2014. Civil Engineering Reference Manual, Fourteenth Edition. Professional Publications, Inc. Belmont, CA*

Method

Working Vessels and Incubation Stacks discharge raw water to the adult holding ponds after interconnecting with the primary drain piping outdoors. Open channel flow calculations followed the equations below (Lindeburg, 2014), and were calculated iteratively using a Newton-Raphson iterating scheme:

$$P = B + 2d$$

$$A = B * d$$

$$R_h = \frac{A}{P}$$

$$\frac{n}{n_{full}} = 1 + \left(\frac{d}{D}\right)^{0.54} - \left(\frac{d}{D}\right)^{1.2}$$

$$V = \left(\frac{1.486}{n}\right) R_h^{2/3} S^{1/2}$$

$$Q = AV$$

where:

$\theta =$ Trench Width
$h =$ Trench Depth
$d =$ Flow depth, ft
$A =$ Flow area, ft^2
$P =$ Wetted perimeter, ft
$R_h =$ Hydraulic radius, ft
$V =$ Average flow velocity, ft/s
$n =$ Manning's roughness coefficient
$S =$ Trench slope, ft/ft
$Q =$ Discharge, cfs
$n_{full} =$ Trench roughness coefficient

Assumptions

The following assumptions are made in these calculations:

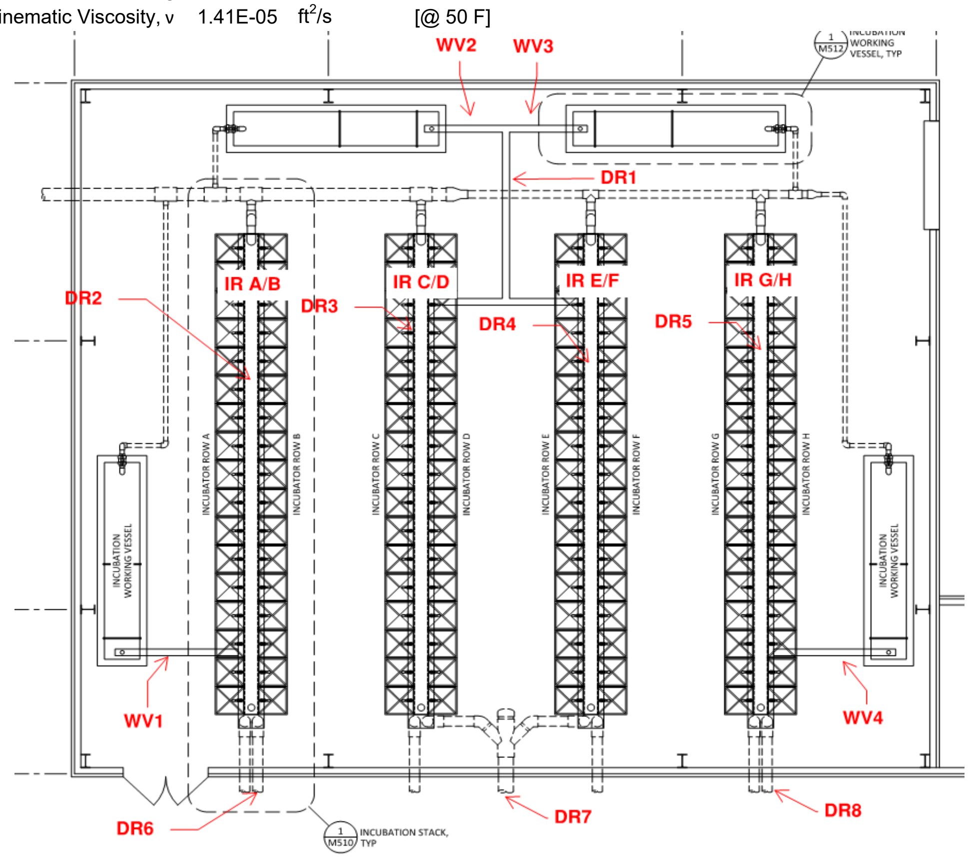
(1) The trench is intended to be formed within the concrete floor slab. Accordingly, a conservative roughness coefficient of 0.015 was applied.

(2) Based on standard sewer design, the trench is considered self-cleaning if the velocity is greater than 2.0 ft/s. Above 1.5 ft/s is acceptable if occasional flushing flows are expected. The pipes were designed to meet this criterion.

Inputs

General Parameters

Gravitational constant, g	32.2	ft/s^2	
Kinematic Viscosity, ν	1.41E-05	ft^2/s	[@ 50 F]



Location I.D.	Description	Discharge, Q gpm	Comments
WV1	Working Vessel #1	15	
WV2	Working Vessel #2	15	
WV3	Working Vessel #3	15	
WV4	Working Vessel #4	15	
IR A/B	Incubation Stack Row A/B	204	34 Stacks @ 5 gpm + 1 gpm waste per stack (34 gpm
IR C/D	Incubation Stack Row C/D	204	34 Stacks @ 5 gpm + 1 gpm waste per stack (34 gpm
IR E/F	Incubation Stack Row E/F	204	34 Stacks @ 5 gpm + 1 gpm waste per stack (34 gpm
IR G/H	Incubation Stack Row G/H	204	34 Stacks @ 5 gpm + 1 gpm waste per stack (34 gpm
DR1	Trench Drain #1	30	WV2+WV3
DR2	Trench Drain #2	219	IR A/B+WV1
DR3	Trench Drain #3	219	IR C/D+WV2
DR4	Trench Drain #4	219	IR E/F + WV3
DR5	Trench Drain #5	219	IR G/H+WV4
DR6	Pipe Drain #1	219	DR2
DR7	Pipe Drain #2	438	DR3+DR4
DR8	Pipe Drain #3	219	DR4

Calculations

Gravity Trenches

Location I.D.	Description	Discharge, Q gpm	Trench Width in	Slope ft/ft	Roughness Coeff, *n*	Flow Depth, d in
WV1	Working Vessel #1	15	6.75	0.008	0.015	0.65
WV2	Working Vessel #2	15	6.75	0.008	0.015	0.65
WV3	Working Vessel #3	15	6.75	0.008	0.015	0.65
WV4	Working Vessel #4	15	6.75	0.008	0.015	0.65
IR A/B	Incubation Stack Row A/B	204	22	0.015	0.015	1.21
IR C/D	Incubation Stack Row C/D	204	22	0.015	0.015	1.21
IR E/F	Incubation Stack Row E/F	204	22	0.015	0.015	1.21
IR G/H	Incubation Stack Row G/H	204	22	0.015	0.015	1.21
DR1	Trench Drain #1	30	6.75	0.008	0.015	1.02
DR2	Trench Drain #2	219	22	0.015	0.015	1.27
DR3	Trench Drain #3	219	22	0.015	0.015	1.27
DR4	Trench Drain #4	219	22	0.015	0.015	1.27
DR5	Trench Drain #5	219	22	0.015	0.015	1.27

Gravity Piping

Location I.D.	Description	Discharge, Q gpm	Pipe Nom. Diameter in	Pipe Inner Diameter ft	Slope ft/ft	Roughness Coeff, *n*	Flow Depth, d ft	<70% Full?
DR6	Pipe Drain #1	219	8	0.63	0.015	0.015	0.33	53%
DR7	Pipe Drain #2	438	12	0.94	0.015	0.015	0.41	43%
DR8	Pipe Drain #3	219	8	0.63	0.015	0.015	0.33	53%

Conclusions

The above calculations provide a set of flow, slope, trench size, and pipe size conditions that will maintain gravity flow in the waste drain pipes within the Chinook Building.

SUBJECT:	Klamath River Renewal Corporation	**BY:** S. Ellenson	**CHK'D BY:** K. DeSomber
	Fall Creek Hatchery	**DATE:** 10/19/2020	
	Chinook Building Waste Drain Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to size the drainage piping within the Chinook Building.

References

• *Lindeburg, Michael R. 2014. Civil Engineering Reference Manual, Fourteenth Edition. Professional Publications, Inc. Belmont, CA.*

Method

Working Vessels and Incubation Stacks discharge raw water to the adult holding ponds after interconnecting with the primary drain piping outdoors. Open channel flow calculations followed the equations below (Lindeburg, 2014), and were calculated iteratively using a Newton-Raphson iterating scheme:

$$P = B + 2d$$

$$A = B * d$$

$$R_h = \frac{A}{P}$$

$$\frac{n}{n_{full}} = 1 + \left(\frac{d}{D}\right)^{0.54} - \left(\frac{d}{D}\right)^{1.2}$$

$$V = \left(\frac{1.486}{n}\right) R_h^{2/3} S^{1/2}$$

$$Q = AV$$

where:

$\theta =$	Trench Width
$h =$	Trench Depth
$d =$	Flow depth, ft
$A =$	Flow area, ft^2
$P =$	Wetted perimeter, ft
$R_h =$	Hydraulic radius, ft
$V =$	Average flow velocity, ft/s
$n =$	Manning's roughness coefficient
$S =$	Trench slope, ft/ft
$Q =$	Discharge, cfs
$n_{full} =$	Trench roughness coefficient

Assumptions

The following assumptions are made in these calculations:

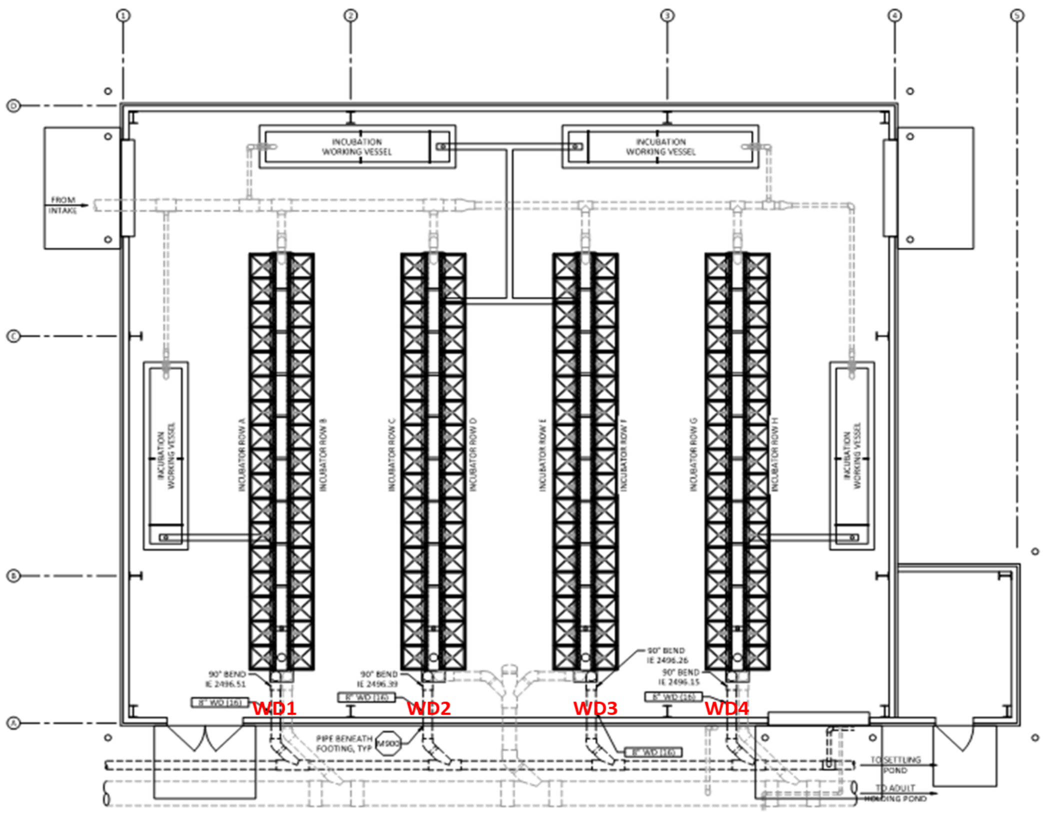
(1) The trench is intended to be formed within the concrete floor slab. Accordingly, a conservative roughness coefficient of 0.015 was applied.

(2) Based on standard sewer design, the trench is considered self-cleaning if the velocity is greater than 2.0 ft/s. Above 1.5 ft/s is acceptable if occasional flushing flows are expected. The pipes were designed to meet this criterion.

Inputs

General Parameters

Gravitational constant, g	32.2	ft/s^2	
Kinematic Viscosity, ν	1.41E-05	ft^2/s	[@ 50 F]



Location I.D.	Description	Discharge, Q gpm	Comments
WD1	Waste Drain #1	200	
WD2	Waste Drain #2	200	
WD3	Waste Drain #3	200	
WD4	Waste Drain #4	200	

Calculations

Gravity Piping

Location I.D.	Description	Discharge, Q gpm	Pipe Nom. Diameter in	Pipe Inner Diameter ft	Slope ft/ft	Roughness Coeff, *n*	Flow Depth, d ft	<70% Full?
WD1	Waste Drain #1	200	8	0.63	0.015	0.015	0.32	50%
WD2	Waste Drain #2	200	8	0.63	0.015	0.015	0.32	50%
WD3	Waste Drain #3	200	8	0.63	0.015	0.015	0.32	50%
WD4	Waste Drain #4	200	8	0.63	0.015	0.015	0.32	50%

Location I.D.	Description	Internal Angle, θ deg	Flow Area, A ft^2	Flow Velocity, V ft/s	Self-Cleaning?
WD1	Waste Drain #1	181	0.16	2.84	OK
WD2	Waste Drain #2	181	0.16	2.84	OK
WD3	Waste Drain #3	181	0.16	2.84	OK
WD4	Waste Drain #4	181	0.16	2.84	OK

Conclusions

The above calculations provide a set of flow, slope, trench size, and pipe size conditions that will maintain gravity flow in the drain pipes within the Chinook Building.

SUBJECT: Klamath River Renewal Corporation
Fall Creek Hatchery
Coho Building HVAC Design

BY: C. Gregory **CHK'D BY:** K. Desomber
DATE: 8/14/2020
PROJECT NO.: 20-024

Purpose

The purpose of this calculation sheet is to determine the required heating load for the Coho building.
Cooling will be provided via mechanical ventilation via 6 air changes per hour

References

ASHRAE, 1997. ASHRAE Handbook - Fundamentals. 1791 Tullie Circle, N.E., Alanta GA 30329

Method

Heat loss and Gain through Conducton

$$q = UA\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
U= $Thermal\ Trasmitance, Btu/(h * ft^2 * °F)$
A = Area, ft^2
$\Delta t_d = Temperature\ difference, °F$

Air Infiltration Heat Loss and Gain

$$q_{infiltration} = V(ACH)C\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
$V = Volume$, ft^3
$\Delta t_d = Temperature\ difference, °F$
ACH = ft^3/hr
C=0.018, Btu/ft^3 °F (Constant)

Ventilation Air Heat Loss and Gain

$$q_{ventilation} = A_{rate} * \rho_{air} * c_p * \Delta t_d * (\frac{60min}{1hr})$$

Where:
$q = heat\ flow\ rate, Btu/h$
$A_{rate} = Air\ Flow\ Rate$, ft^3/min
$\Delta t_d = Temperature\ difference, °F$
$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3$
$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$

Where air is assumed to be at 'standard air' conditions the equation can be reduced to:

$$q_{ventilation} = A_{rate} * 1.08 * \Delta t_d)$$

Heat Loss and Gain through Evaporation

$$W_P = \frac{A}{\gamma}(P_W - P_a)(95\text{-}0.425V)$$

Where:
W_P = *Evaporation of Water lbs/hr*
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w= **Saturation vapor pressure taken at surface water temperature, in. Hg**
P_a= *Saturation* **pressure at room air dew point, in. Hg**
$V = air\ velocity\ over\ water\ surface, fpm$

Units for the constant 95 are Btu/(hr*ft^2*in.Hg). Units for the constant 0.425 are Btu*min/(hr*ft^3*in.Hg).
Equation (2) may be modified by evaportion rate based on the level of activity supported For γ values of about 1000 Btu/lb and values ranging from 10 to 30 fpm, Equation (2) can be reduced to:

$$W_P = 0.1A(P_W - P_a)F_A$$

Where:
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w = *Saturation vapor pressure taken at surface water temperature, in. Hg*
P_a = *Saturation pressure at room air dew point, in. Hg*
F_A = *Activity Factor*

$$q_l = W_P h_w$$

Where:
q_l = *Heat flow rate to water, Btu/hr*
W_P = *Evaporation of Water lbs/hr*
h_w = *Enthalpy of Surface Water Evaporization at* T_W *Degrees of Water, Btu/lb*

Assumptions

The following assumptions were made in the generating the heating loss calculations:
The intent of the HVAC design is to maintain an indoor space temperature of 50 degree Fahrenheit inside of the building envelope.
The air is at 'standard air' conditions

$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3 = .075\ lb/ft^3$ $c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F} = .241 \frac{Btus}{lb*°F}$

Inputs

Coho Building Ventilation Requirements

Occupancy Category Used for Calculation: Warehouse

Description	Area (sf)	Height (ft)	Density	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	1 CFM/SF	6 ACH	Design CFM
Coho Building	3575	18	10.00	35.8	5	0.06	393	1	393	3,575	6,435	393

Total Building Heat Loss to Ventilation - Winter Design Loads

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

Heat Loss to Ventilation (Btu/hr)
14482.6

Total Building Skin Heat Loss - Winter Design Loads

Length (ft)	Width (ft)	Height (ft)
65	55	18

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

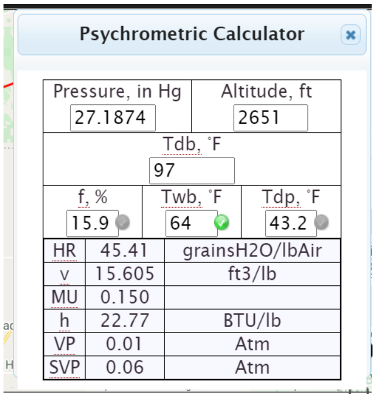
Wall Area (ft^2)	Roof Area (ft^2)	Floor Area (ft^2)
4560.00	3646.5	240

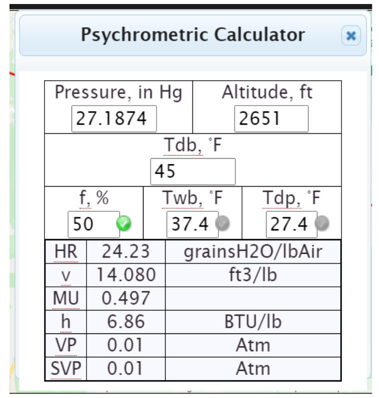
R-value Walls (ft2·°F·h) / BTU	R-value Roof (ft2·°F·h) / BTU	R-value Floor (ft2·°F·h) / BTU
17	25	0.730

Infiltration Rate (ACH) (Ft^3/Hr)
0.6

Heat Loss Walls (Btu/hr)	Heat Loss Roof (Btu/hr)	Heat Loss Floor (Btu/hr)	Heat Loss Infiltration (Btu/hr)
9146.8	4973.8	11211.0	23698.8

Total Building Heat Loss to Water Evaportion - Winter Design Loads





Summer Time Conditions - Coho Building		
Area of Tanks	1570	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (55 Deg Water)	0.4359	in. Hg
Partial Vapor Pressure at Room Air Dew Point (43 Deg Air)	0.18	in Hg
Evaporation Rate	20.08815	lb/hr
Enthalpy of Surface Water Evaporization (55 degree Water)	1062.14	Btu/lb
Heat Loss to Water	21336.43	Btu/Hr
Heat Lost to Water	6.789	KW
Air Flow Rate	6000	cfm
Amount of Water in Return Air	0.000056	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	97	Deg F
Space WB Temp	64	Deg F

Winter Time Conditions - Coho Building		
Area of Tanks	1570	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (43 Deg Water)	0.27831	in. Hg
Partial Vapor Pressure at Room Air Dew Point (27.4 Deg Air)	0.1502	in Hg
Evaporation Rate	10.056635	lb/hr
Enthalpy of Surface Water Evaporization (43 Deg Water)	1068.92	Btu/lb
Heat Loss to Water	10749.74	Btu/Hr
Heat Lost to Water	3.420	KW
Air Flow Rate	1200	cfm
Amount of Water in Return Air	0.00013968	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	45	Deg F
Space WB Temp	37.4	Deg F

Results

The required heating load totals are listed below.

TOTAL Heat Loss (Btu/hr)
74263
TOTAL Heat Loss (kW)
21.76

Safety Factor
0.10

TOTAL Heat Loss (Btu/hr) + Safety Factor
81689.05
TOTAL Heat Loss (kW)
23.93

Conclusions

A 25 KW electric heater load will provide sufficent heating to maintain the space at 50 degrees during peak winter outdoor temperatures

SUBJECT: Klamath River Renewal Corporation
Fall Creek Hatchery
Incubation Building HVAC Design

BY: C. Gregory **CHK'D BY:** K. Desomber
DATE: 8/14/2020
PROJECT NO.: 20-024

Purpose

The purpose of this calculation sheet is to determine the required heating load for the Incubation building.
Cooling will be provided via mechanical ventilation via 6 air changes per hour

References

ASHRAE, 1997. ASHRAE Handbook - Fundamentals. 1791 Tullie Circle, N.E., Alanta GA 30329

Method

Heat loss and Gain through Conducton

$$q = UA\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
U= $Thermal\ Trasmitance, Btu/(h * ft^2 * °F)$
A = Area, ft^2
$\Delta t_d = Temperature\ difference, °F$

Air Infiltration Heat Loss and Gain

$$q_{infiltration} = V(ACH)C\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
$V = Volume$, ft^3
$\Delta t_d = Temperature\ difference, °F$
ACH = ft^3/hr
C=0.018, Btu/ft^3 °F (Constant)

Ventilation Air Heat Loss and Gain

$$q_{ventilation} = A_{rate} * \rho_{air} * c_p * \Delta t_d * (\frac{60min}{1hr})$$

Where:
$q = heat\ flow\ rate, Btu/h$
$A_{rate} = Air\ Flow\ Rate$, ft^3/min
$\Delta t_d = Temperature\ difference, °F$
$\rho_{air} = Density\ of\ Air\ at\ Sea\ level$, lb/ft^3
$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$

Where air is assumed to be at 'standard air' conditions the equation can be reduced to:

$$q_{ventilation} = A_{rate} * 1.08 * \Delta t_d)$$

Heat Loss and Gain through Evaporation

$$W_P = \frac{A}{\gamma}(P_W - P_a)(95\text{-}0.425V)$$

Where:
W_P = *Evaporation of Water lbs/hr*
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w= **Saturation vapor pressure taken at surface water temperature, in. Hg**
P_a= *Saturation* **pressure at room air dew point, in. Hg**
$V = air\ velocity\ over\ water\ surface, fpm$

Units for the constant 95 are Btu/(hr*ft^2*in.Hg). Units for the constant 0.425 are Btu*min/(hr*ft^3*in.Hg).
Equation (2) may be modified by evaportion rate based on the level of activity supported For γ values of about 1000 Btu/lb and values ranging from 10 to 30 fpm, Equation (2) can be reduced to:

$$W_P = 0.1A(P_W - P_a)F_A$$

Where:
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w = *Saturation vapor pressure taken at surface water temperature, in. Hg*
P_a = *Saturation pressure at room air dew point, in. Hg*
F_A = *Activity Factor*

$$q_l = W_P h_w$$

Where:
q_l = *Heat flow rate to water, Btu/hr*
W_P = *Evaporation of Water lbs/hr*
h_w = *Enthalpy of Surface Water Evaporization at* T_W *Degrees of Water, Btu/lb*

Assumptions

The following assumptions were made in the generating the heating loss calculations:
The intent of the HVAC design is to maintain an indoor space temperature of 50 degree Fahrenheit inside of the building envelope.
The air is at 'standard air' conditions

$\rho_{air} = Density\ of\ Air\ at\ Sea\ level$, lb/ft^3 = .075 lb/ft^3

$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$ = .241 $\frac{Btus}{lb*°F}$

Inputs

Incubation Building Ventilation Requirements

Occupancy Category Used for Calculation: Warehouse

Description	Area (sf)	Height (ft)	Density	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	1 CFM/SF	6 ACH	Design CFM
Incubation Building	3111	18	10.00	31.1	5	0.06	342	1	342	3,111	5,600	342

Total Building Heat Loss to Ventilation - Winter Design Loads

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

Heat Loss to Ventilation (Btu/hr)
12602.9

Total Building Skin Heat Loss - Winter Design Loads

Length (ft)	Width (ft)	Height (ft)
61	51	15

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

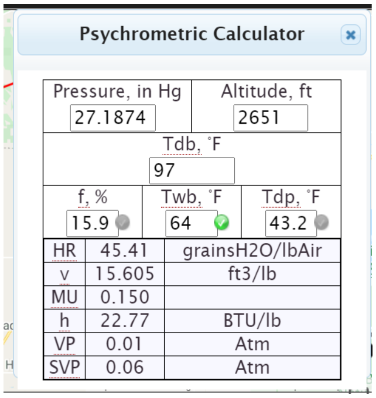
Wall Area (ft^2)	Roof Area (ft^2)	Floor Area (ft^2)
3584.00	3173.2	224

R-value Walls (ft2·°F·h) / BTU	R-value Roof (ft2·°F·h) / BTU	R-value Floor (ft2·°F·h) / BTU
17	25	0.730

Infiltration Rate (ACH) (Ft^3/Hr)
0.6

Heat Loss Walls (Btu/hr)	Heat Loss Roof (Btu/hr)	Heat Loss Floor (Btu/hr)	Heat Loss Infiltration (Btu/hr)
7189.1	4328.3	10463.6	17185.8

Total Building Heat Loss to Water Evaportion - Winter Design Loads



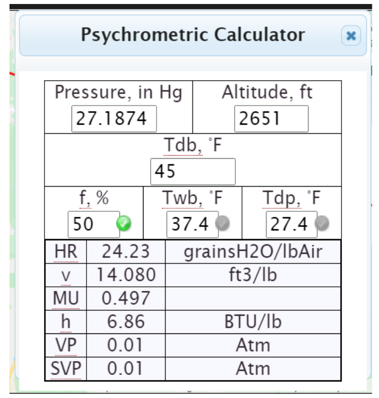
Psychrometric Calculator

Pressure, in Hg	Altitude, ft
27.1874	2651

Tdb, °F
97

f, %	Twb, °F	Tdp, °F
15.9	64	43.2

HR	45.41	grainsH2O/lbAir
v	15.605	ft3/lb
MU	0.150	
h	22.77	BTU/lb
VP	0.01	Atm
SVP	0.06	Atm



Psychrometric Calculator

Pressure, in Hg	Altitude, ft
27.1874	2651

Tdb, °F
45

f, %	Twb, °F	Tdp, °F
50	37.4	27.4

HR	24.23	grainsH2O/lbAir
v	14.080	ft3/lb
MU	0.497	
h	6.86	BTU/lb
VP	0.01	Atm
SVP	0.01	Atm

Summer Time Conditions - Incubation Building		
Area of Tanks	4495	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (55 Deg Water)	0.4359	in. Hg
Partial Vapor Pressure at Room Air Dew Point (43 Deg Air)	0.18	in Hg
Evaporation Rate	57.513525	lb/hr
Enthalpy of Surface Water Evaporization (55 degree Water)	1062.14	Btu/lb
Heat Loss to Water	61087.42	Btu/Hr
Heat Lost to Water	19.436	KW
Air Flow Rate	6000	cfm
Amount of Water in Return Air	0.000160	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	97	Deg F
Space WB Temp	64	Deg F

Winter Time Conditions - Incubation Building		
Area of Tanks	4495	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (43 Deg Water)	0.27831	in. Hg
Partial Vapor Pressure at Room Air Dew Point (27.4 Deg Air)	0.1502	in Hg
Evaporation Rate	28.7927225	lb/hr
Enthalpy of Surface Water Evaporization (43 Deg Water)	1068.92	Btu/lb
Heat Loss to Water	30777.12	Btu/Hr
Heat Lost to Water	9.792	KW
Air Flow Rate	1200	cfm
Amount of Water in Return Air	0.0003999	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	45	Deg F
Space WB Temp	37.4	Deg F

Results

The required heating load totals are listed below.

TOTAL Heat Loss (Btu/hr)
82547
TOTAL Heat Loss (kW)
24.19

Safety Factor
0.10

TOTAL Heat Loss (Btu/hr) + Safety Factor
90801.40
TOTAL Heat Loss (kW)
26.60

Conclusions

A total of 25 KW for all the electric heaters combined will provide sufficent heating to maintain the space at 50 degrees during peak winter outdoor temperatures

McMILLEN JACOBS ASSOCIATES

SUBJECT:	Klamath River Renewal Corporation	**BY:** C. Gregory	**CHK'D BY:** K. Desomber
	Fall Creek Hatchery	**DATE:** 8/14/2020	
	Spawning Building HVAC Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to determine the required heating load for the Spawning building.
Cooling will be provided via mechanical ventilation via 6 air changes per hour

References

ASHRAE, 1997. ASHRAE Handbook - Fundamentals. 1791 Tullie Circle, N.E., Alanta GA 30329

Method

Heat loss and Gain through Conducton

$$q = UA\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
U= $Thermal\ Trasmitance, Btu/(h * ft^2 * °F)$
A = *Area, ft^2*
$\Delta t_d = Temperature\ difference, °F$

Air Infiltration Heat Loss and Gain

$$q_{infiltration} = V(ACH)C\Delta t_d$$

Where:
$q = heat\ flow\ rate, Btu/h$
$V = Volume$, ft^3
$\Delta t_d = Temperature\ difference, °F$
ACH = ft^3/hr
C=0.018, Btu/ft^3 °F (Constant)

Ventilation Air Heat Loss and Gain

$$q_{ventilation} = A_{rate} * \rho_{air} * c_p * \Delta t_d * \left(\frac{60min}{1hr}\right)$$

Where:
$q = heat\ flow\ rate, Btu/h$
$A_{rate} = Air\ Flow\ Rate$, ft^3/min
$\Delta t_d = Temperature\ difference, °F$
$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3$
$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$

Where air is assumed to be at 'standard air' conditions the equation can be reduced to:

$$q_{ventilation} = A_{rate} * 1.08 * \Delta t_d)$$

Heat Loss and Gain through Evaporation

$$W_P = \frac{A}{\gamma}(P_W - P_a)(95\text{-}0.425V)$$

Where:
W_P = *Evaporation of Water lbs/hr*
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w= **Saturation vapor pressure taken at surface water temperature, in. Hg**
P_a= *Saturation* **pressure at room air dew point, in. Hg**
$V = air\ velocity\ over\ water\ surface, fpm$

Units for the constant 95 are Btu/(hr*ft^2*in.Hg). Units for the constant 0.425 are Btu*min/(hr*ft^3*in.Hg).
Equation (2) may be modified by evaportion rate based on the level of activity supported For γ values of about 1000 Btu/lb and values ranging from 10 to 30 fpm, Equation (2) can be reduced to:

$$W_P = 0.1A(P_W - P_a)F_A$$

Where:
A = *Area of Pool Surface, ft^2*
γ = latent heat required to change water to vapor at surface water temparture, Btu/lb
P_w = *Saturation vapor pressure taken at surface water temperature, in. Hg*
P_a = *Saturation pressure at room air dew point, in. Hg*
F_A = *Activity Factor*

$$q_l = W_P h_w$$

Where:
q_l = *Heat flow rate to water, Btu/hr*
W_P = *Evaporation of Water lbs/hr*
h_w = *Enthalpy of Surface Water Evaporization at* T_W *Degrees of Water, Btu/lb*

Assumptions

The following assumptions were made in the generating the heating loss calculations:
The intent of the HVAC design is to maintain an indoor space temperature of 50 degree Fahrenheit inside of the building envelope.
The air is at 'standard air' conditions

$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3$ = .075 lb/ft^3

$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$ = .241 $\frac{Btus}{lb*°F}$

Inputs

Spawning Building Ventilation Requirements

Occupancy Category Used for Calculation: Warehouse

Description	Area (sf)	Height (ft)	Density	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	1 CFM/SF	6 ACH	Design CFM
Spawning Building	897.6	18	10.00	9.0	5	0.06	99	1	99	898	1,616	99

Total Building Heat Loss to Ventilation - Winter Design Loads

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

Heat Loss to Ventilation (Btu/hr)
3636.2

Total Building Skin Heat Loss - Winter Design Loads

Length (ft)	Width (ft)	Height (ft)
34	26	15

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

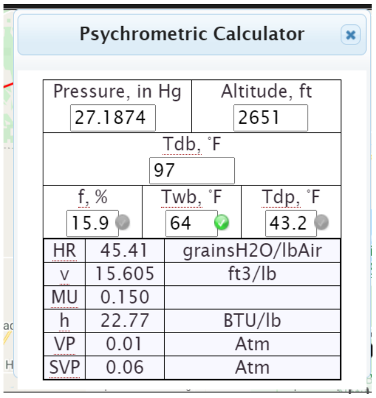
Wall Area (ft^2)	Roof Area (ft^2)	Floor Area (ft^2)
1932.80	915.6	120.8

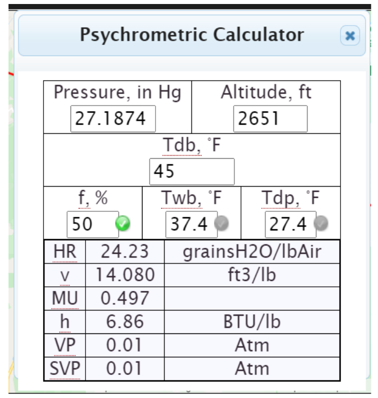
R-value Walls (ft2·°F·h) / BTU	R-value Roof (ft2·°F·h) / BTU	R-value Floor (ft2·°F·h) / BTU
17	25	0.730

Infiltration Rate (ACH) (Ft^3/Hr)
0.6

Heat Loss Walls (Btu/hr)	Heat Loss Roof (Btu/hr)	Heat Loss Floor (Btu/hr)	Heat Loss Infiltration (Btu/hr)
3877.0	1248.8	5642.8	4958.5

Total Building Heat Loss to Water Evaportion - Winter Design Loads





Summer Time Conditions - Spawning Building		
Area of Tanks	500	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (55 Deg Water)	0.4359	in. Hg
Partial Vapor Pressure at Room Air Dew Point (43 Deg Air)	0.18	in Hg
Evaporation Rate	6.3975	lb/hr
Enthalpy of Surface Water Evaporization (55 degree Water)	1062.14	Btu/lb
Heat Loss to Water	6795.04	Btu/Hr
Heat Lost to Water	2.162	KW
Air Flow Rate	6000	cfm
Amount of Water in Return Air	0.000018	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	97	Deg F
Space WB Temp	64	Deg F

Winter Time Conditions - Spawning Building		
Area of Tanks	500	sf
Activity Factor	0.5	
Saturation Vapor Pressure at Water Surface (43 Deg Water)	0.27831	in. Hg
Partial Vapor Pressure at Room Air Dew Point (27.4 Deg Air)	0.1502	in Hg
Evaporation Rate	3.20275	lb/hr
Enthalpy of Surface Water Evaporization (43 Deg Water)	1068.92	Btu/lb
Heat Loss to Water	3423.48	Btu/Hr
Heat Lost to Water	1.089	KW
Air Flow Rate	1200	cfm
Amount of Water in Return Air	4.4483E-05	lb/cf
Water Content of Saturated Air at (65 Deg)	0.00095	lb/cf
Space DB Temp	45	Deg F
Space WB Temp	37.4	Deg F

Results

The required heating load totals are listed below.

TOTAL Heat Loss (Btu/hr)
22787
TOTAL Heat Loss (kW)
6.68

Safety Factor
0.10

TOTAL Heat Loss (Btu/hr) + Safety Factor
25065.58
TOTAL Heat Loss (kW)
7.34

Conclusions

A 10 KW electric heater load will provide sufficent heating to maintain the space at 50 degrees during peak winter outdoor temperatures

SUBJECT:	Klamath River Renewal Corporation	**BY:** C. Gregory	**CHK'D BY:** K. Desomber
	Fall Creek Hatchery	**DATE:** 8/14/2020	
	Electrical Room HVAC Design	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to determine the required heating load for the Chinook building.
Cooling will be provided mechancial by a direct expansion cooling and heating unit.

References

ASHRAE, 1997. ASHRAE Handbook - Fundamentals. 1791 Tullie Circle, N.E., Alanta GA 30329

Method

Heat loss and Gain through Conducton

$$q = UA\Delta t_d$$

Where:

$q = heat\ flow\ rate, Btu/h$

U= $Thermal\ Trasmitance, Btu/(h * ft^2 * °F)$

A =Area, ft^2

$\Delta t_d = Temperature\ difference, °F$

Air Infiltration Heat Loss and Gain

$$q_{infiltration} = V(ACH)C\Delta t_d$$

Where:

$q = heat\ flow\ rate, Btu/h$

V = Volume, ft^3

$\Delta t_d = Temperature\ difference, °F$

ACH = ft^3/hr

C=0.018, Btu/ft^3 °F (Constant)

Ventilation Air Heat Loss and Gain

$$q_{ventilation} = A_{rate} * \rho_{air} * c_p * \Delta t_d * (\frac{60min}{1hr})$$

Where:

$q = heat\ flow\ rate, Btu/h$

$A_{rate} = Air\ Flow\ Rate$, *ft^3/min*

$\Delta t_d = Temperature\ difference, °F$

$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3$

$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F}$

Where air is assumed to be at 'standard air' conditions the equation can be reduced to:

$$q_{ventilation} = A_{rate} * 1.08 * \Delta t_d)$$

Heat Loss and Gain through Evaporation

$$W_P = \frac{A}{\gamma}(P_W - P_a)(95\text{-}0.425V)$$

Where:

W_P = *Evaporation of Water lbs/hr*

A = Area of Pool Surface, ft^2

γ = latent heat required to change water to vapor at surface water temparture, Btu/lb

P_w**= Saturation vapor pressure taken at surface water temperature, in. Hg**

P_a= *Saturation* **pressure at room air dew point, in. Hg**

$V = air\ velocity\ over\ water\ surface, fpm$

Units for the constant 95 are Btu/(hr*ft^2*in.Hg). Units for the constant 0.425 are Btu*min/(hr*ft^3*in.Hg).
Equation (2) may be modified by evaportion rate based on the level of activity supported For γ values of about 1000 Btu/lb and values ranging from 10 to 30 fpm, Equation (2) can be reduced to:

$$W_P = 0.1A(P_W - P_a)F_A$$

Where:

A = Area of Pool Surface, ft^2

γ = latent heat required to change water to vapor at surface water temparture, Btu/lb

P_w = *Saturation vapor pressure taken at surface water temperature, in. Hg*

P_a = *Saturation pressure at room air dew point, in. Hg*

F_A = *Activity Factor*

$$q_l = W_P h_w$$

Where:

q_l = *Heat flow rate to water, Btu/hr*

W_P = *Evaporation of Water lbs/hr*

h_w = *Enthalpy of Surface Water Evaporization at* T_W *Degrees of Water, Btu/lb*

Assumptions

The following assumptions were made in the generating the heating loss calculations:
The intent of the HVAC design is to maintain an indoor space temperature of 40+ degree Fahrenheit inside of the building envelope.
The air is at 'standard air' conditions

$\rho_{air} = Density\ of\ Air\ at\ Sea\ level, lb/ft^3 = .075\ lb/ft^3$

$c_p = Specific\ Heat\ of\ Air, \frac{Btus}{lb*°F} = .241 \frac{Btus}{lb*°F}$

Inputs

Electrical Room Ventilation Requirements

Occupancy Category Used for Calculation: Electrical Room **Space is considered unoccupied - no ventilation required**

Description	Area (sf)	Height (ft)	Density	P_z	R_p	R_a	V_{bz}	E_z	V_{oz}	1 CFM/SF	6 ACH	Design CFM
Electrical room	120	18	10.00	1.2	5	0.06	13	1	13	120	216	13

Total Building Heat Loss to Ventilation - Winter Design Loads

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

Heat Loss to Ventilation (Btu/hr)
486.1

Total Building Skin Heat Loss - Winter Design Loads

Length (ft)	Width (ft)	Height (ft)
10	12	15

Outdoor Temp (F)	Indoor Temp (F)	Avg Outdoor Temp Range (F)
15.9	50.0	35.3

Wall Area (ft^2)	Roof Area (ft^2)	Floor Area (ft^2)
704.00	122.4	44

R-value Walls (ft2·°F·h) / BTU	R-value Roof (ft2·°F·h) / BTU	R-value Floor (ft2·°F·h) / BTU
17	25	0.730

Infiltration Rate (ACH) (Ft^3/Hr)
0.6

Heat Loss Walls (Btu/hr)	Heat Loss Roof (Btu/hr)	Heat Loss Floor (Btu/hr)	Heat Loss Infiltration (Btu/hr)
1412.1	167.0	2055.3	662.9

The required heating load totals are listed below.

TOTAL Heat Loss (Btu/hr)
4297
TOTAL Heat Loss (kW)
1.26

Safety Factor
0.10

TOTAL Heat Loss (Btu/hr) + Safety Factor
4727.08
TOTAL Heat Loss (kW)
1.39

Total Building Skin Heat Gain - Summer Design Loads

Length (ft)	Width (ft)	Height (ft)
10	12	12

Indoor Temp (F)	Outdoor Temp (F)	Avg Outdoor Temp Range (F)
75.0	97.0	35.3

Wall Area (ft^2)	Roof Area (ft^2)	Floor Area (ft^2)
528.00	122.4	44

R-value Walls (ft2·°F·h) / BTU	R-value Roof (ft2·°F·h) / BTU	R-value Floor (ft2·°F·h) / BTU
17	25	0.730

Infiltration Rate (ACH) (Ft^3/Hr)
0.6

Heat Gain Walls (Btu/hr)	Heat Gain Roof (Btu/hr)	Heat Gain Floor (Btu/hr)	Heat Gain Infiltration (Btu/hr)
683.3	107.7	1326.0	342.1

Electrical Equiment Heat Gain - Summer Design Loads

Item	Raw Load (kW)	Qty	Total Raw Load (kW)	Heat Gain %	Total Heat Gain (Btu/hr)
Misc. Electrical load	2.500	1	2.50	100%	8533
	0.000	0	0.00	100%	0
	0.000	0	0.000	100%	0
			2.50		**8533**

Results

The required cooling load totals are listed below.

TOTAL Heat Gain (Btu/hr)
10992
TOTAL Heat Gain (kW)
3.22

Safety Factor
0.10

TOTAL Heat Gain (Btu/hr) + Safety Factor
12090.85
TOTAL Heat Gain (kW)
3.54

TOTAL Heat Gain (Tons of Cooling)
1.0

The required heating load totals are listed below.

TOTAL Heat Loss (Btu/hr)
-4235
TOTAL Heat Loss (kW)
-1.24

Saftey Factor
0.10

TOTAL Heat Loss (Btu/hr) + Saftey Factor
-4658.67
TOTAL Heat Loss (kW)
-1.36

Conclusions

Winter Time Design Results - Due to the high heating load already present in the electrical room there will not be a need to provide heating to the space to maintain the space at 50 degrees during peak winter outdoor temperatures

Summer Time Design Results - The total cooling load required for the space will be 12,090 Btus/h or approximitly 1 ton of cooling

Appendix E
Electrical Design Calculations

Calculation Cover Sheet

Project: Fall Creek Fish Hatchery

Client: Klamath River Renewal Corporation (KRRC) **Proj. No.:** 20-024

Title: Electrical Calculations

Prepared By, Name: Mitchell Skelton

Prepared By, Signature: **Date:** 10/28/2020

Peer Reviewed By, Name: John Bakken, P.E.

Peer Reviewed, Signature: **Date:** 10/28/2020

SUBJECT:	Klamath River Renewal Corporation (KRRC)	**BY:** M. Skelton	**CHK'D BY:** J. Bakken
	Fall Creek Fish Hatchery	**DATE:** 10/28/2020	
	Electrical Calculations - Table of Content	**PROJECT NO.:** 20-024	

Table of Content

Electrical	**Page**
Lighting Level Calculations	3
• *Determine the optimal lighting level and quantity of fixtures for each room/area*	
Genset Sizing Calculations	7
• *Determine the preliminary required size for a propane standby generator using vendor software*	

SUBJECT:	Klamath River Renewal Corporation (KRRC)	**BY:** M. Skelton	**CHK'D BY:** J. Bakken
	Fall Creek Fish Hatchery	**DATE:** 10/28/2020	
	Lighting Level Calcs	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to analyze the required fixture and lumen count to achieve a desired light level for a given room or area.

Information - Input

Room/Area: Coho Building

Design footcandle (ave. maintained), F: 20 fc

Luminaire H1 manuf.: LITHONIA
Luminaire H1 Cat. No.: JCBL 18000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

Luminaire H2 manuf.: LITHONIA
Luminaire H2 Cat. No.: JCBL 24000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

	Fixture H1:		Fixture H2:	
Lamp type:	LED		LED	
Total lumens for fixture, Lf:	17018	lumens	22090	lumens

Room Shape:		Rectangular		
Room/Area dimensions:	Length, L =	65	ft.	
	Width, W =	50	ft.	
	Fixture mounting height (highest), H =	14	ft.	
	Work plane, P =	2.5	ft.	
	Area, A =	3250	sq. ft.	
	Perimeter, P =	230	ft.	
	Cavity Depth, D =	11.5	ft.	*D=(H-P)*

Fixture maintenance factor, M: 0.93

Reflectances:	Ceiling:	80	%
	Walls:	50	%
	Floors:	20	%

Calculation

Room cavity ratio calculation:

RCR= 2.03

*RCR (Rectangular Rooms) = (5*D*(L+W))/A*
*RCR (Irregular Rooms) = (2.5*D*P)/A*

Coefficient of Utilization from table:

CU= 0.39

Required total lumens for room: 65000 lumens — *Lr = (F*A)*

	Fixture A:		Fixture B:		
Minimum no. of fixtures required to achieve desired footcandles:	10.5	fixtures	8.1	fixtures	*N = (Lr)/(Lf*M*CU)*

Conclusions

Choice #1 -					
Alternate no. of fixtures used, n1:	12	fixtures	9	fixtures	
Footcandles produced, f1:	22.8	fc	22.2	fc	*f1=(F*n1)/N*
Choice #2 -					
Alternate no. of fixtures used, n2:	16	fixtures	12	fixtures	
Footcandles produced, f2:	30.4	fc	29.6	fc	*f2=(F*n2)/N*

Choices #1 and #2 provide reasonable illumination to the area for night-time working conditions.
Select Choice #1 for a cost-effective illumination capacity and dimmability range.

SUBJECT:	Klamath River Renewal Corporation (KRRC)	**BY:** M. Skelton	**CHK'D BY:** J. Bakken
	Fall Creek Fish Hatchery	**DATE:** 10/28/2020	
	Lighting Level Calcs	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to analyze the required fixture and lumen count to achieve a desired light level for a given room or area.

Information - Input

Room/Area: Chinook Incubation Building

Design footcandle (ave. maintained), F: 20 fc

Luminaire H1 manuf.: LITHONIA
Luminaire H1 Cat. No.: JCBL 18000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

Luminaire H2 manuf.: LITHONIA
Luminaire H2 Cat. No.: JCBL 24000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

	Fixture H1:		Fixture H2:	
Lamp type:	LED		LED	
Total lumens for fixture, Lf:	17018	lumens	22090	lumens

Room Shape:		Rectangular		
Room/Area dimensions:	Length, L =	60	ft.	
	Width, W =	50	ft.	
	Fixture mounting height (highest), H =	12	ft.	
	Work plane, P =	2.5	ft.	
	Area, A =	3000	sq. ft.	
	Perimeter, P =	220	ft.	
	Cavity Depth, D =	9.5	ft.	*D=(H-P)*

Fixture maintenance factor, M: 0.93

Reflectances:	Ceiling:	80	%
	Walls:	50	%
	Floors:	20	%

Calculation

Room cavity ratio calculation: *RCR (Rectangular Rooms) = (5*D*(L+W))/A*

RCR= 1.74 *RCR (Irregular Rooms) = (2.5*D*P)/A*

Coefficient of Utilization from table:

CU= 0.4

Required total lumens for room: 60000 lumens *Lr = (F*A)*

	Fixture A:		Fixture B:		
Minimum no. of fixtures required to achieve desired footcandles:	9.5	fixtures	7.3	fixtures	*N = (Lr)/(Lf*M*CU)*

Conclusions

Choice #1 -					
Alternate no. of fixtures used, n1:	10	fixtures	8	fixtures	
Footcandles produced, f1:	21.1	fc	21.9	fc	*f1=(F*n1)/N*
Choice #2 -					
Alternate no. of fixtures used, n2:	12	fixtures	9	fixtures	
Footcandles produced, f2:	25.3	fc	24.7	fc	*f2=(F*n2)/N*

Choices #1 and #2 provide reasonable illumination to the area for night-time working conditions.
Select Choice #2 for a cost-effective illumination capacity and dimmability range, and practical layout.

SUBJECT: Klamath River Renewal Corporation (KRRC) | **BY:** M. Skelton | **CHK'D BY:** J. Bakken
Fall Creek Fish Hatchery | **DATE:** 10/28/2020
Lighting Level Calcs | **PROJECT NO.:** 20-024

Purpose

The purpose of this calculation sheet is to analyze the required fixture and lumen count to achieve a desired light level for a given room or area.

Information - Input

Room/Area: Chinook Incubation Building - Electrical Room

Design footcandle (ave. maintained), F: 20 fc

Luminaire manuf.: LITHONIA
Luminaire Cat. No.: MSL 8000LM L/LV 120 GZ10 40K 80CRI E10WLCP WH

Lamp type: LED
Total lumens for fixture, Lf: 8733 lumens

Room Shape: Rectangular

Room/Area dimensions:	Length, L =	12	ft.	
	Width, W =	9	ft.	
	Fixture mounting height (highest), H =	12	ft.	
	Work plane, P =	2.5	ft.	
	Area, A =	108	sq. ft.	
	Perimeter, P =	42	ft.	
	Cavity Depth, D =	9.5	ft.	*D=(H-P)*

Fixture maintenance factor, M: 0.91

Reflectances:	Ceiling:	80	%
	Walls:	50	%
	Floors:	20	%

Calculation

Room cavity ratio calculation:
RCR= 9.24
*RCR (Rectangular Rooms) = (5*D*(L+W))/A*
*RCR (Irregular Rooms) = (2.5*D*P)/A*

Coefficient of Utilization from table:
CU= 0.185

Required total lumens for room: 2160 lumens *Lr=(F*A)*

Minimum no. of fixtures required to achieve desired footcandles: 1.5 fixtures *N=(Lr)/(Lf*M*CU)*

Conclusions

Choice #1 -
Alternate no. of fixtures used, n1: 2 fixtures
Footcandles produced, f1: 27.2 fc *f1=(F*n1)/N*

Choice #2 -
Alternate no. of fixtures used, n2: 3 fixtures
Footcandles produced, f2: 40.8 fc *f2=(F*n2)/N*

Choice #1 provides reasonable illumination to the area for general working conditions. Choice #2 provides exceptional illumination to the area.
Select Choice #1 for a cost-effective illumination capacity.

SUBJECT:	Klamath River Renewal Corporation (KRRC)	**BY:** M. Skelton	**CHK'D BY:** J. Bakken
	Fall Creek Fish Hatchery	**DATE:** 10/28/2020	
	Lighting Level Calcs	**PROJECT NO.:** 20-024	

Purpose

The purpose of this calculation sheet is to analyze the required fixture and lumen count to achieve a desired light level for a given room or area.

Information - Input

Room/Area: Spawning Building

Design footcandle (ave. maintained), F: 20 fc

Luminaire H1 manuf.: LITHONIA
Luminaire H1 Cat. No.: JCBL 18000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

Luminaire H2 manuf.: LITHONIA
Luminaire H2 Cat. No.: JCBL 24000LM ACCR ACRFGL MVOLT GZ10 40K 80CRI E10WCP DWHXD

	Fixture H1:		Fixture H2:	
Lamp type:	LED		LED	
Total lumens for fixture, Lf:	17018	lumens	22090	lumens

Room Shape:		Rectangular		
Room/Area dimensions:	Length, L =	35	ft.	
	Width, W =	25	ft.	
	Fixture mounting height (highest), H =	14	ft.	
	Work plane, P =	2.5	ft.	
	Area, A =	875	sq. ft.	
	Perimeter, P =	120	ft.	
	Cavity Depth, D =	11.5	ft.	*D=(H-P)*

Fixture maintenance factor, M: 0.93

Reflectances:	Ceiling:	80	%
	Walls:	50	%
	Floors:	20	%

Calculation

Room cavity ratio calculation:

RCR= 3.94

*RCR (Rectangular Rooms) = (5*D*(L+W))/A*
*RCR (Irregular Rooms) = (2.5*D*P)/A*

Coefficient of Utilization from table:

CU= 0.3

Required total lumens for room: 17500 lumens — *Lr = (F*A)*

	Fixture A:		Fixture B:		
Minimum no. of fixtures required to achieve desired footcandles:	3.7	fixtures	2.8	fixtures	*N = (Lr)/(Lf*M*CU)*

Conclusions

Choice #1 -					
Alternate no. of fixtures used, n1:	4	fixtures	3	fixtures	
Footcandles produced, f1:	21.7	fc	21.1	fc	*f1=(F*n1)/N*
Choice #2 -					
Alternate no. of fixtures used, n2:	6	fixtures	4	fixtures	
Footcandles produced, f2:	32.6	fc	28.2	fc	*f2=(F*n2)/N*

Choice #1 provides reasonable illumination to the area for night-time working conditions. Choice #2 provides exceptional illumination to the area.

Project information

Project name: Fall Creek Fish Hatchery – Worst-Case (Summer)

This report is provided to prove the capability of an existing 100REZGD propane generator with 4R12X alternator to carry the load of the new facility. Based on these results, McMillen Jacobs asserts that no new generator is needed for this facility.

Site requirements

Voltage:	277/480
Phase:	3
Frequency:	60Hz
Alt. Temp. Rise Duty:	130°C Standby
Qty of Gensets:	1
Fuel type:	LP Vapor
Country :	United States

Application:	Construction
Emissions Requirement:	Stationary emergency (US EPA)
Altitude:	2589 Feet
Max. Ambient Temp.:	100 Degrees F
Min. Genset Loading :	10 %
Max. Genset Loading :	100 %

Site load requirements summary

Running kW:	21.95
Running kVA:	28.15
Running P.F.:	0.78

Max. Starting kW:	67.62 in step 1
Max. Starting kVA:	96.70 in step 1

Generator selection

Genset Model:	KG100
Engine:	KG6208TAHD
Emission level:	EPA Certified
BHP:	175.00
Displacement:	377.00
RPM:	1800

Alternator:	4R12X
Alternator Leads:	12
Alt. Starting kVA **at 35% V dip**:	448.00
Cal Alt Temp rise with site loads:	80C
Excitation System :	PMG

Rated kW :	100.00
Site Alt / Temp De-Rated **kW** :	91.94
Seismic Certified	
UL 2200 Certified	

Generator Performance Summary

Voltage Dip Limit:	20.00 %
Frequency Dip Limit:	15.00 %
Harmonic Distortion Limit:	10.00 %

Calculated Voltage Dip:	15.60 %
Calculated Frequency Dip:	14.97 %
Calculated Harmonic Distortion:	0.56 %
Calculated Genset % Loaded:	23.87 %

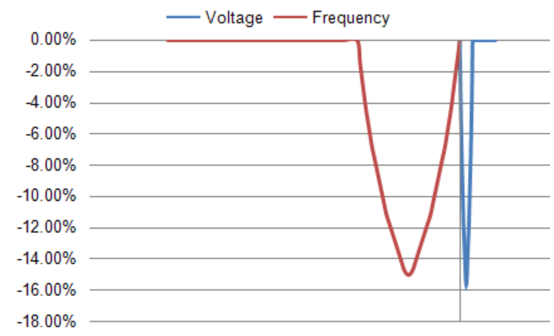
Report prepared by: Mitch Skelton

Software version: 1.0037.5.165 October 28, 2020

Model : KG100, Alternator : 4R12X

Load Profile

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **Traveling Screens** 1.00 HP 3 Phase Motor code : L Loaded NEMA Design across the line	2	1.99	2.84	0.70	12.92	19.00	0.68			
Motor **Screen Spray Pumps** 2.00 HP 3 Phase Motor code : K Loaded NEMA Design across the line	2	3.83	5.39	0.71	20.74	34.00	0.61			
Lighting **Lighting** Evenly distributed LED Filtered Ballast	1	3.84	4.27	0.90	3.84	4.27	0.90			
Misc. Linear Load **Convenience Receptacles** 3 Phase	1	6.91	8.64	0.80	8.64	8.64	1.00			
Misc. Linear Load **SCADA and Control Loads** 3 Phase	1	0.60	0.60	1.00	0.60	0.60	1.00			



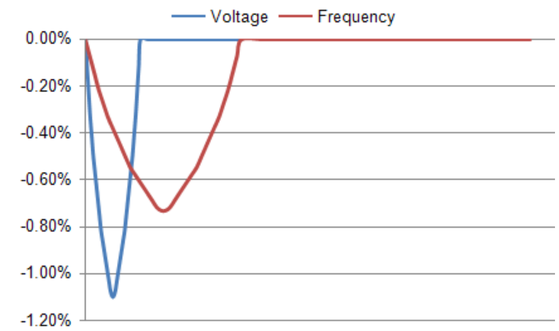
Report prepared by: Mitch Skelton

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **Duct Fan Dampers** **0.07 HP** **Phase C-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	3	0.24	0.30	0.80	1.08	1.80	0.60			
Motor **Exhaust Fan Dampers** **0.07 HP** **Phase A-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	5	0.40	0.50	0.80	1.80	3.00	0.60			
Motor **Coho Exhaust Fans** **0.57 HP** **Phase B-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	2	1.22	1.74	0.70	6.46	10.77	0.60			
Motor **Coho Duct Fan** **0.19 HP** **Phase C-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.21	0.30	0.70	1.08	1.81	0.60			

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **Chinook Exhaust Fans** **0.21 HP** **Phase A-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	2	0.47	0.67	0.70	2.39	3.99	0.60			
Motor **Chinook Duct Fan** **0.15 HP** **Phase B-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.17	0.25	0.70	0.86	1.43	0.60			
Motor **Spawning Bldg Exhaust Fan** **0.24 HP** **Phase C-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.27	0.39	0.70	1.37	2.28	0.60			
Motor **Spawning Bldg Duct Fan** **0.04 HP** **Phase A-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.03	0.05	0.70	0.23	0.38	0.60			

Step # 1	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **Split Unit - Cooling** **0.97 HP** **Phase A-C** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.96	1.37	0.70	5.60	8.24	0.68			
Step Total		21.15	26.98	0.78	67.62	96.70	0.70	15.60	14.97	0.56
Cum.Total		21.15	26.98	0.78						

Step # 2	Qty	Run			Start			Volt Dip %	Freq Dip %	Volt. Dist. %
		kW	kVA	PF	kW	kVA	PF			
Motor **Meter Vault Sump Pump** **0.77 HP** **Phase A-N** **Motor code : L** **Loaded** **NEMA Design** **across the line**	1	0.80	1.18	0.68	4.90	7.20	0.68			
Step Total		0.80	1.18	0.68	4.90	7.20	0.68	1.10	0.73	0.56
Cum.Total		21.95	28.15	0.78						
Grand Total		21.95	28.15	0.78				15.60	14.97	0.56



Appendix F
Biological Design Criteria Technical Memo

Technical Memorandum 001

To:	Klamath River Renewal Corporation California Department of Fish and Wildlife	Project:	Fall Creek Fish Hatchery
From:	Jodi Burns, Project Manager Derek Nelson Jeff Heindel	cc:	Mort McMillen, P.E. – McMillen Jacobs File
Date:	March 11, 2020	Job No.:	20-024
Subject:	Technical Memo 001 – Fall Creek Fish Hatchery Biological Design Criteria, Rev 02		

Revision Log

Revision No.	Date	Revision Description
0	02/27/2020	Initial Draft
1	03/02/2020	KRRC Comments Addressed
2	03/11/2020	CDFW Comments Addressed; Final

1.0 Introduction

Technical Memorandum (TM) No. 001 summarizes the biological design criteria that will be used as the basis for the development of the California Department of Fish and Wildlife's (CDFW) Fall Creek Fish Hatchery (FCFH) project (Project). The criteria presented within this TM provide key water supply and fish culture facility programming information that will serve as the foundation for the Alternatives Analysis to evaluate potential modifications to the existing fish hatchery facility, as well as the selected alternative design development.

The following acronyms and abbreviations are used within this TM:

CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CTU	Celsius temperature unit
CWT	coded-wire tag
DI	density index
D.O.	dissolved oxygen
FCFH	Fall Creek Fish Hatchery
FI	flow index
fpp	fish per pound
ft^3	cubic feet
gpm	gallons per minute
HRT	hydraulic retention time

IGFH	Iron Gate Fish Hatchery
lb/cf/in	pounds of fish per cubic foot of rearing volume per inch of fish length
lbs/ft^3	pounds of fish per cubic foot of rearing space
mm	millimeter
NPDES	National Pollutant Discharge Elimination System
Project	Fall Creek Fish Hatchery Project
R	water turnovers per hour
TM	Technical Memorandum

2.0 Background

The Klamath River Restoration Project includes removal of four (4) dams along the Klamath River and a new hatchery to provide salmon mitigation production for a period of eight (8) years. The original 50 percent design package was developed by CDM Smith as a subconsultant to AECOM. The 50 percent design included proposed modifications to FCFH with the capability of rearing the current Coho Salmon *Oncorhynchus kisutch* yearling target (~ 75,000 yearlings at ~ 10 fish per pound [fpp]; ~ May release [age-1+]), ~ 115,000 Chinook Salmon *O. tshawytscha* yearlings (~ 10 fpp; November release [age-1+]), and approximately 2,885,000 Chinook sub-yearlings (~ 90 fpp; May release [age-0+]) using mixed-size, dual-drain circular tanks. The design included incubation and spawn-building structures, a concrete pad for ball-and-hitch camper (single-resident temporary housing), and a clarifier to handle increased effluent demands. Limited impacts to the existing facility "footprint" were considered throughout the design process. The design included facilities and land-disturbing activities on both the east and west sides of Fall Creek.

During the technical review of the 50 percent design package (CDM Smith, 2019), several areas of the proposed FCFH design were identified that could benefit from a refined analysis and design approach. The analysis started with the basic input parameters of the hatchery bioprogram with the goal of achieving an optimum rearing configuration considering fish numbers, rearing flow, and rearing densities. The refined bioprogram is presented within this TM. Once the proposed program has been reviewed and approved by CDFW, the FCFH layout will be updated to reflect the final rearing unit numbers, type, water supply piping, and effluent treatment.

3.0 Proposed Facility Upgrades

Site layout and land-disturbing activities/areas were generally addressed in the 50 percent drawing package. Moving forward with continued facility design alternatives, CDFW acknowledged that both ongoing and future permitting discussions dictate that future changes to the design/layout will not deviate from the impact areas provided in the previous design. The previous design suggested major facility upgrades on both the east and west sides of Fall Creek with recommendations to remove all existing infrastructure (e.g., old fish production raceways); initial site investigations conducted by McMillen Jacobs staff on January 28, 2020 suggest that future design is likely possible exclusively on the east side of Fall Creek (minimal to no infrastructure upgrades on west side) and that existing raceways (2 north of Copco Road, 4 south of Copco Road) could be retained (renovated) to minimize the need for "new" aquaculture rearing space.

Initial bio-programming efforts will determine an “optimum” number of fish to be reared over a calendar year based on CDFW guidelines. The total number of fish that can be reared to a certain size (biomass) are directly linked to the key variables of total water flow available (gallons per minute [gpm] and cubic feet per second [cfs]) and total rearing space available (cubic feet of rearing space). Bio-programming analysis presented within this TM will result in determination of a total flow and rearing space requirements to arrive at optimized aquaculture tank/rearing vessels and sizes to meet CDFW aquaculture operational requirements. These preliminary values will be refined as the design is advanced.

The water rights and maximum available flow for the Project are set at 10 cfs. This water right is non-consumptive and water must be returned to Fall Creek with the facility design addressing National Pollutant Discharge Elimination System (NPDES) water quality permit considerations. Facility water treatment designs will be determined after critical aquaculture variables are addressed. Future water treatment design efforts will prioritize the development of systems that maximize water quality/discharge to receiving water bodies (Fall Creek) while minimizing the technological and operational costs of these systems.

4.0 Production Goals

Discussions with CDFW Fish Production staff on January 27, 2020 resulted in a “priority” list of fish species, life stages, and numbers to aid in future design efforts:

- 75,000 Coho yearlings at approximately 10 fpp at release (top priority)
- Adult holding capacity for 100 Coho Salmon adults and 200 Chinook Salmon adults (ideally spawned at Fall Creek facility once production releases return adults to Fall Creek)
- Up to 3M Chinook sub-yearlings at approximately 90 fpp at release (at minimum, 1.5M coded-wire tag [CWT] groups would be ideal for monitoring and evaluation)
- Approximately 115,000 Chinook yearlings at approximately 10 fpp at release (lowest priority)

Table 4-1 provides a high-level overview of fish production goals for the proposed FCFH Program (data compiled from CDFW information):

Table 4-1. Fall Creek Hatchery – Fish Production Goals

Species (Juvenile Life History)	Adult Return*	Incubation Start Date	Incubation Start Number	Target Release Dates	Release Number	Release Size
Coho (Yearling)	Oct. – Dec.	Oct. – Mar.	120,000	Mar. 15 – May 1	75,000	10 fpp
Chinook (Sub-Yearling)	Oct. – Dec.	Oct. – Mar.	4.5M**	Pre-Mar. 31	1,250,000	520 fpp
Chinook (Sub-Yearling)	Oct. – Dec.	Oct. – Mar.	-	May 1 – June 15	1,750,000	90-100 fpp
Chinook (Yearling)	Oct. – Dec.	Oct. – Mar.	-	Oct. 15 – Nov. 20	250,000	10 fpp

*Adult trapping period from Iron Gate Fish Hatchery data

** Estimated Total Green Egg Requirement at Spawning

5.0 Biological Variables

The primary biological variables generally used to develop a preliminary fish hatchery operations schedule include water temperature, species-specific condition factors, growth rates, feed conversion rates, as well as density and flow indices. Understanding that CDFW has prior culture history with the target aquaculture species (Coho, Chinook) and rearing cycles (growth and feed rates relative to period of culture) for the program, the initial bio-programming analysis will identify high-level fish condition factor and growth rate assumptions, provide summary water temperature profile data for the facility, and present recommendations on industry-standard (State/Federal/Tribal conservation programs for Pacific salmon) density and flow indices. These variables will serve as general guidelines for assuring rearing units and water conveyance systems are sized appropriately.

5.1 Fish Condition Factor and Growth Rate

Fish condition factors provide fish culturists with a hypothetical "ideal" condition value of various fish species (body types) that is tied directly to mean fish weight and length. For the purpose of modeling growth and size (total length and/or total weight), a Coho Salmon condition factor of C3500 and a Chinook Salmon condition factor of C3000 are assumed. Coho of a given size (either length or weight) will generally have a higher condition factor than Chinook; for example, Coho juveniles compared to similarly-sized (fish per pound or grams per fish) Chinook juveniles will generally be *shorter* (total length) and *heavier* (mean weight) and have a resulting *higher* condition factor.

Fish growth rate was initially modeled at 0.035 millimeters (mm) per Celsius temperature unit (CTU) per day (0.035 mm/CTU/day) in the original hatchery bio-program documents. Actual growth rates for similar species of fish in similar rearing conditions (water temperature profiles) suggest that this rate is lower than actual rates of growth using conventional fish food diets. CDFW provided actual growth rate data from previous rearing events at FCFH (calendar year 2003 rearing history) that demonstrated that actual growth rates are closer to 0.05 mm/CTU/day for Chinook Salmon. CDFW identified that actual growth rates are controlled by hatchery feeding guidelines and fish may be restricted (growth slowed) during colder periods of rearing (lower metabolic requirements) to target specific release sizes. Fish growth modeling efforts assume a growth rate of 0.045 and 0.05 mm/CTU/day for Coho and Chinook rearing, respectively.

5.2 Water Temperature

Water temperature is a primary determining factor in the development and growth rate of fish. The Fall Creek Fish Hatchery water supply includes a 10 cfs year-round water right from Fall Creek. The Fall Creek water source has a demonstrated history of water temperature ranges (and assumed water *quality* based on prior positive rearing history) that generally favor the growth and development of anadromous salmonids. Figure 5-1 provides mean monthly rearing temperature data (degrees Fahrenheit) for the water source currently supplying the abandoned Fall Creek facility. Additional water chemistry testing is to be completed on source water, with the results described in future TMs.

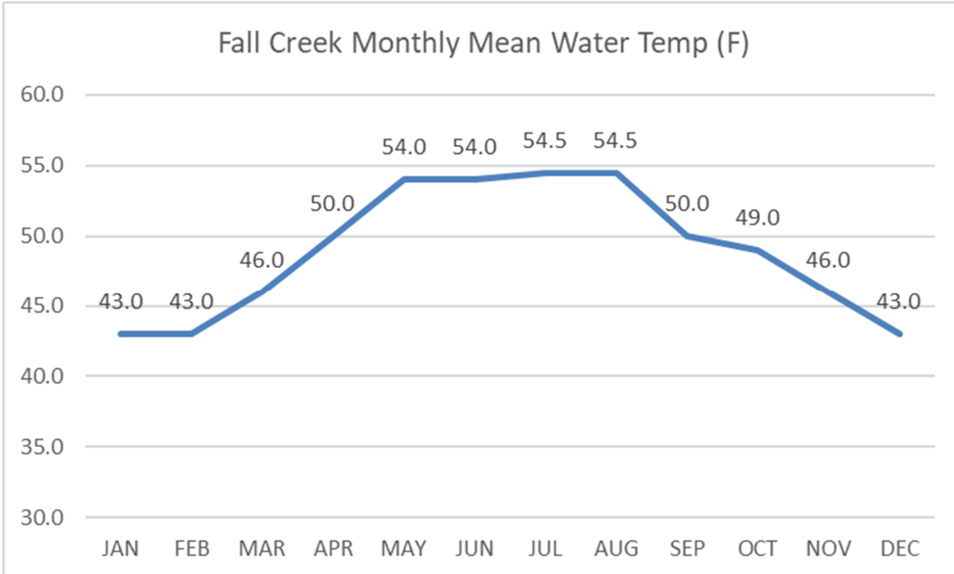


Figure 5-1. Mean Monthly Fall Creek Rearing Temperatures (Data from L. Radford, CDFW)

The proposed facility upgrades will use the existing Fall Creek source as the sole source for water supply to the facility (no groundwater well development planned). The water source, water rights, and general flow rates at the facility will remain unchanged for the proposed project design.

5.3 Density Index

Density index (DI) is a common method for estimating maximum carrying capacity in a rearing vessel. DI is a function of pounds of fish per cubic foot of rearing volume, per inch of fish length (lb/cf/in). The DI used for Pacific salmon species in a raceway (flow-through) environment is typically in the 0.2 to 0.3 range (Heindel, 2020), but can be highly variable depending on species, rearing goals, fish performance, and water quality. Additional information specific to DI is provided in the example below (adapted from Piper et al., 1982) and in Table 5-1:

"A common method for estimating maximum carrying capacity in a tank/raceway is the Density Index (DI). D.I. is a factor which, when multiplied by container volume in CUBIC FEET (V) and by fish length in inches (L) will give the maximum allowable weight of fish (W). A general rule of thumb for salmonids (Pacific salmon in this case) is DI should be from 0.2 to 0.5 (pounds of fish per cubic foot of tank space); fish densities should be no greater than 0.2 to 0.5 times their length in inches (for Pacific salmon)".

Table 5-1. Key DI Calculations

Design Question	Calculation
What is permissible weight of fish?	$W = D * V * L$
What is Density Index (D.I.)?	$D = \frac{W}{(L * V)}$

Design Question	Calculation
What Volume is Required at Certain D.I.?	$V = \frac{W}{(D * L)}$

Where: W = Weight in lbs. (biomass); D = Density Index; V = Volume of Unit in ft^3; L = Fish Length in Inches

"Example: If DI of 0.2 is used, 2-inch fish could be held at a density of 0.4 pounds per cubic foot (0.2 x 2 = 0.4) / If DI of 0.5 is used, 2-inch fish could be held at a density of 1 pounds per cubic foot (0.5 x 2 = 1). Note: DI is useful in estimating carrying capacity but only considers SPACE, not flow!"

CDFW staff generally employ aquaculture rearing guidelines that focus on pounds of fish per cubic foot of rearing space (lbs/ft3) and the rate of water exchange through a given sized vessel. The water exchange is identified as water turnovers per hour (R) and/or hydraulic retention time (HRT) in water exchanges every "X" minutes. Acknowledging that historic survival from green egg through release at Iron Gate Hatchery is extremely variable based on previous survival data provided by CDFW (sub-yearling and/or yearling Chinook and Coho), FCFH rearing volume estimates provided below will assume a maximum DI of 0.3.

It is important to note that conservative rearing values should always be utilized in designing new hatchery facilities. While higher DIs are possible in some circumstances and with some species/stocks of fish, the values used in the current design are considered a prudent starting point providing the greatest number of fish with the highest level of fitness and smolt quality. Production of high-quality juveniles should translate into higher downstream survival of anadromous emigrants with a corresponding increase in adults returning from original hatchery production efforts.

The DI is used to calculate the total volume of rearing space required in terms of cubic feet. Table 5-2 reflects the rearing volume required for the Coho yearling program proposed at the FCFH using density indices of 0.3 and a mean fish size of 10 fpp at release based on current production goals. The total volume can then be divided by the volume of individual rearing units in order to show the total number of rearing units required per scenario. The number of rearing units will vary with fish species, fish size, and management requirements.

Table 5-2. FCFH Coho Bio-Program – DI and Rearing Unit Calculations

75,000 Coho @10 fpp, 6.57" mean, 45.1 g/f mean (C3500 Piper)						
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**
75,000	10	6.570	45.4	7,500	0.3	3,805

The bio-program assumes that CDFW staff will manipulate feed rates (and resulting growth profile) during colder months to achieve the 10 fpp target release size. Based on the fish number and size in Table 5-2, the total maximum rearing volume for Coho yearlings is approximately 3,805 cubic feet. When considering a rearing buffer volume, a total rearing volume of 4,000 cubic feet would be required.

The fish rearing tank numbers and sizes will be discussed with CDFW to select the optimum configuration to meet fish marking, tank changes, and fish health management objectives.

Table 5-3 reflects the rearing volume required for the Chinook sub-yearling/yearling program proposed at the FCFH using density indices of 0.3 and a mean fish size at release based on current production goals. Discussions with CDFW Fish Managers suggest that the new design parameters should consider maximizing full use of the available water (10 cfs). Table 5-3 presents a rearing scenario that was developed to maximize Chinook production at the facility with the following guidelines:

- Initial ponding of approximately 3,250,000 first-feeding fry;
- Rear 3.25M through end of March and release ~ 1.25M sub-yearlings at ~ 520 fpp/0.871 g/f mean size;
- Rear remaining ~ 2.0M through end of May and release ~1.75M sub-yearlings at ~ 104 fpp/4.35 g/f mean size;
- Rear remaining ~250,000 yearlings and release ~ end of November at ~ 10 fpp/45.27 g/f mean size.
- Marking and tagging strategies will be determined at a later date.

Table 5-3. FCFH Chinook Bio-Program – DI and Rearing Unit Calculations

3,250,000 Chinook @521 fpp, 1.862" mean, 0.87 g/f mean (C3000 Piper)						
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**
3,250,000	521	1.862	0.87	6,241	0.3	11,170

2,000,000 Chinook @104 fpp, 3.175" mean, 4.35 g/f mean (C3000 Piper)						
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**
2,000,000	104	3.175	4.35	19,231	0.3	20,190

250,000 Chinook @10 fpp, 6.98" mean, 45.27 g/f mean (C3000 Piper)						
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**
250,000	10	6.980	45.27	25,000	0.3	11,915

The fish rearing tank numbers and sizes will be discussed with CDFW to select the optimum configuration to meet fish marking, tank changes, and fish health management objectives; a follow-up TM will be produced once tank sizes and configuration have been determined.

5.4 Flow Index

Flow index (FI) is a function of pounds of fish per fish length in inches times flow in gallons per minute (gpm). Flow index is an indication of how much oxygen is available for fish metabolism and is adjusted based on the elevation of the project site and water temperature. Both of these variables affect the amount of dissolved oxygen (D.O.) in the water supply at saturation. Additional information specific to FI is provided in the example below (adapted from Piper et al., 1982) and in Table 5-4.

"The Flow Index (FI) describes how rapidly fresh water will replace "used" water (water in which fish have reduced D.O. concentrations and excreted waste products). The FI takes flow rate into consideration when estimating maximum allowable weight of fish that a culture unit can hold."

Table 5-4. Key Flow Index Calculations

Design Question	Calculation
What is Flow Index (F.I.) if you know Weight, Length and Inflow?	$F = \frac{W}{(L * I)}$
What is permissible Weight if you know F.I., Length and Inflow?	$W = F * L * I$
What is Inflow requirement if you know Weight, F.I. and Length?	$I = \frac{W}{(F * L)}$

Where: W = Weight in lbs. (biomass); F = Flow Index; I = Inflow of water in gpm; L = Fish Length in inches

"As a rule of thumb for salmonids (certainly Pacific salmon), FI values should range from 0.5 to 1.5. Actual FI values will depend on several factors, especially the dissolved oxygen concentration of the inflowing water. To correctly estimate the FI for a specific unit, fish are added while water flow is held constant; when enough fish have been added to the system so that the DO level in the outflow has been reduced below ~ 6ppm, the unit is at maximum [fish capacity]."

According to Table 8 in *Fish Hatchery Management* (Piper et al., 1982), the recommended flow index for the FCFH at an elevation of 2,200 feet and a range of actual water temperatures (degrees Fahrenheit) is provided below:

- 40 F = 2.50 FI
- 45 F = 2.10 FI
- 50 F = 1.68 FI
- 55 F = 1.40 FI

Using the conservative design guidelines identified in the DI section above and experience with conservation stocks of both Coho and Chinook salmon (Heindel, 2020), flow considerations modeled below assume an FI of no greater than 1.5. As noted previously, this is a reasonable starting point for a new facility (at stated elevation and water temperature profiles). Rearing experience gained over multiple years will allow operators the opportunity to modify actual FIs based on demonstrated fish performance/survival. Flow indices of 1.5 are applied to the rearing scenarios described previously to establish maximum water requirements for the proposed Coho yearling and Chinook sub-yearling/yearling programs as illustrated in Tables 5-5 and 5-6.

Table 5-5. FCFH Coho Bio-Program – FI and DI Unit Calculations

75,000 Coho @10 fpp, 6.57" mean, 45.1 g/f mean (C3500 Piper)								Single-Pass	
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**	**F.I. (lb/gpm/in)**	**Flow Req (gpm)**	**Flow Req (cfs)**
75,000	10	6.570	45.1	7,500	0.3	3,805	1.50	761	1.70

Table 5-6. FCFH Chinook Bio-Program – FI and DI Unit Calculations

3,250,000 Chinook @521 fpp, 1.862" mean, 0.87 g/f mean (C3000 Piper)								Single-Pass	
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**	**F.I. (lb/gpm/in)**	**Flow Req (gpm)**	**Flow Req (cfs)**
3,250,000	521	1.862	0.87	6,241	0.3	11,170	1.50	2,234	4.98

2,000,000 Chinook @104 fpp, 3.175" mean, 4.35 g/f mean (C3000 Piper)								Single-Pass	
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**	**F.I. (lb/gpm/in)**	**Flow Req (gpm)**	**Flow Req (cfs)**
2,000,000	104	3.175	4.35	19,231	0.3	20,190	1.50	4,028	9.00

250,000 Chinook @10 fpp, 6.98" mean, 45.27 g/f mean (C3000 Piper)								Single-Pass	
Number Fish	**Fish Size Out (fpp)**	**Fish Size Out (L inches)**	**Fish Size Out (g/f)**	**End Biomass (lbs)**	**D.I. (lb/cf/in)**	**Tank Space Req (cu ft)**	**F.I. (lb/gpm/in)**	**Flow Req (gpm)**	**Flow Req (cfs)**
250,000	10	6.980	45.27	25,000	0.3	11,915	1.50	2,383	5.31

The initial flow modeling suggests that the fish numbers and sizes proposed above can be accommodated with the available 10 cfs water right. The analysis indicates that the peak flow of 9.0 cfs for the Chinook group is required about 1 month after the release of the Coho yearling. The maximum flow required for newly-ponded Coho during the same period is 166 gpm with sufficient water available for the proposed rearing and release scenario.

6.0 Incubation and Rearing Facilities

This section provides a brief summary of the incubation and rearing flows and volumes required for the program based on CDFW input. The bio-programming information provided is largely tied to incubation needs in early design.

6.1 Mean Survival Assumptions

Mean survival data by life stage was provided during a meeting with CDFW (CDFW, 2020). The initial sizing of incubation facilities is based on the following survival data provided by CDFW (2020):

- Green egg to eyed survival: 80% (~ 20% loss)
- Eyed egg to ponding survival: 93% (~7% loss)
- Green egg to ponding survival: 73% (~27% loss)
- Ponding inventory to release: 95% (5% loss)

Based on the mean survival data and tied to the rearing scenarios presented above, estimates of total green eggs required for the Project are provided in Table 6-1.

Table 6-1. Starting Inventory at FCFH - Coho and Chinook

Species	Incubation Period	Incubation Start Number	% Survival Green to Pond	Pond Number	Ponding Period
Coho	Oct. – Mar.	120,000	73%	~88,000	~ Jan. – Mar.
Chinook	Oct. – Mar.	4,500,000	73%	~3,250,000	~ Jan. – Mar.

6.2 Incubation

Incubation systems currently at Iron Gate Fish Hatchery (IGFH) will be used for egg/alevin incubation at FCFH. A total of 130 incubation stacks are currently available for future rearing needs. The existing incubation units are vertical stack incubators with a double-stack arrangement (15 useable trays per stack); hydraulic head requirements at Fall Creek dictate that new incubation systems will be reduced to "½" stack design with eight useable trays per incubator (empty tray on top for sediment collection). Water flow requirements are modeled at 5 gpm per manufacturer's recommendations (industry standard). Incubation requirements for Coho and Chinook based on updated tray loading densities are provided in Table 6-2.

Table 6-2. Incubation Loading at FCFH – Coho and Chinook (Proposed Loading Rates)

Species	Green Inventory	Mean # Eggs/Ounce	Ounces/Tray	Total Trays	Total Stacks**	Total Flow (gpm)
Coho	120,000	TBD	TBD	40*	6	30
Chinook	4,500,000	80	50-55	1,088	136	680

*Per CDFW Egg Incubation Data; L. Radford

**8-tray setup (1/2 stack); required because of reduced hydraulic head (no pumping)

Current facility bio-program efforts will assume a maximum incubation need of 40 gpm for Coho incubation and 680 gpm for Chinook incubation. Historic tray loading for the Chinook incubators at Iron Gate often approached ~8,000-10,000 green eggs per tray (100 ounces). Reducing the total number of eggs/tray to ~4,000 (approximately 50 ounces/tray) for the Chinook incubation increases the total footprint and water demand yet should improve survival of resulting eggs/alevins while also reducing the risks associated with disease/fungal infection.

6.3 First-Feeding Vessels

First-feeding vessel requirements will be addressed once the final Program size is determined. Estimates of total rearing volume and flow requirements will be refined at a later date. Coho brood cohorts (first-feeding fry & smolt program) will overlap from early-ponding through smolt release; Coho production for the second cohort is assumed to require approximately 500 ft^3 of rearing space from first-feeding through late-April transfer to larger production ponds (post-smolt release).

6.4 Grow-out Vessels

Grow-out vessel (post-marking and parr/smolt rearing containers/sizes) requirements will be addressed once the final Program size is determined. Estimates of total rearing volume and flow requirements will be refined at a later date. Initial bio-program estimates suggest a maximum grow-out rearing need of 3,800 ft^3 of Coho rearing space (April release) and approximately 20,200 ft^3 of Chinook rearing space (May release).

6.5 Adult Holding Ponds

Adult holding and spawning ponds will be designed per CDFW recommendations for design flows, holding volumes, and fish handling systems; adult flow and holding requirements will align with NOAA guidelines for anadromous adults. Initial site investigations suggest that the four (4) raceways currently on-site (south of Copco Road) could be retained, renovated, and would provide sufficient space to hold the requested 100 Coho and 200 Chinook pre-spawn adults. Early design efforts will assume that all non-cleaning (effluent) flows, which is approximately 10 cfs, will be routed to the adult ponds and used for adult holding and fish ladder attraction flows.

6.6 Peak Water Supply

Peak water demand is modeled based on the rearing scenarios presented within this TM. Considering the design limitation that the total surface water supplies from Fall Creek will not exceed 10 cfs, Table 6-3 provides an overview of the annual water budget based on initial modeling efforts.

Table 6-3. FCFH Water Requirements – Full Production (Concurrent Use of All Facilities)

Month:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Juv. CFS	3.1	5.9	6.7	7.2	9.3	2.2	3.1	4.1	5.1	7.6	8.3	3.1
Total Ladder CFS									10.0	10.0	10.0	10.0

7.0 Effluent Treatment Systems

Effluent treatment system requirements will be addressed once the final Program size is determined; estimates of total effluent treatment will be refined at a later date. We understand that an NPDES permit will be required for the Program and that all design efforts will focus on minimizing downstream water quality impacts to Fall Creek (and beyond).

8.0 Fish Passage Design and Screening Criteria

Fish passage design and screening criteria will be addressed in the Facility Design Criteria Technical Memorandum (TM 002).

9.0 Biological Reference Documents

Biological design criteria presented within this TM were obtained from the following sources/literature:

CDFW (California Department of Fish and Wildlife). 2020. CDFW Staff meeting held in Redding, CA on January 27 & 28, 2020.

CDM Smith. 2019. Basis of Design Report.

Heindel, J. 2020. Personal experience and industry standard rearing values for conservation stocks of Pacific salmon.

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Fish Passage Facility Design. Northwest Region. July 2011.

Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish Hatchery Management. U.S. Fish and Wildlife Service. Washington, D.C.

Wedemeyer, G.A. 1996. Physiology of Fish in Intensive Culture Systems. New York: International Thompson Publishing.

9-Mar-20

PRELIMINARY BIOPROGRAM AND APPROXIMATE HATCHERY OPERATION SCHEDULE
Fall Creek Hatchery - Coho Yearling / Chinook Sub-Yearling & Yearling Program

				OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
CHINOOK PRODUCTION																												
Egg Take - Green to Eyed Egg Period																												
On Station Incubation - Eyed Eggs xfr in Nov 15 at 400 CTU																												
Chinook Brood Year Rearing in TBD (~12x4x50 Vats Pond-Rls.)									Mark and Xfr by May 31																			
~ 250k Chinook Yearlings																			Xfr out Nov									
Coho BY-A Early Rearing in Vats & Small Raceways											Xfr to Large Ponds																	
Coho BY-A in Production Raceways/Vats																							Xfr out Mid-April					
Coho BY-B in Early Rearing Vats & Small Raceways											Xfr to Large Ponds												Xfr to Large Ponds					
Coho BY-B in Production Raceways/Vats																												
			(F)	*49.0*	*46.0*	*43.0*	*43.0*	*43.0*	*46.0*	*50.0*	*54.0*	*54.0*	*54.5*	*54.5*	*50.0*	*49.0*	*46.0*	*43.0*	*43.0*	*43.0*	*46.0*	*50.0*	*54.0*	*54.0*	*54.5*	*54.5*	*50.0*	*49.0*
FC Sub-Yearling Chinook	*3,250,000*	*(Start Inv)*						3,250,000	3,250,000	2,000,000	2,000,000	250,000	250,000	250,000	250,000	250,000	250,000			3,250,000	3,250,000	2,000,000	2,000,000	250,000	250,000	250,000	250,000	250,000
Fall Creek Monthly Mean Water Temperature (C)				9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44
Projected Growth Rate (mm/month)	*0.05*	*mm/ctu/day*						4.58	11.67	15.00	18.33	18.33	18.75	18.75	15.00	14.16	11.67			4.58	11.67	15.00	18.33	18.33	18.75	18.75	15.00	14.16
Fish Length Inches EOM - Assumes 1200 fpp & .376 g/f @ ponding				*L*				1.403	1.862	2.453	3.175	3.896	4.634	5.373	5.963	6.521	6.980		*L*	1.403	1.862	2.453	3.175	3.896	4.634	5.373	5.963	6.521
Fish Weight Grams EOM (Piper Tables; Assumes C3000)				*g/f*				0.376	0.871	2	4.35	7.98	13.7	20.96	28.94	37.65	45.27		*g/f*	0.376	0.871	2	4.35	7.98	13.7	20.96	28.94	37.65
Fish Per Pound EOM				*fpp*				1200 #	521 #	227 #	104#	57#	33 #	22 #	16 #	12 #	10 #		*fpp*	1200 #	521 #	227 #	104#	57#	33 #	22 #	16 #	12 #
Biomass In Pounds EOM				*biom*				2,694	6,241	8,819	19,180	4,398	7,551	11,552	15,951	20,751	24,951		*biom*	2,694	6,241	8,819	19,180	4,398	7,551	11,552	15,951	20,751
Volume Required EOM (cu.ft.)	*0.3*	*DI*		*cu.ft.*				6,401	11,169	11,983	20,139	3,763	5,431	7,167	8,916	10,608	11,915		*cu.ft.*	6,401	11,169	11,983	20,139	3,763	5,431	7,167	8,916	10,608
Flow Required EOM (gpm)	*1.5*	*FI*		680	680	680	680	1,280	2,234	2,397	4,028	753	1,086	1,433	1,783	2,122	2,383			1,280	2,234	2,397	4,028	753	1,086	1,433	1,783	2,122
Assume ~4.5M green; 4,136 green eggs/tray; 1,088 trays = 136 1/2 stacks								680	1.25M Rls End Mar		1.75M Rls End May (post-mark 150/lb)				Incub:	680	680	680	680	680	1.25M Rls End Mar		1.75M Rls End May					680
CDFW Growth Reduction; Days Feed/Month																23 days	15 days	7 days	7 days	7 days	15 days							
									78,400	77,600	77,400	77,200	77,000	76,800	76,600	76,400	76,200	76,000	75,800	75,600	75,400	75,000						
FC Yearling Coho	*80,000*	*(Start Inv)*													Ration:	75%	50%	25%	25%	25%	50%	Ap. 15 Rls						
Fall Creek Monthly Mean Water Temperature (C)				9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44
Projected Growth Rate (mm/month)	*0.045*	*mm/ctu/day*						4.12	10.50	13.50	16.50	16.50	16.88	16.88	13.50	9.77	5.25	1.92	1.92	1.92	5.25	4.50						
Fish Length Inches EOM - Assumes 1400 fpp & .323 g/f @ ponding				*L*				1.270	1.684	2.215	2.864	3.514	4.178	4.843	5.374	5.759	5.966	6.041	6.117	6.193	6.400	6.577						
Fish Weight Grams EOM (Piper Tables; Assumes C3500)			***Brood Year A***	*g/f*				0.323	0.744	1.72	3.72	6.99	11.7	18.23	24.77	30.2	33.5	35.3	37.5	37.8	41.8	45.4						
Fish Per Pound EOM				*fpp*				1400 #	610 #	263 #	122#	65 #	39 #	25 #	18 #	15 #	14 #	12.9 #	12.1 #	11.9 #	10.8 #	10 #						
Biomass In Pounds EOM				*biom*				57	129	294	635	1,190	1,986	3,087	4,183	5,087	5,628	5,915	6,267	6,300	6,948	7,500						
Volume Required EOM (cu.ft.)	*0.3*	*DI*		*cu.ft.*				150	255	443	739	1,129	1,584	2,125	2,595	2,944	3,145	3,263	3,415	3,391	3,619	3,801						
Flow Required EOM (gpm)	*1.5*	*FI*		40	40	40	40	30	51	89	148	226	317	425	519	589	629	653	683	678	724	760						40
CDFW Growth Reduction; Days Feed/Month					15 days	7 days	7 days	7 days	15 days																			
					76,200	76,000	75,800	75,600	75,400	75,000																		23 days
FC Yearling Coho	*80,000*	*(Start Inv)*		Ration:	50%	25%	25%	25%	50%	Ap. 15 Rls											78,400	77,600	77,400	77,200	77,000	76,800	76,600	76,400
Fall Creek Monthly Mean Water Temperature (C)				9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44	7.78	6.11	6.11	6.11	7.78	10	12.22	12.22	12.5	12.5	10	9.44
Projected Growth Rate (mm/month)	*0.045*	*mm/ctu/day*			5.25	1.92	1.92	1.92	5.25	4.50										4.12	10.50	13.50	16.50	16.50	16.88	16.88	13.50	9.77
Fish Length Inches EOM - Assumes 1400 fpp & .323 g/f @ ponding				*L*	5.966	6.041	6.117	6.193	6.400	6.577									*L*	1.270	1.684	2.215	2.864	3.514	4.178	4.843	5.374	5.759
Fish Weight Grams EOM (Piper Tables; Assumes C3500)			***Brood Year B***	*g/f*	33.5	35.3	37.5	37.8	41.8	45.4									*g/f*	0.323	0.744	1.72	3.72	6.99	11.7	18.23	24.77	30.2
Fish Per Pound EOM				*fpp*	14 #	12.9 #	12.1 #	11.9 #	10.8 #	10 #									*fpp*	1400 #	610 #	263 #	122#	65 #	39 #	25 #	18 #	15 #
Biomass In Pounds EOM				*biom*	5,628	5,915	6,267	6,300	6,948	7,500									*biom*	57	129	294	635	1,190	1,986	3,087	4,183	5,087
Volume Required EOM (cu.ft.)	*0.3*	*DI*		*cu.ft.*	3,145	3,263	3,415	3,391	3,619	3,801									*cu.ft.*	150	255	443	739	1,129	1,584	2,125	2,595	2,944
Flow Required EOM (gpm)	*1.5*	*FI*		*gpm*	629	653	683	678	724	760						40	40	40	40	30	51	89	148	226	317	425	519	589
			GPM	720	1,349	1,373	1,403	2,668	3,009	3,245	4,176	978	1,403	1,858	2,302	3,430	3,732	1,373	1,403	2,668	3,009	3,245	4,176	978	1,403	1,858	2,302	3,430
			CFS	1.6	3.0	3.1	3.1	5.9	6.7	7.2	9.3	2.2	3.1	4.1	5.1	7.6	8.3	3.1	3.1	5.9	6.7	7.2	9.3	2.2	3.1	4.1	5.1	7.6
			Tot. Adult Flow	10.0	10.0	10.0									10.0	10.0	10.0	10.0									10.0	10.0
				OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT

Appendix G
Water Quality Sampling Technical Memo

Technical Memorandum No. 003

To:	Mark Bransom, KRRC Jason Roberts, CDFW	Project:	Klamath River Renewal Project – Fall Creek Hatchery Project
From:	Derek Nelson Jeff Heindel	Cc:	Jodi Burns, Project Manager Morton D. McMillen, P.E. File
Date:	May 5, 2020	Job No.:	20-024
Subject:	Technical Memorandum No. 003 – Fall Creek Hatchery Water Quality Analysis		

Revision Log

Revision No.	Date	Revision Description
0	03/19/2020	Initial Draft
1	05/05/2020	City of Yreka - Water Sampling Database Review

May 5, 2020 Update – REV01

California Department of Fish and Wildlife and Klamath River Renewal Corporation staff reviewed the original Technical Memorandum 003 submittal in March 2020 (REV00) and recommended a review of available City of Yreka water quality data. Section 3.0 of this TM has been updated to reflect the resulting City of Yreka database review and provides additional water quality data for the proposed Fall Creek Fish Hatchery (dataset also provided as Appendix C); no additional report information has been modified.

1.0 Purpose

The purpose of this technical memorandum (TM) is to summarize the Fall Creek water quality analysis results obtained from Basic Laboratory, Inc. The primary purpose of water sampling was to develop baseline water quality data for the proposed Fall Creek Fish Hatchery (FCFH) facility renovations. The Fall Creek water source has been used as recently as 2003 for the rearing of anadromous Pacific salmon juveniles with positive fish production results. During past fish rearing operations, there were no known water chemistry concerns and no major fish pathogens detected during the period of culture. The site historically had good fish survival and performance.

Water samples were collected at the proposed FCFH intake location on January 28, 2020 by Dr. Mark Clifford from the California Department of Fish & Wildlife (CDFW), and delivered on the same day to Basic Laboratory, Inc., located in Redding, California. Water quality samples were collected in Fall Creek at approximately 10:15 a.m. Pacific Standard Time (PST) immediately above the existing Dam A and the City of Yreka's water supply intake.

2.0 Sampling Results

Table 2-1 provides the general chemistry and total metals results of the analyses for the sampling location as well as the Basic Laboratory, Inc. Method Detection Limit (MDL) for each parameter. Final results received from Basic Laboratory, Inc. are attached as Appendix A. General coldwater aquaculture parameter limits are presented for reference. Stated coldwater aquaculture recommendations are taken from industry-standard guidelines and published literature (Piper et al., 1982; Daily and Economon, 1983; Wedemeyer, 1996; Summerfelt et al., 2004). The parameter standards are presented for use as general guidelines only and final water quality determinations should not be made until surrogate trials have been conducted with live fish during a partial and/or full rearing cycle.

Table 2-1. Fall Creek Water Quality Analysis

Parameter	Units	Typical Limit for Aqua-Culture	MDL	Sample Results
General Chemistry				
Sulfide as Hydrogen Sulfide	mg/L	<0.002	0.0106	0.0181*
pH	SU	6.5-8.0	-	8.15* (field test required)
Alkalinity as $CaCO_3$	mg/L	>20	2	67
Bicarbonate	mg/L	75-100	2	82
Chloride	mg/L	4.0 (reuse systems)	0.16	0.95
Fluoride	mg/L	<0.2	0.04	0.05
Nitrate as N	mg/L	<1.0	0.02	0.55
Nitrite as N	mg/L	<0.1	0.003	0.007
Sulfate as $S0_4$	mg/L	<50	0.20	0.42
Total Dissolved Solids	mg/L	<200	3	97
Total Suspended Solids	mg/L	<80	2	3.6
Ammonia (TAN)	mg/L	<1.0	0.020	0.022
Chlorine	mg/L	<0.003	0.03[a]	ND
Carbon Dioxide	mg/L	1.5-15	1.6	2.6
Dissolved Oxygen	mg/L	>6.0	0.2	11.0
Metals - Total				
Aluminum	mg/L	<0.075[b] <0.01[c]	0.0011	0.312*
Arsenic	mg/L	<0.05	0.0001	0.00049
Barium	mg/L	<5.0	0.0001	0.00459
Cadmium	mg/L	<0.0005 (soft water)	0.00004	ND
Calcium	mg/L	>5.0	0.1	12.5
Chromium	mg/L	<0.03	0.0001	0.00118
Copper	mg/L	<0.0006 (soft water)	0.00012	0.00052
Iron	mg/L	<0.15	.003	0.282*

Parameter	Units	Typical Limit for Aqua-Culture	MDL	Sample Results
Lead	mg/L	<0.02	0.00007	ND
Magnesium	mg/L	<15	0.1	7.6
Manganese	mg/L	<0.01	0.0001	0.0044
Mercury	mg/L	<0.0002[b]	0.00004	ND
Nickel	mg/L	<0.01	0.00011	0.00049
Potassium	mg/L	<5	0.3	1.2
Selenium	mg/L	<0.01	0.0003	ND
Silver	mg/L	<0.003	0.00004	ND
Sodium	mg/L	<75	0.2	5.3
Sulfur	mg/L	<1.0	0.34	0.105
Vanadium	mg/L	<0.1	0.00028	0.00472
Zinc	mg/L	<0.005	0.0005	0.0006

[a] – MDL is above maximum standard value

[b] – Wedemeyer, 1996

[c] – Daily and Economon, 1983

ND – Analyte not detected; mg/L = milligrams per liter

Of the Fall Creek source parameters evaluated, three samples yielded results that were higher than typical published limits for aquaculture:

1. The sulfide as hydrogen sulfide sample resulted in a 0.0181 value (typical limits of <0.003 mg/L [Wedemeyer, 1996] and <0.002 mg/L [Timmons and Ebeling, 2010]).
2. The aluminum sample resulted in a 0.312 mg/L value (typical limits of <0.01 mg/L [Timmons and Ebeling, 2010] and <0.075 mg/L [Wedemeyer, 1996]).
3. The iron sample resulted in a 0.282 mg/L value (typical limits of <0.1 mg/L [Wedemeyer, 1996] and <0.15 mg/L [Timmons and Ebeling, 2010]).

The results for sulfide as hydrogen sulfide were elevated at 0.0181. The maximum safe exposure level is 0.002 mg/L for fish and other aquatic life in natural surface waters (Wedemeyer, 1996). Hydrogen sulfide rarely occurs in surface water at detrimental levels due to aerobic conditions, and sulfides are oxidized to sulfates (Wedemeyer, 1996). Potential sources of hydrogen sulfide in surface waters are usually associated with upstream lakes and reservoirs that may have higher levels of hydrogen sulfide produced from bottom sediments. The addition of aeration structures can reduce levels by volatilization to the atmosphere as well as continuing the aerobic conditions that further degrade hydrogen sulfide. Aeration is not anticipated based on the past production success at the hatchery site.

Sampling of pH resulted in a slightly elevated reading of 8.15; optimum pH values for freshwater fish are generally in the range of 6.5 to 9.0 (Wedemeyer, 1996; Timmons and Ebeling, 2010). It is important to note that pH tests should ideally be analyzed in the field within 15 minutes of sampling (*per Basic Laboratory, Inc. recommendations*). We suggest another field sampling event for pH using one or more hand-held pH units for a more accurate value of this analyte. It is anticipated that additional sample results will be within normal ranges for aquaculture.

Sampling of chlorine resulted in a *Not Detected* (ND) value based on the MDL value for this analyte (0.03 mg/L). It is important to note that most published literature for chlorine levels and freshwater fish suggest values of less than 0.003 mg/L (below the MDL). While elevated background levels are unlikely, given the surface water source and remote location, we recommend a backup sampling event to verify values based on more rigorous MDLs (</= 0.003 mg/L). As noted for pH above, Basic Laboratory, Inc. recommends that chlorine tests be field analyzed within 15 minutes of sampling. A field test using one or more approved testing methods is warranted to verify actual chlorine values for the Fall Creek system.

Iron and aluminum sample values for this sampling event yielded values outside the range generally accepted as safe for salmonids in freshwater. These analytes should be discussed, and potential resampling events conducted if these values are concerning to CDFW staff. If available, water sampling data from the Iron Gate Fish Hatchery (IGFH) could be reviewed to determine whether or not similar values are common in the area. Additional discussions of these values are warranted prior to advanced design of the Fall Creek facility.

All remaining water sampling results yielded sample values that were well within general water chemistry recommendations for salmonid (coldwater) aquaculture facility water supplies. If deemed necessary, resampling of the Fall Creek source water can be arranged to verify sample results for hydrogen sulfide, pH, chlorine, as well as iron and aluminum.

CDFW staff performed Total Gas Pressure (TGP) and Dissolved Oxygen (DO) measurements at three locations on Fall Creek on February 4, 2020. The results were reviewed by CDFW Fish Health staff with no major concerns reported. A copy of the CDFW Fish Pathologist Report is attached to this document as Appendix B.

As discussed above, the Fall Creek site has successfully reared anadromous salmonids in the past. The recent water quality results do not present any major concerns for the production of Coho or Chinook. Water quality parameters are often interdependent, and although a few parameters are slightly out of the recommended range, other parameters can negate any adverse impacts that would be detrimental to aquaculture. Continued monitoring of water quality over the next year is recommended to provide a baseline for the entire year to ensure that parameters do not fluctuate significantly. On-site measurements of pH, dissolved oxygen, and turbidity are recommended.

3.0 City of Yreka Water Sampling Database Review

The City of Yreka's Rob Taylor (rtaylor@ci.yreka.ca.us) provided the following link containing historic water quality testing data for the Dam A Impoundment (Primary Station Code 4710011-002):

https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=4717&tinwsys_st_code=CA&counter=0

The database was queried only for the following parameters identified as a possible concern during the initial sampling (see Appendix C for full dataset):

- Sulfide as Hydrogen Sulfide
- Aluminum
- Iron
- pH
- Chlorine

Table 3-1 provides a summary of the testing values as compared to initial sampling efforts on January 28. 2020:

Table 3-1. Fall Creek Water Quality Analysis – Combined Analysis

Parameter	Units	Typical Limit for Aqua-Culture	Sample Date	Sample Results
General Chemistry				
Sulfide as Hydrogen Sulfide	mg/L	<0.002	01/28/2020	0.0181
Sulfide as Hydrogen Sulfide			Data Set	Not Sampled; 1984 - 2020
pH	SU	6.5-8.0	01/28/2020	8.15 (field test required)
pH	SU	6.5-8.0	11/02/2011	7.9
pH	SU	6.5-8.0	11/02/2005	7.93
pH	SU	6.5-8.0	06/25/1991	7.9
pH	SU	6.5-8.0	06/26/1990	7.6
pH	SU	6.5-8.0	06/08/1989	8.2
pH	SU	6.5-8.0	06/23/1988	7.27
pH	SU	6.5-8.0	06/24/1987	7.87
pH	SU	6.5-8.0	08/13/1986	7.4
pH	SU	6.5-8.0	10/01/1985	7.95
Chlorine	mg/L	<0.003	0.03	ND
Chlorine			Data Set	Not Sampled; 1984 - 2020
Metals - Total				
Aluminum	mg/L	<0.075[b] <0.01[c]	01/28/2020	0.312
Aluminum	mg/L	<0.075[b] <0.01[c]	08/23/2016	0.083
Aluminum	mg/L	<0.075[b] <0.01[c]	10/01/2007	0.0515
Aluminum	mg/L	<0.075[b] <0.01[c]	11/02/2005	0.0666
Aluminum	mg/L	<0.075[b] <0.01[c]	06/25/1991	0.1
Aluminum	mg/L	<0.075[b] <0.01[c]	06/26/1990	0.1

Parameter	Units	Typical Limit for Aqua-Culture	Sample Date	Sample Results
Aluminum	mg/L	<0.075[b] <0.01[c]	06/08/1989	0.0002
Iron	mg/L	<0.15	01/28/2020	0.282
Iron	mg/L	<0.15	06/25/1991	0.056
Iron	mg/L	<0.15	06/26/1990	0.05
Iron	mg/L	<0.15	06/08/1989	0.06
Iron	mg/L	<0.15	06/23/1988	0.012
Iron	mg/L	<0.15	06/24/1987	0.05
Iron	mg/L	<0.15	08/13/1986	0.05
Iron	mg/L	<0.15	10/01/1985	0.05
Iron	mg/L	<0.15	09/11/1984	0.05

[b] – Wedemeyer, 1996

[c] – Daily and Economon, 1983

Historic water sampling values obtained from the City of Yreka database provided the following range and mean values for the parameters analyzed:

1. The historic pH sampling data provided a range of 7.27 - 8.2 and a mean of 7.78 over the nine (9) years of sampling values vs. the 8.15 value obtained from the 1/28/20 sampling. The 1/28/20 pH value of 8.15 was a result of a field sample that was analyzed within a lab setting and a sample that was recommended to be obtained directly in the field and analyzed within 15 minutes of sampling (*per Basic Laboratory, Inc. recommendations)*. Assuming a normal pH range of 7.2 – 8.2 from historic data, these values are within the optimum pH values for culture of freshwater fish (generally in the range of 6.5 to 9.0 - Wedemeyer, 1996; Timmons and Ebeling, 2010).
2. The historic aluminum sampling data provided a range of 0.0002 – 0.1 mg/L and a mean of 0.0669 mg/L over the six (6) years of sampling values vs. the 0.312 mg/L value obtained from the 1/28/20 sampling. Acknowledging the broad range of recommended limits in published literature (<0.01 mg/L [Timmons and Ebeling, 2010] and <0.075 mg/L [Wedemeyer, 1996]), the mean of 0.0669 mg/L for the six (6) years sampled is below the recommended limit provided by Wedemeyer and the range (0.0002 – 0.1 mg/L) was below this limit in three (3) of six (6) sampling years.
3. The historic iron sampling data provided a range of 0.012 – 0.06 mg/L and a mean of 0.0473 mg/L over the eight (8) years of sampling values vs. the 0.282 mg/L value obtained from the 1/28/20 sampling. Assuming a normal iron range of 0.012 – 0.06 mg/L based on historic data, these values are below threshold levels reported by both literature references (typical limits of <0.1 mg/L [Wedemeyer, 1996] and <0.15 mg/L [Timmons and Ebeling, 2010]).

A review of the historic water sampling database did not yield sample values for sulfide as hydrogen sulfide or chlorine. Based solely upon successful historic Chinook Salmon production rearing at Fall Creek Fish Hatchery, it is assumed that these analytes are not a limiting factor for future production at Fall Creek Fish Hatchery. If CDFW and/or KRRC are interested in future sampling for either sulfide as hydrogen sulfide or chlorine, we would gladly arrange for follow-up sampling efforts at the site.

4.0 Literature Cited

Daily, J.B. and P. Economon. 1983. A guide to integrated fish health management in the Great Lakes Basin. Great Lakes Fishery Commission Special Publication 83-2. Ann Arbor, MI 48105.

Piper, G.R., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish Hatchery Management. U.S. Fish and Wildlife Service. Washington, D.C.

Summerfelt, S.T., Davidson, J.W., Waldrop, T.B., Tsukuda, S.M. and Bebak- Williams, J. 2004. A partial-reuse system for coldwater aquaculture. Aquacultural Engineering 31: 157–181.

Timmons M.B. and J.M. Ebeling. 2010, 2nd edition. Recirculating aquaculture. Cayuga qua Ventures. Ithaca, NY 14850.

Wedemeyer, G. 1996. Physiology of Fish in Intensive Culture Systems. Chapman and Hall, New York, NY.

Appendix A

CDFW Fall Creek Water Sampling – Analytical Results
Basic Laboratory, Inc., Redding, CA

basic laboratory
www.basiclab.com
2218 Railroad Avenue
Redding, California 96001
voice 530.243.7234
fax 530.243.7494
3860 Morrow Lane, Suite F
Chico, California 95928
voice 530.894.8966
fax 530.894.5143

February 12, 2020

Lab ID: 20A1078

JODI BURNS
MCMILLEN JACOBS ASSOCIATES
1471 SHORELINE DRIVE SUITE 100
BOISE, ID 83702
RE: GENERAL TESTING

Dear JODI BURNS,

Enclosed are the analysis results for Work Order number 20A1078. All analyses were performed under strict adherence to our established Quality Assurance Plan. Any abnormalities are listed in the qualifier section of this report.

If you have any questions regarding these results, please feel free to contact us at any time. We appreciate the opportunity to service your environmental testing needs.

Sincerely,

For

Ricky D. Jensen
Laboratory Director
California ELAP Certification Number 1677

basic laboratory

www.basiclab.com

2218 Railroad Avenue
Redding, California 96001
voice 530.243.7234
fax 530.243.7494

3860 Morrow Lane, Suite F
Chico, California 95928
voice 530.894.8966
fax 530.894.5143

Report To: MCMILLEN JACOBS ASSOCIATES
1471 SHORELINE DRIVE SUITE 100
BOISE, ID 83702

Attention: JODI BURNS

Project: GENERAL TESTING FALL CREEK

Description: FALLL CREEK DAM A INTAKE

Matrix: Water

Lab No: 20A1078
Reported: 02/12/20
Phone: (208) 342-4214

Lab ID: 20A1078-01

Sampled: 01/28/20 10:18
Received: 01/28/20 15:25

General Chemistry

Analyte	Units	Results	Qualifier	MDL	RL	Method	Analyzed	Prepared	Batch
Sulfide as Hydrogen Sulfide	mg/l	**0.0181**	J	0.0106	0.0213	[CALC]	02/03/20	02/03/20	[CALC]
pH (see note 2)	pH Units	**8.15**				SM 4500-H+ B	01/28/20	01/28/20	B0A1456
Alkalinity as CaCO3	mg/l	**67**		2	5	SM 2320B	01/31/20	01/31/20	B0A1557
Bicarbonate	"	**82**		2	5	"	"	"	"
Carbonate	"	ND		2	5	"	"	"	"
Hydroxide	"	ND		2	5	"	"	"	"
Chloride	"	**0.95**		0.16	0.50	EPA 300.0	01/30/20	01/30/20	B0A1526
Fluoride	"	**0.05**	J	0.04	0.10	"	02/06/20	02/05/20	B0B0905
Nitrate as N	"	**0.55**		0.02	0.05	EPA 353.2	01/29/20	01/29/20	B0A1490
Nitrite as N	"	**0.007**	J	0.003	0.010	"	"	"	"
Sulfate as SO4	"	**0.42**	J	0.20	0.50	EPA 300.0	01/30/20	01/30/20	B0A1526
Sulfide	"	**0.017**	J	0.010	0.020	SM 4500-S2- D	02/03/20	02/03/20	B0B0826
Total Dissolved Solids	"	**97**		3	6	SM 2540C	01/29/20	01/29/20	B0A1492
Total Suspended Solids	"	**3.6**	J	2.0	6.0	SM 2540D	01/28/20	01/28/20	B0A1452
Nitrogen, Total	"	**0.864**		0.0900	0.200	(CALC)	01/31/20	01/29/20	[CALC]
Total Kjeldahl Nitrogen	"	**0.30**		0.09	0.20	EPA 351.2	"	"	B0A1503
Ammonia as N	"	**0.022**	J	0.020	0.050	EPA 350.1	02/03/20	02/03/20	B0B0807
Nitrate+Nitrite as N	"	**0.56**		0.02	0.05	EPA 353.2	01/29/20	01/29/20	B0A1490
Chlorine, Total Residual (see note 2)	"	ND		0.03	0.10	SM 4500-Cl G	01/28/20	01/28/20	B0A1463
Carbon Dioxide	"	**2.6**	J	1.6	4.4	SM 4500-CO2 C	01/28/20	01/28/20	B0A1466
Dissolved Oxygen (see note 2)	"	**11.0**		0.2	0.6	SM4500-O G	01/28/20	01/28/20	B0A1464

Metals - Total

Analyte	Units	Results	Qualifier	MDL	RL	Method	Analyzed	Prepared	Batch
Aluminum	ug/l	**312**		1.1	5.0	EPA 200.8	02/07/20	01/31/20	B0A1535
Arsenic	"	**0.49**	J	0.10	0.50	"	01/31/20	01/30/20	B0A1494
Barium	"	**4.59**		0.10	0.50	"	"	"	"
Cadmium	"	ND		0.04	0.20	"	"	"	"
Calcium	mg/l	**12.5**		0.1	1.0	EPA 200.7	02/06/20	02/04/20	B0B0836
Chromium	ug/l	**1.18**		0.13	0.50	EPA 200.8	01/31/20	01/30/20	B0A1494
Copper	"	**0.52**		0.12	0.50	"	"	"	"
Iron	"	**282**		3.0	15.0	"	"	"	"
Lead	"	ND		0.07	0.50	"	"	"	"
Magnesium	mg/l	**7.6**		0.1	1.0	EPA 200.7	02/06/20	02/04/20	B0B0836
Manganese	ug/l	**4.44**		0.10	0.50	EPA 200.8	01/31/20	01/30/20	B0A1494
Mercury	"	ND		0.04	0.10	EPA 245.2	02/06/20	02/06/20	B0B0918
Nickel	"	**0.49**	J	0.11	0.50	EPA 200.8	01/31/20	01/30/20	B0A1494
Potassium	mg/l	**1.2**		0.3	1.0	EPA 200.7	02/06/20	02/04/20	B0B0836
Selenium	ug/l	ND		0.3	2.0	EPA 200.8	01/31/20	01/30/20	B0A1494
Silver	"	ND		0.04	0.20	"	02/06/20	02/06/20	B0B0861
Sodium	mg/l	**5.3**		0.2	1.0	EPA 200.7	02/06/20	02/04/20	B0B0836
Sulfur	ug/l	**105**		34	100	"	"	"	"
Vanadium	"	**4.72**		0.28	0.50	EPA 200.8	02/07/20	01/31/20	B0A1535
Zinc	"	**0.6**	J	0.5	2.0	"	01/31/20	01/30/20	B0A1494

Approved By
Basic Laboratory Inc
California ELAP Cert #1677 and #2718

www.basiclab.com

basic laboratory

2218 Railroad Avenue
Redding, California 96001
voice 530.243.7234
fax 530.243.7494

3860 Morrow Lane, Suite F
Chico, California 95928
voice 530.894.8966
fax 530.894.5143

Report To: MCMILLEN JACOBS ASSOCIATES
1471 SHORELINE DRIVE SUITE 100
BOISE, ID 83702
Attention: JODI BURNS
Project: GENERAL TESTING FALL CREEK

Lab No: 20A1078
Reported: 02/12/20
Phone: (208) 342-4214

Notes and Definitions

QR-04	Duplicate results are within one reporting limit and pass all necessary QC criteria.
J	Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag). The J flag is equivalent to the DNQ Estimated Concentration flag.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the detection limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
<	Less than reporting limit
≤	Less than or equal to reporting limit
>	Greater than reporting limit
≥	Greater than or equal to reporting limit
MDL	Method Detection Limit
RL/ML	Minimum Level of Quantitation
MCL/AL	Maxium Contaminant Level/Action Level
mg/kg	Results reported as wet weight
TTLC	Total Threshold Limit Concentration
STLC	Soluble Threshold Limit Concentration
TCLP	Toxicity Characteristic Leachate Procedure
Note 1	Received Temperature - according to EPA guidelines, samples for most chemistry methods should be held at ≤6 degrees C after collection, including during transportation, unless the time from sampling to delivery is <2 hours. Regulating agencies may invalidate results if temperature requirements are not met.
Note 2	According to 40 CFR Part 136 Table II, the following tests should be analyzed in the field within 15 minutes of sampling: pH, chlorine, dissolved oxygen, and sulfite.

Approved By
Basic Laboratory Inc
California ELAP Cert #1677 and #2718

20A1078

1

BASIC LABORATORY CHAIN OF CUSTODY RECORD

2218 Railroad Avenue, Redding, CA 96001 (530) 243-7234 FAX (530) 243-7494

LAB #: 20A 1078

PAGE 1 OF 1

CLIENT NAME: McMillen Jacobs

PROJECT NAME: Fall Creek

PROJECT #:

MAILING ADDRESS: 1471 SHORELINE DRIVE SUITE 100 BOISE, ID 83702

REPORT DUE DATE:

TURN AROUND TIME: (Standard) Rush

OF SAMPLES: 7

MATRIX / TYPE: W

PROJECT MANAGER: JODI BURNS

CUSTODY SEAL INTACT? Yes No N/A

PHONE: 208.342.4214

EMAIL: jburns@mcmjac.com

SYSTEM #:

FAX:

RESULTS SENT: (Email) Fax EDD Mail

EDD TYPE:

INVOICE TO: McMillen Jacobs

PO#:

QC: Standard Level II

ANALYSIS REQUESTED

SAMPLE DATE	SAMPLE TIME	WATER	COMP	SOLID	SAMPLE LOCATION / IDENTIFICATION (DAM A)	NUMBER OF BOTTLES	TSS	Alk, Cl, Cl, F, NO2, NO3	CO2	Total Metals	NH3 Total N	Sulfide	D.O.				LAB ID	CHLORINE RESIDUAL OR COMMENTS
1/28	10:18	X			Fall Creek Intake	1	X										1	12.0 C
1/28	10:19	X			Fall Creek Intake	1		X										
1/28	10:20	X			Fall Crk Dam A Intake	1			X									
1/28	10:20	X			Fall Crk Dam A Intake	1				X								
1/28	10:22	X			Fall Crk DAM A Intake	1					X							
1/28	10:22	X			Fall Crk DAM A INTAKE	1						X						
1/28	10:24	X			Fall Crk DAM A INTAKE	1							X					

pH, TDS, SO4 as per email

Total Metals includes: Al, As, Ba, Cd, Cr, Ca, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, S, V, Zn as per attached

pH<2 1.28.20 @ 1604

pH<2 prepreserved pH > 9 prepreserved

PAID JAN 28 2020 By Visa $863.00

718253 $115.00

718223 $112.00

online 3722

PRESERVED WITH: (HNO3) (H2SO4) NaOH (ZnAce/NaOH) HCL NaThio OTHER______

SAMPLED BY (PRINT): Derek Nelson	SAMPLE DATE/TIME: 1/28/20 10:30	RELINQUISHED BY: [signature]	DATE/TIME: 1/28/20 320
RECEIVED BY:	DATE/TIME:	RELINQUISHED BY:	DATE/TIME:
RECEIVED BY (LAB): Ethan S	DATE/TIME: 1.28.20 1525	PROCESSED AND VERIFIED BY: Ethan S	DATE/TIME: 1.28.20 1542
LOGGED IN BY: Ethan S	DATE/TIME: 1.28.20 1525	CARRIER: ______	COOLER TEMPERATURE: ______ °c

INSTRUCTIONS, TERMS AND CONDITIONS ON BACK.

ES SAMPLE TYPE: 1 = ROUTINE, 2 = REPEAT, 3 = REPLACEMENT, 4 = SPECIAL 5 = RAW

250 545 3654

Table 1. Water quality standards for salmonid aquaculture

Parameter	A	B	C	D
Alkalinity (as $CaCO_3$)	20 mg/l	undetermined	20-200 mg/l	120 - 400 mg/l
Aluminum (Al)	.01 mg/l	.01 mg/l	--	
Ammonia (NH_3) un-ionized	.02 mg/l	.0125 mg/l	.012 mg/l	.0125 mg/l
Arsenic (As)	.05 mg/l	.05 mg/l	--	
Barium (Ba)	5.0 mg/l	5.0 mg/l	--	
Cadmium (alk < 100)	.0005 mg/l	.0005 mg/l	--	.0004 mg/l
Cadmium (alk > 100)	.005 mg/l	.005 mg/l	--	.003 mg/l
Calcium (Ca)	52 mg/l	--	52 mg/l	4 - 160 mg/l
Chloride ( )	--	4.0 mg/l	--	
Chlorine (Cl)	.003 mg/l	.003 mg/l	--	
Chromium (Cr)	.03 mg/l	.03 mg/l	--	.03 mg/l
Carbon dioxide (CO_2)	1.5-15.0 mg/l	1.0 mg/l	2.0 mg/l	0 - 10.0 mg/l
Copper (alk < 100)	.006 mg/l	.006 mg/l	.006 mg/l	
(Cu) (alk > 100)	.03 mg/l	.03 mg/l	.03 mg/l	
Dissolved Oxygen (DO)	75%, never	7.0 mg/l	5.0 mg/l	5.0 - sat. mg/l
	below 5.0 mg/l	--	--	
Fluoride (F)	.5 mg/l	.5 mg/l	--	
Hydrogen cyanide (HCN)	.005 mg/l	--	--	
Hydrogen sulfide (H_2S)	.003 mg/l	.003 mg/l	.002 mg/l	0 mg/l
Iron (Fe)	.1 mg/l	.1 mg/l	1.0 mg/l	.5 mg/l
Lead (Pb)	.02 mg/l	.02 mg/l	--	
Magnesium (Mg)	15 mg/l	15 mg/l	--	needed
Manganese (Mn)	.01 mg/l	.01 mg/l	--	0 - .01 mg/l
Mercury (Hg)	.2 mg/l	.0002 mg/l	--	.002 mg/l
Nitrogen (N)	110% TDG	110% TDG	110% TDG	110% TDG
	103% N_2	103% N_2	--	
Nitrate (NO_3)	1.0 mg/l	1.0 mg/l	--	0 - 3.0 mg/l
Nitrite (NO_2)	.1 mg/l	.1 mg/l	.55 mg/l	.1 - .2 mg/l
Nickel (Ni)	.01 mg/l	.01 mg/l	--	
PCB	.002 mg/l	--	--	
pH	6.7-8.6	6.5-8.0	6.7-9.0	6.5 - 8.0
Potassium (K)	5.0 mg/l	5.0 mg/l	--	
Salinity	5.0 ppt	5.0 ppt	--	
Selenium (Se)	.01 mg/l	.01 mg/l	--	
Silver (Ag)	.003 mg/l	.003 mg/l	--	
Sodium (Na)	75 mg/l	75 mg/l	--	
Sulfur (S)	1.0 mg/l		--	
Sulphate (SO_4)	50 mg/l	50 mg/l	--	
Total dissolv. solids (TDS)	400 mg/l	400 mg/l	400 mg/l	
Total susp. solids (TSS)	80 mg/l	80 mg/l	80 mg/l	80 mg/l
Uranium (U)	.1 mg/l		--	
Vanadium (V)	.1 mg/l		--	
Zinc (Zn)	.005 mg/l	.005 mg/l	.04 m/gl pH7.6	.03 mg/l
Zirconium (Z)	.1 mg/l		--	
Temperature	--	0°-15°C	--	

A: Daily, J.P. and P. Economon, 1983.
B: Fish Culture Manual, Alaska Dept. Fish and Game, FRED Div., June, 1983.
C: Wedemeyer and Wood, 1974.
D: Piper, G. P., et. al. 1982.

Receipt

Invoice Number
2001107
Invoiced On
01/30/20

Invoice To
MCMILLEN JACOBS ASSOCIATES
JODI BURNS
1471 SHORELINE DRIVE SUITE 100
BOISE, ID 83702

Project
GENERAL TESTING

Project Contact
JODI BURNS
Project Number
FALL CREEK
PO Number

Work Order(s)
20A1078

basic laboratory

Thank you!

Basic Laboratory, Inc
2218 Railroad Avenue
Redding, CA 96001-2504
530-243-7234 x 203

Terms: Paid in Full

Quantity	Matrix	Analysis/Description	Unit Cost	Extended Cost
		Project turn around time: Standard		
1	Water	Ag Total ICPMS 200.8	$22.00	$22.00
1	Water	Al Total ICPMS 200.8	$11.00	$11.00
1	Water	Alkalinity w/Bicarb/Carb 2320B	$28.00	$28.00
1	Water	Ammonia as N 350.1	$50.00	$50.00
1	Water	As Total ICPMS 200.8	$22.00	$22.00
1	Water	Ba Total ICPMS 200.8	$22.00	$22.00
1	Water	Ca Total ICP 200.7	$11.00	$11.00
1	Water	Carbon Dioxide	$55.00	$55.00
1	Water	Cd Total ICPMS 200.8	$22.00	$22.00
1	Water	Chloride 300.0	$30.00	$30.00
1	Water	Chlorine - Total Residual 4500	$25.00	$25.00
1	Water	Cr Total ICPMS 200.8	$22.00	$22.00
1	Water	Cu Total ICPMS 200.8	$22.00	$22.00
1	Water	DO by SM4500-O G	$30.00	$30.00
1	Water	Fe Total ICPMS 200.8	$22.00	$22.00
1	Water	Fluoride 300.0	$30.00	$30.00
1	Water	Hg Total CVAA 245.2	$70.00	$70.00
1	Water	K Total ICPMS 200.8	$22.00	$22.00
1	Water	Mg Total ICP 200.7	$22.00	$22.00
1	Water	Mn Total ICPMS 200.8	$22.00	$22.00
1	Water	Na Total ICP 200.7	$22.00	$22.00
1	Water	Ni Total ICPMS 200.8	$22.00	$22.00
1	Water	Nitrate 353.2 as N	$40.00	$40.00

CALIFORNIA SMALL BUSINESS 0001875

MasterCard VISA

Receipt

Invoice Number
2001107
Invoiced On
01/30/20

Invoice To
MCMILLEN JACOBS ASSOCIATES
JODI BURNS
1471 SHORELINE DRIVE SUITE 100
BOISE, ID 83702

Project
GENERAL TESTING

Project Contact
JODI BURNS
Project Number
FALL CREEK
PO Number

Work Order(s)
20A1078

basic laboratory

Thank you!

Basic Laboratory, Inc
2218 Railroad Avenue
Redding, CA 96001-2504
530-243-7234 x 203

Terms: Paid in Full

Quantity	Matrix	Analysis/Description	Unit Cost	Extended Cost
		Project turn around time: Standard		
1	Water	Nitrite 353.2 as N	$40.00	$40.00
1	Water	Nitrogen, Total	$115.00	$115.00
1	Water	Pb Total ICPMS 200.8	$22.00	$22.00
1	Water	pH 4500-H+	$25.00	$25.00
1	Water	Sample Handling & Disposal Fee	$1.00	$1.00
1	Water	Se Total ICPMS 200.8	$22.00	$22.00
1	Water	Sulfate 300.0	$30.00	$30.00
1	Water	Sulfide as H2S 4500S D	$55.00	$55.00
1	Water	Sulfur Total ICP 200.7	$22.00	$22.00
1	Water	TDS 2540C	$35.00	$35.00
1	Water	TSS 2540D	$35.00	$35.00
1	Water	V Total ICPMS 200.8	$22.00	$22.00
1	Water	Zn Total ICPMS 200.8	$22.00	$22.00
			Total Paid	**$1,090.00**

CALIFORNIA SMALL BUSINESS 0001875

Appendix B

CDFW Fall Creek Water Sampling – Fish Pathologist Report; Total Gas Pressure and Dissolved Oxygen Sampling

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Director's Office
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

FISH PATHOLOGIST REPORT

Location
Fall Creek Hatchery

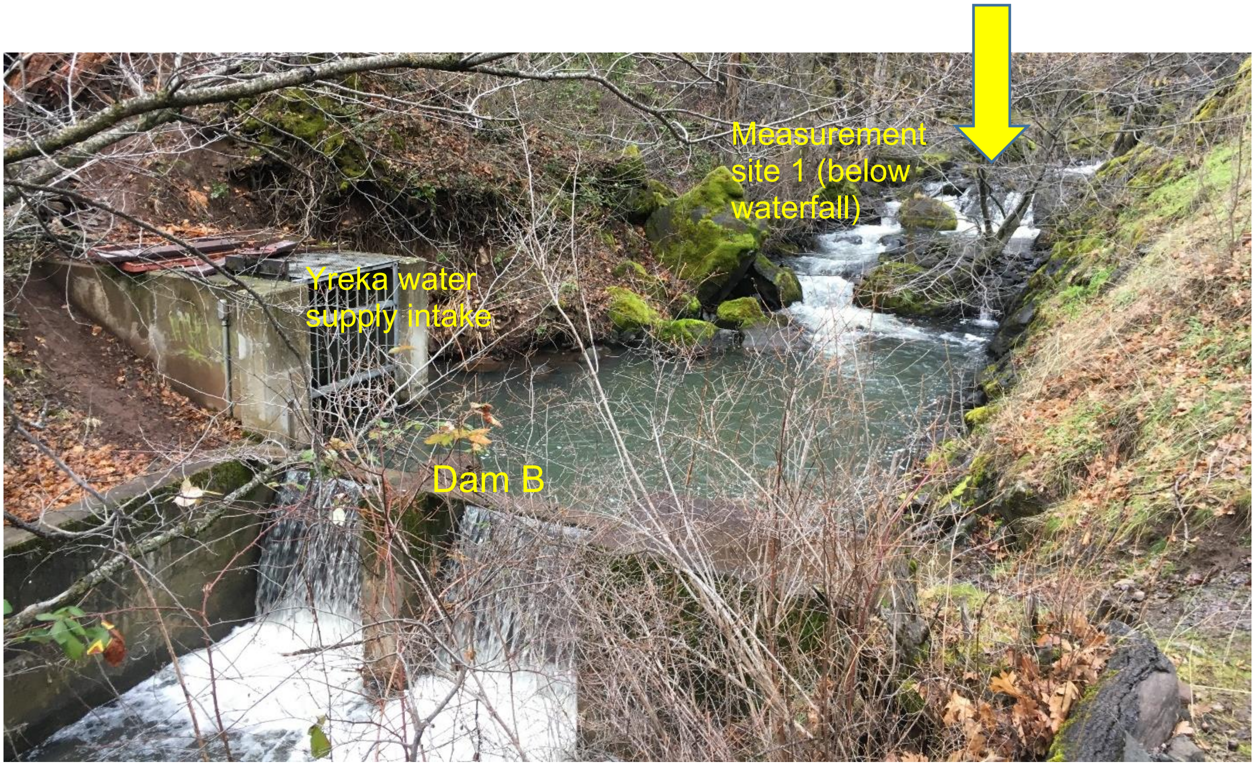
Date
4 February 2020

Background:

Fall Creek Hatchery, located above Iron Gate Lake, has been the backup facility to Iron Gate Hatchery in the past, and will become the primary facility when the Iron Gate Dam removal process is initiated. The facility water supply is sourced from southern Oregon mountain drainage, and includes a waterfall with two plunge-pools, and two smaller plunge-pools extending the width of the creek (created by Dam A and Dam B) all of which are upstream of the hatchery. A pipe intake from the first plunge-pool halfway up the waterfall provides supplemental water for the hatchery - the main intake is below Dam A (pictures 1-5). Plunge-pools below dams are a known source of water gas-supersaturation.

Hatchery water total gas pressure (TGP) and dissolved oxygen (DO) levels will be monitored over the next few months to assess whether increased flows due to spring run-off will create a gas supersaturation issue for future rearing of salmonids. Nitrogen and oxygen partial pressures were calculated from TGP and DO levels measured at three locations, and are summarized in the table below. The first measurement was taken downstream of the waterfall but upstream of Dam B, the second downstream of Dam A in the hatchery water intake from the creek, and the third measurement was in one of the hatchery raceways downstream of the spray-bar.

Picture 1: Fall Creek creates two plunge-pools upstream of the hatchery. The hatchery intake pipe is located near the upper plunge-pool (arrow)



Picture 2: Dam B (upstream of Dam A)

Picture 3: Dam A is below Dam B, both of which are below Fall Creek waterfall/plunge-pool.

Picture 4: Hatchery intake from Fall Creek below Dam B

Picture 5: Hatchery raceway-head spray-bar

Table 1: Fall Creek TGP/DO meter readings and % gas saturation - 2020

Date	Location	TGP mmHg/%	ºC	BP mmHg	dP mmHg	DO ppm	%N_2 sat	%O_2 sat
2/4	Below water-fall above Dam B (furthest upstream measurement)	712/101	5.0	706	6	11.87	101.1	100.2
2/4	Intake below Dam A	714/101	7.5	708	6	11.19	101.0	100.3
2/4	Raceway below spray-bar (furthest downstream measurement)	712/101	7.5	707	5	11.2	100.8	100.5

Comments:
None of the partial pressures constitute a concern at this point. If pressures increase during higher run-off flows, spray-bars with more, smaller holes could be installed to increase degassing surface area.

Submitted by:
Tresa Veek, Fish Pathologist, RS1, CDFW

Appendix C

City of Yreka Water Quality Sampling Dataset (1984-2020)

https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=4717&tinwsys_st_code=CA&counter=0

From: Burns, Jodi
To: Andrew Leman; Heindel, Jeff
Cc: Nelson, Derek
Subject: FW: KRRP - City of Yreka Dam A Historical Data
Date: Tuesday, April 28, 2020 9:10:58 AM
Attachments: RE YWSL kick-off meeting with KRRC.msg

Team,

FYI, see Rob Taylor's email below regarding locations for water quality results and flow information at Dam A. Also, attached are some drawings of Dam A and B.

Jeff, would you compile and review the water quality data?

Andrew, will you please review the drawings and the flow data. It looks like they have mostly provided their pumped flows from Dam A. I have also saved everything at the following location on Box:

\Box\Projects\Klamath River Renewal Corp\12.0 Fall Creek Facility\12.4 Design\12.4.2 Civil\City-of_Yreka_Data

Feel free to give me a call to discuss. I will review as well.

Thank you,

Jodi Burns, P.E.*
Project Manager/Civil Engineer

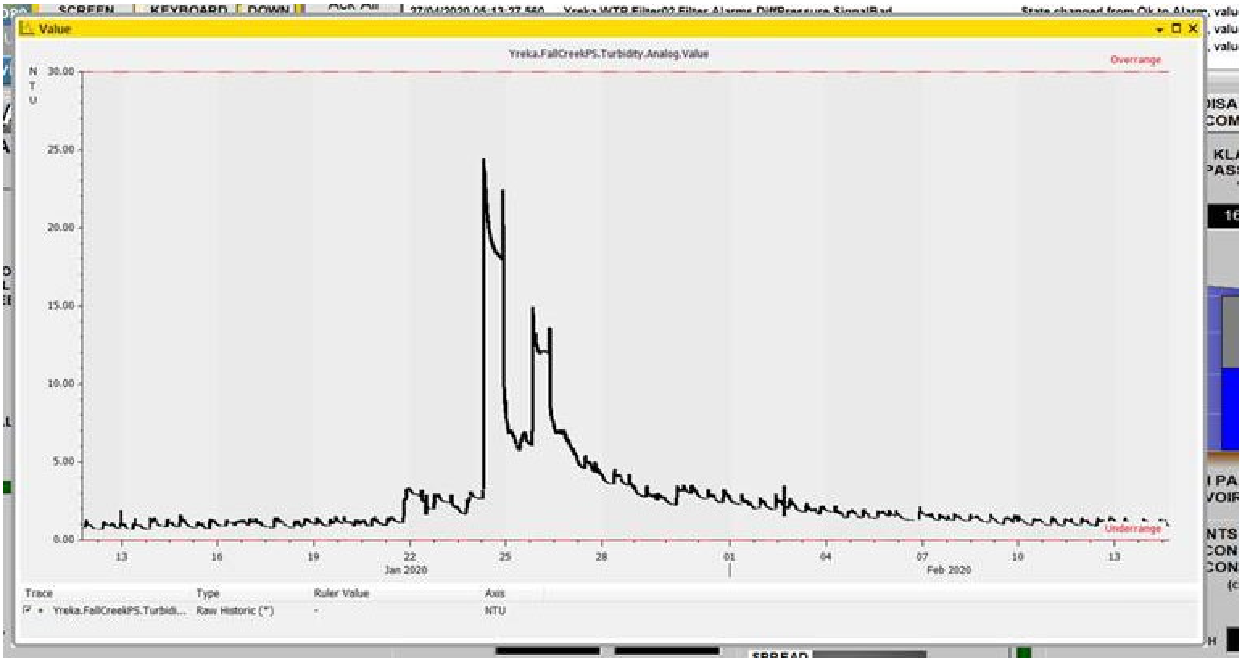
McMillen Jacobs Associates
1471 Shoreline Drive, Suite 100 |Boise, ID 83702
208.955.8278 d |208.342.4214 Ext:224 o |806.341.4166 c
jburns@mcmjac.com

***Idaho, Hawaii, Texas, Washington**

From: Rob Taylor <rtaylor@ci.yreka.ca.us>
Sent: Monday, April 27, 2020 4:30 PM
To: Burns, Jodi <burns@mcmjac.com>
Cc: Mark Bransom <mark@klamathrenewal.org>; McMillen, Morton D. <Mortmcmillen@mcmjac.com>; Matt Bray <MBray@ci.yreka.ca.us>
Subject: RE: KRRP - City of Yreka Dam A Historical Data

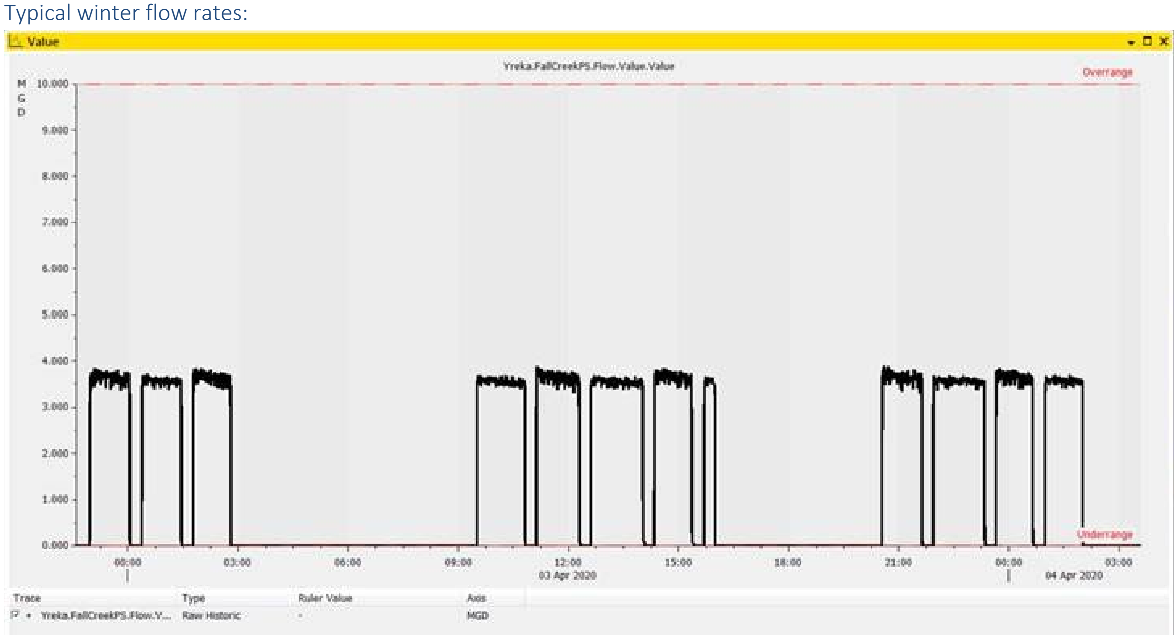
CAUTION: This email was received from an external source

Hi Jody,
I'm glad to help in any way I can. I've attached an email from last fall that details our limitations with continuously diverting water from the B dam. The email also has the original as-built schematics and details of the City's intake if needed.
Water Quality: The following link contains all the lab results of water quality testing.
https://sdwis.waterboards.ca.gov/PDWW/JSP/MonitoringResults.jsp?tinwsys_is_number=4717&tinwsys_st_code=CA&counter=0 PS code 4710011-002 samples were taken from the A dam impoundment. Coliform bacteria and E. coli test results are not listed, but are available if needed. We also have some turbidity data available through our SCADA system. We don't always take in and monitor raw water during periods of high turbidity since our treatment limit is about 15 NTU's. The graph shows an example what we have available. It gives an idea of peak NTU and duration. The data is available back to about summer of 2017.

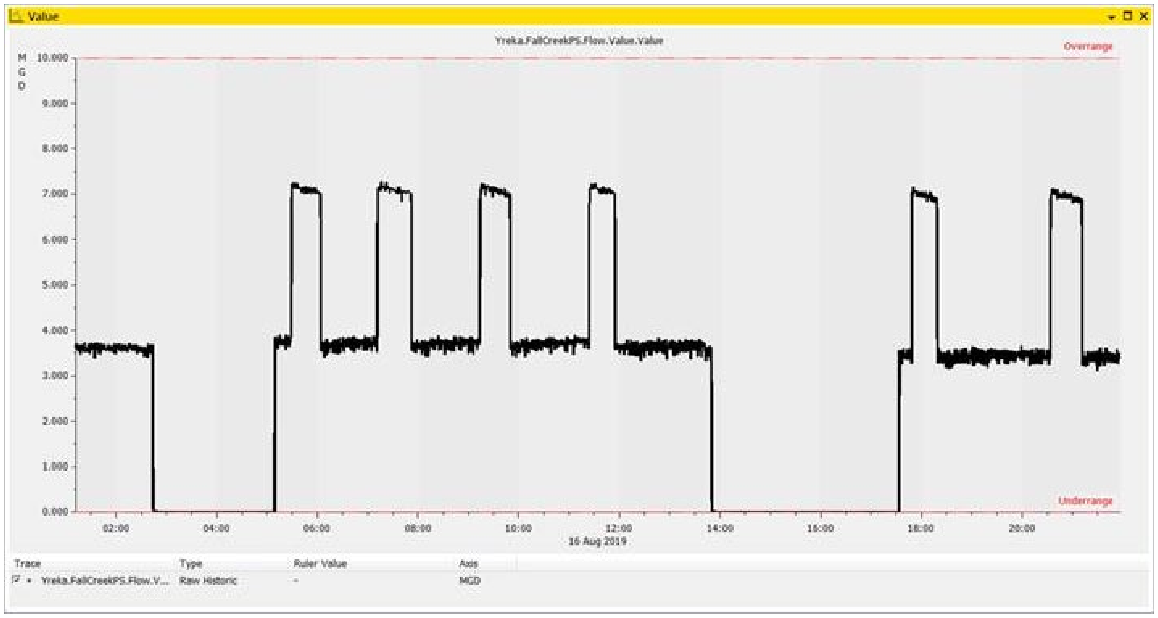


Flow Data: I've attached graphs showing typical flow rates for both winter and summer scenarios. The meter is located at the effluent side of the pump station and indicates our withdrawal rate at the A dam intake. Up to three pumps will be called upon to run based on tank level set points at the 135,000-gallon Klamath Pass tank. Three of our available four pumps are fixed speed and can do about 2500 gpm, so flows rates are about 6 cfs for one pump running, 11 cfs for two, and 15 cfs for all three. The forth (spare) pump is VFD controlled and can maintain a constant tank level sometimes in the winter when only one pump is sufficient.

Typical winter flow rates:



Typical summer flow rates:



Let me know if you have any questions or if you would like more detailed information. My office phone # is 530-841-2327.
Thanks, Rob

From: Burns, Jodi <burns@mcmjac.com>
Sent: Friday, April 24, 2020 9:50 AM
To: Rob Taylor <rtaylor@ci.yreka.ca.us>
Cc: Mark Bransom <mark@klamathrenewal.org>; McMillen, Morton D. <Mortmcmillen@mcmjac.com>
Subject: KRRP - City of Yreka Dam A Historical Data

Hello Robert,

Thank you for coordinating and attending the conference meeting held on April 22nd to discuss the Yreka water pipeline crossing and the Fall Creek Hatchery design. In the meeting you stated that you would be willing to provide McMillen Jacobs with historical flow data at Dam A to support the Fall Creek Hatchery design. Do you mind providing me with the flow data you referenced and potentially any historical water quality data that you may have for the Dam A site? We completed a water quality analysis in January but any additional water quality data would be helpful to gain an understanding of the water source.

Feel free to reach out or give me a call if you would like to discuss this data request further.

Thank you,

Jodi Burns, P.E.*
Project Manager/Civil Engineer

McMillen Jacobs Associates
1471 Shoreline Drive, Suite 100 |Boise, ID 83702
208.955.8278 d |208.342.4214 Ext:224 o |806.341.4166 c
jburns@mcmjac.com

***Idaho, Hawaii, Texas, Washington**

Water Quality Sampling Results

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
00010	SOURCE TEMPERATURE C	2011-11-02		15.7000	0.000	0.000	0.000	C
00081	COLOR	1985-10-01	<	5.0000	15.000	0.000	15.000	UNITS
00081	COLOR	1987-06-24	<	5.0000	15.000	0.000	15.000	UNITS
00081	COLOR	1988-06-23	<	5.0000	15.000	0.000	15.000	UNITS
00081	COLOR	1989-06-08	<	3.0000	15.000	0.000	15.000	UNITS
00081	COLOR	1990-06-26	<	3.0000	15.000	0.000	15.000	UNITS
00086	ODOR THRESHOLD @ 60 C	1985-10-01	<	.0000	3.000	0.000	3.000	TON
00086	ODOR THRESHOLD @ 60 C	1987-06-24	<	.0000	3.000	0.000	3.000	TON
00086	ODOR THRESHOLD @ 60 C	1988-06-23	<	.0000	3.000	0.000	3.000	TON
00086	ODOR THRESHOLD @ 60 C	1989-06-08	<	1.0000	3.000	0.000	3.000	TON
00086	ODOR THRESHOLD @ 60 C	1990-06-26	<	1.0000	3.000	0.000	3.000	TON
00095	SPECIFIC CONDUCTANCE	1984-09-11		151.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1985-10-01		146.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1986-08-13		150.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1987-06-24		154.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1988-06-23		150.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1989-06-08		200.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1990-06-26		170.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	1991-06-25		150.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	2005-11-02		145.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	2007-10-01		146.0000	1600.000	0.000	900.000	US
00095	SPECIFIC CONDUCTANCE	2011-11-02		150.0000	1600.000	0.000	900.000	US
00403	PH, LABORATORY	1984-09-11		7.8900	0.000	0.000	0.000	
00403	PH, LABORATORY	1985-10-01		7.9500	0.000	0.000	0.000	
00403	PH, LABORATORY	1986-08-13		7.4000	0.000	0.000	0.000	
00403	PH, LABORATORY	1987-06-24		7.8700	0.000	0.000	0.000	
00403	PH, LABORATORY	1988-06-23		7.2700	0.000	0.000	0.000	
00403	PH, LABORATORY	1989-06-08		8.2000	0.000	0.000	0.000	
00403	PH, LABORATORY	1990-06-26		7.6000	0.000	0.000	0.000	
00403	PH, LABORATORY	1991-06-25		7.9000	0.000	0.000	0.000	
00403	PH, LABORATORY	2005-11-02		7.9300	0.000	0.000	0.000	
00403	PH, LABORATORY	2011-11-02		7.9000	0.000	0.000	0.000	
00410	ALKALINITY (TOTAL) AS CACO3	1984-09-11		80.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1985-10-01		79.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1986-08-13		77.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1987-06-24		76.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1988-06-23		76.3000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1989-06-08		72.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1990-06-26		71.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	1991-06-25		72.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	2005-11-02		77.0000	0.000	0.000	0.000	MG/L
00410	ALKALINITY (TOTAL) AS CACO3	2011-11-02		77.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1984-09-11		97.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1985-10-01		96.3990	0.000	0.000	0.000	MG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
00440	BICARBONATE ALKALINITY	1986-08-13		94.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1987-06-24		93.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1988-06-23		93.1000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1989-06-08		71.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1990-06-26		71.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	1991-06-25		72.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	2005-11-02		94.0000	0.000	0.000	0.000	MG/L
00440	BICARBONATE ALKALINITY	2011-11-02		94.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1984-09-11	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1985-10-01	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1986-08-13	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1987-06-24	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1988-06-23	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1989-06-08		1.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1990-06-26	<	1.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	1991-06-25	<	1.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	2005-11-02	<	.0000	0.000	0.000	0.000	MG/L
00445	CARBONATE ALKALINITY	2011-11-02	<	.0000	0.000	0.000	0.000	MG/L
00618	NITRATE (AS N)	2015-08-24	<	0000000000	10.000	0.400	5.000	mg/L
00618	NITRATE (AS N)	2016-08-23	<	0000000000	10.000	0.400	5.000	mg/L
00618	NITRATE (AS N)	2017-08-23	<	0000000000	10.000	0.400	5.000	mg/L
00618	NITRATE (AS N)	2018-08-22	<	0000000000	10.000	0.400	5.000	mg/L
00618	NITRATE (AS N)	2019-08-07		0	10.000	0.400	5.000	mg/L
00620	NITRITE (AS N)	1997-01-28	<	.0000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2001-03-19	<	.0000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2005-11-02	<	.0000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2009-07-20	<	.0000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2012-08-27	<	.0000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2015-08-24	<	0000000000	1000.000	400.000	500.000	UG/L
00620	NITRITE (AS N)	2018-08-22	<	0000000000	1.000	0.400	0.500	mg/L
00680	TOTAL ORGANIC CARBON (TOC)	2011-08-30		1.3000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2012-08-27		.8000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2012-11-29		.5000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2013-02-25		.4000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2013-05-20		.3000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2013-08-29		.7000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2013-11-13		.5000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2014-02-26	<	.0000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2014-05-20		.5000	0.000	0.300	0.000	MG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
00680	TOTAL ORGANIC CARBON (TOC)	2014-08-20		.6000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2014-11-25		.7000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2015-02-24		.7000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2015-05-28	<	.0000	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2015-08-24		1.2	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2015-11-23		0.6	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2016-02-24		1.2	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2016-08-23		0.8	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2016-11-30		0.8	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2017-03-01		1.2	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2017-05-24		0.5	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2017-08-23		0.6	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2017-11-15		0.5	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2018-02-14		0.4	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2018-05-16		0.5	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2018-08-22		0.7	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2018-12-12		0.5	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2019-02-06		0.4	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2019-05-22		0.4	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2019-08-07		0.4	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2019-11-12		0.6	0.000	0.300	0.000	MG/L
00680	TOTAL ORGANIC CARBON (TOC)	2020-02-26		0.4	0.000	0.300	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1984-09-11		64.8990	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1985-10-01		68.0000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1987-06-24		68.5000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1988-06-23		62.0000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1989-06-08		65.0000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1990-06-26		63.0000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	1991-06-25		65.0000	0.000	0.000	0.000	MG/L
00900	HARDNESS (TOTAL) AS CACO3	2005-11-02		61.0000	0.000	0.000	0.000	MG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
00900	HARDNESS (TOTAL) AS CACO3	2011-11-02		74.0000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1984-09-11		14.1000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1985-10-01		15.4000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1986-08-13		13.2000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1987-06-24		13.6000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1988-06-23		12.9000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1989-06-08		13.0000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1990-06-26		14.0000	0.000	0.000	0.000	MG/L
00916	CALCIUM	1991-06-25		13.0000	0.000	0.000	0.000	MG/L
00916	CALCIUM	2005-11-02		12.6000	0.000	0.000	0.000	MG/L
00916	CALCIUM	2011-11-02		12.9000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1984-09-11		7.2200	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1985-10-01		7.1900	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1986-08-13		6.6000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1987-06-24		8.4000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1988-06-23		7.1500	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1989-06-08		8.0000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1990-06-26		6.9000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	1991-06-25		7.8000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	2005-11-02		7.4000	0.000	0.000	0.000	MG/L
00927	MAGNESIUM	2011-11-02		7.9400	0.000	0.000	0.000	MG/L
00929	SODIUM	1984-09-11		6.2200	0.000	0.000	0.000	MG/L
00929	SODIUM	1985-10-01		6.7100	0.000	0.000	0.000	MG/L
00929	SODIUM	1986-08-13		5.4000	0.000	0.000	0.000	MG/L
00929	SODIUM	1987-06-24		5.6000	0.000	0.000	0.000	MG/L
00929	SODIUM	1988-06-23		5.4600	0.000	0.000	0.000	MG/L
00929	SODIUM	1989-06-08		5.2000	0.000	0.000	0.000	MG/L
00929	SODIUM	1990-06-26		5.6000	0.000	0.000	0.000	MG/L
00929	SODIUM	1991-06-25		5.5000	0.000	0.000	0.000	MG/L
00929	SODIUM	2005-11-02		4.1500	0.000	0.000	0.000	MG/L
00929	SODIUM	2011-11-02		5.6500	0.000	0.000	0.000	MG/L
00937	POTASSIUM	2005-11-02		.8800	0.000	0.000	0.000	MG/L
00937	POTASSIUM	2011-11-02		1.1700	0.000	0.000	0.000	MG/L
00940	CHLORIDE	1984-09-11		1.7000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1985-10-01		2.3000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1986-08-13		1.0000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1987-06-24		4.0000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1988-06-23	<	1.0000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1989-06-08		1.1000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1990-06-26		1.7000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	1991-06-25		2.9000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	2005-11-02		1.0700	500.000	0.000	250.000	MG/L
00940	CHLORIDE	2007-10-01		1.2000	500.000	0.000	250.000	MG/L
00940	CHLORIDE	2011-11-02		1.1000	500.000	0.000	250.000	MG/L
00945	SULFATE	1984-09-11	<	1.0000	600.000	0.500	500.000	MG/L
00945	SULFATE	1985-10-01	<	1.0000	600.000	0.500	500.000	MG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
00945	SULFATE	1986-08-13	<	1.0000	600.000	0.500	500.000	MG/L
00945	SULFATE	1987-06-24	<	1.0000	600.000	0.500	500.000	MG/L
00945	SULFATE	1988-06-23		1.2000	600.000	0.500	500.000	MG/L
00945	SULFATE	1989-06-08	<	.5000	600.000	0.500	500.000	MG/L
00945	SULFATE	1990-06-26	<	.5000	600.000	0.500	500.000	MG/L
00945	SULFATE	1991-06-25		.7300	600.000	0.500	500.000	MG/L
00945	SULFATE	2005-11-02	<	.0000	500.000	0.500	250.000	MG/L
00945	SULFATE	2007-10-01	<	.0000	500.000	0.500	250.000	MG/L
00945	SULFATE	2011-11-02	<	.0000	500.000	0.500	250.000	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1984-09-11	<	.0500	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1985-10-01	<	.0600	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1986-08-13	<	.0500	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1987-06-24	<	.0500	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1988-06-23	<	.0600	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1989-06-08	<	.0500	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1990-06-26	<	.1000	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	1991-06-25	<	.1000	1.400	0.100	1.400	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	2005-11-02	<	.0000	2.000	0.100	2.000	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	2007-10-01	<	.0000	2.000	0.100	2.000	MG/L
00951	FLUORIDE (F) (NATURAL-SOURCE)	2016-08-23	<	0000000000	2.000	0.100	2.000	MG/L
01002	ARSENIC	1984-09-11	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1985-10-01	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1986-08-13	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1987-06-24	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1988-06-23	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1989-06-08	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1990-06-26	<	5.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	1991-06-25	<	10.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	2005-11-02	<	.0000	50.000	2.000	5.000	UG/L
01002	ARSENIC	2007-10-01	<	.0000	10.000	2.000	5.000	UG/L
01002	ARSENIC	2016-08-23	<	0000000000	10.000	2.000	5.000	UG/L
01007	BARIUM	1984-09-11	<	100.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1985-10-01	<	100.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1986-08-13	<	100.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1987-06-24	<	100.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1988-06-23	<	3.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1989-06-08	<	20.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	1990-06-26	<	20.0000	1000.000	100.000	1000.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
01007	BARIUM	1991-06-25	<	100.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	2005-11-02	<	.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	2007-10-01	<	.0000	1000.000	100.000	1000.000	UG/L
01007	BARIUM	2016-08-23	<	0000000000	1000.000	100.000	1000.000	UG/L
01012	BERYLLIUM	1997-01-28	<	.0000	4.000	1.000	4.000	UG/L
01012	BERYLLIUM	1998-03-30	<	.0000	4.000	1.000	4.000	UG/L
01012	BERYLLIUM	1999-10-18	<	.0000	4.000	1.000	4.000	UG/L
01012	BERYLLIUM	2009-07-20	<	.0000	4.000	1.000	4.000	UG/L
01012	BERYLLIUM	2018-08-22	<	0000000000	4.000	1.000	4.000	UG/L
01020	BORON	2001-12-28	<	.0000	0.000	100.000	1000.000	UG/L
01020	BORON	2002-04-10	<	.0000	0.000	100.000	1000.000	UG/L
01020	BORON	2002-06-24	<	.0000	0.000	100.000	1000.000	UG/L
01027	CADMIUM	1984-09-11	<	5.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1985-10-01	<	5.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1986-08-13	<	5.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1987-06-24		25.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1988-06-23	<	2.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1989-06-08	<	1.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1990-06-26	<	1.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	1991-06-25	<	1.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	2005-11-02	<	.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	2007-10-01	<	.0000	5.000	1.000	5.000	UG/L
01027	CADMIUM	2016-08-23	<	0000000000	5.000	1.000	5.000	UG/L
01032	CHROMIUM, HEXAVALENT	2014-09-29	<	.0000	10.000	1.000	10.000	UG/L
01032	CHROMIUM, HEXAVALENT	2015-08-24	<	1	10.000	1.000	10.000	UG/L
01032	CHROMIUM, HEXAVALENT	2016-08-23	<	0000000000	10.000	1.000	10.000	UG/L
01034	CHROMIUM (TOTAL)	1984-09-11	<	20.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1985-10-01	<	20.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1986-08-13	<	20.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1987-06-24	<	20.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1988-06-23	<	2.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1989-06-08	<	5.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1990-06-26	<	5.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	1991-06-25	<	10.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	2001-12-28		5.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	2007-10-01	<	.0000	50.000	10.000	50.000	UG/L
01034	CHROMIUM (TOTAL)	2016-08-23	<	0000000000	50.000	10.000	50.000	UG/L
01042	COPPER	1984-09-11	<	20.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1985-10-01	<	20.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1986-08-13	<	20.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1987-06-24	<	25.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1988-06-23	<	3.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1989-06-08	<	50.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1990-06-26		70.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	1991-06-25	<	50.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	2005-11-02	<	.0000	1000.000	50.000	1000.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
01042	COPPER	2007-10-01	<	.0000	1000.000	50.000	1000.000	UG/L
01042	COPPER	2011-11-02	<	.0000	1000.000	50.000	1000.000	UG/L
01045	IRON	1984-09-11	<	50.0000	300.000	100.000	300.000	UG/L
01045	IRON	1985-10-01	<	50.0000	300.000	100.000	300.000	UG/L
01045	IRON	1986-08-13	<	50.0000	300.000	100.000	300.000	UG/L
01045	IRON	1987-06-24	<	50.0000	300.000	100.000	300.000	UG/L
01045	IRON	1988-06-23	<	12.0000	300.000	100.000	300.000	UG/L
01045	IRON	1989-06-08	<	60.0000	300.000	100.000	300.000	UG/L
01045	IRON	1990-06-26	<	50.0000	300.000	100.000	300.000	UG/L
01045	IRON	1991-06-25		56.0000	300.000	100.000	300.000	UG/L
01045	IRON	2005-11-02	<	.0000	300.000	100.000	300.000	UG/L
01045	IRON	2007-10-01	<	.0000	300.000	100.000	300.000	UG/L
01045	IRON	2011-11-02	<	.0000	300.000	100.000	300.000	UG/L
01051	LEAD	1984-09-11	<	25.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1985-10-01	<	25.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1986-08-13	<	25.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1987-06-24	<	25.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1988-06-23	<	5.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1989-06-08	<	5.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1990-06-26	<	5.0000	0.000	5.000	15.000	UG/L
01051	LEAD	1991-06-25	<	5.0000	0.000	5.000	15.000	UG/L
01055	MANGANESE	1984-09-11	<	10.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1985-10-01	<	10.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1986-08-13	<	10.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1987-06-24	<	10.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1988-06-23	<	1.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1989-06-08	<	30.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1990-06-26	<	30.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	1991-06-25	<	30.0000	50.000	10.000	50.000	UG/L
01055	MANGANESE	2005-11-02	<	.0000	50.000	20.000	50.000	UG/L
01055	MANGANESE	2007-10-01	<	.0000	50.000	20.000	50.000	UG/L
01055	MANGANESE	2011-11-02	<	.0000	50.000	20.000	50.000	UG/L
01059	THALLIUM	1997-01-28	<	.0000	2.000	1.000	2.000	UG/L
01059	THALLIUM	1998-03-30	<	.0000	2.000	1.000	2.000	UG/L
01059	THALLIUM	1999-10-18	<	.0000	2.000	1.000	2.000	UG/L
01059	THALLIUM	2009-07-20	<	.0000	2.000	1.000	2.000	UG/L
01059	THALLIUM	2018-08-22	<	0000000000	2.000	1.000	2.000	UG/L
01067	NICKEL	1997-01-28	<	.0000	100.000	10.000	100.000	UG/L
01067	NICKEL	1998-03-30	<	.0000	100.000	10.000	100.000	UG/L
01067	NICKEL	1999-10-18	<	.0000	100.000	10.000	100.000	UG/L
01067	NICKEL	2009-07-20	<	.0000	100.000	10.000	100.000	UG/L
01067	NICKEL	2018-08-22	<	0000000000	100.000	10.000	100.000	UG/L
01077	SILVER	1984-09-11	<	20.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1985-10-01	<	20.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1986-08-13	<	20.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1987-06-24	<	5.0000	100.000	10.000	100.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
01077	SILVER	1988-06-23	<	10.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1989-06-08	<	2.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1990-06-26	<	2.0000	100.000	10.000	100.000	UG/L
01077	SILVER	1991-06-25	<	10.0000	100.000	10.000	100.000	UG/L
01077	SILVER	2005-11-02	<	.0000	100.000	10.000	100.000	UG/L
01077	SILVER	2007-10-01	<	.0000	100.000	10.000	100.000	UG/L
01077	SILVER	2016-08-23	<	0000000000	100.000	10.000	100.000	UG/L
01087	VANADIUM	2001-12-28		6.0000	0.000	3.000	50.000	UG/L
01087	VANADIUM	2002-04-10		10.0000	0.000	3.000	50.000	UG/L
01087	VANADIUM	2002-06-24		9.0000	0.000	3.000	50.000	UG/L
01092	ZINC	1984-09-11	<	20.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1985-10-01	<	20.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1986-08-13	<	20.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1987-06-24	<	28.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1988-06-23	<	18.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1989-06-08		100.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1990-06-26	<	50.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	1991-06-25	<	50.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	2005-11-02	<	.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	2007-10-01	<	.0000	5000.000	50.000	5000.000	UG/L
01092	ZINC	2011-11-02	<	.0000	5000.000	50.000	5000.000	UG/L
01097	ANTIMONY	1997-01-28	<	.0000	6.000	6.000	6.000	UG/L
01097	ANTIMONY	1998-03-30	<	.0000	6.000	6.000	6.000	UG/L
01097	ANTIMONY	1999-10-18	<	.0000	6.000	6.000	6.000	UG/L
01097	ANTIMONY	2009-07-20	<	.0000	6.000	6.000	6.000	UG/L
01097	ANTIMONY	2018-08-22	<	0000000000	6.000	6.000	6.000	UG/L
01105	ALUMINUM	1989-06-08	<	.2000	1000.000	50.000	200.000	UG/L
01105	ALUMINUM	1990-06-26	<	100.0000	1000.000	50.000	200.000	UG/L
01105	ALUMINUM	1991-06-25	<	100.0000	1000.000	50.000	200.000	UG/L
01105	ALUMINUM	2005-11-02		66.6000	1000.000	50.000	200.000	UG/L
01105	ALUMINUM	2007-10-01		51.5000	1000.000	50.000	200.000	UG/L
01105	ALUMINUM	2016-08-23		83	1000.000	50.000	200.000	UG/L
01147	SELENIUM	1984-09-11	<	10.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1985-10-01	<	10.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1986-08-13	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1987-06-24	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1988-06-23	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1989-06-08	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1990-06-26	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	1991-06-25	<	5.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	2005-11-02	<	.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	2007-10-01	<	.0000	50.000	5.000	50.000	UG/L
01147	SELENIUM	2016-08-23	<	0000000000	50.000	5.000	50.000	UG/L
01501	GROSS ALPHA	1989-06-08		.3800	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2001-03-19	<	1.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2001-06-28	<	1.0000	15.000	3.000	5.000	PCI/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
01501	GROSS ALPHA	2001-09-25	<	1.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2001-12-28	<	1.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2005-11-02	<	3.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2008-10-07	<	.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2009-01-13	<	.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2009-04-08	<	.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2009-07-20	<	.0000	15.000	3.000	5.000	PCI/L
01501	GROSS ALPHA	2018-08-22	<	3	15.000	3.000	5.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	1989-06-08		1.2900	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2001-03-19		.4000	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2001-06-28		.4000	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2001-09-25		.4000	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2001-12-28		.4000	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2005-11-02		1.0000	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2008-10-07		.8200	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2009-01-13		.8200	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2009-04-08		.8200	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2009-07-20		.8200	0.000	0.000	0.000	PCI/L
01502	GROSS ALPHA COUNTING ERROR	2018-08-22		0.385	0.000	0.000	0.000	PCI/L
11501	RADIUM 228	2008-10-07	<	1.0000	0.000	1.000	0.000	PCI/L
11501	RADIUM 228	2009-01-13	<	1.0000	0.000	1.000	0.000	PCI/L
11501	RADIUM 228	2009-04-08	<	1.0000	0.000	1.000	0.000	PCI/L
11501	RADIUM 228	2009-07-20	<	1.0000	0.000	1.000	0.000	PCI/L
11502	RADIUM 228 COUNTING ERROR	2008-10-07		.6000	0.000	0.000	0.000	PCI/L
11502	RADIUM 228 COUNTING ERROR	2009-01-13		.6000	0.000	0.000	0.000	PCI/L
11502	RADIUM 228 COUNTING ERROR	2009-04-08		.6000	0.000	0.000	0.000	PCI/L
11502	RADIUM 228 COUNTING ERROR	2009-07-20		.6000	0.000	0.000	0.000	PCI/L
32101	BROMODICHLOROMETHANE (THM)	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
32101	BROMODICHLOROMETHANE (THM)	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
32101	BROMODICHLOROMETHANE (THM)	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
32101	BROMODICHLOROMETHANE (THM)	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
32102	CARBON TETRACHLORIDE	1989-06-08	<	.0000	0.500	0.500	0.500	UG/L
32102	CARBON TETRACHLORIDE	1989-11-08	<	.0000	0.500	0.500	0.500	UG/L
32102	CARBON TETRACHLORIDE	2000-01-31	<	.0000	0.500	0.500	0.500	UG/L
32102	CARBON TETRACHLORIDE	2004-01-26	<	.5000	0.500	0.500	0.500	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
32104	BROMOFORM (THM)	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
32104	BROMOFORM (THM)	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
32104	BROMOFORM (THM)	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
32104	BROMOFORM (THM)	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
32105	DIBROMOCHLOROMETHANE (THM)	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
32105	DIBROMOCHLOROMETHANE (THM)	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
32105	DIBROMOCHLOROMETHANE (THM)	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
32105	DIBROMOCHLOROMETHANE (THM)	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
32106	CHLOROFORM (THM)	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
32106	CHLOROFORM (THM)	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
32106	CHLOROFORM (THM)	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
32106	CHLOROFORM (THM)	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
34010	TOLUENE	1989-06-08	<	.0000	150.000	0.500	0.500	UG/L
34010	TOLUENE	1989-11-08	<	.0000	150.000	0.500	0.500	UG/L
34010	TOLUENE	2000-01-31	<	.0000	150.000	0.500	0.500	UG/L
34010	TOLUENE	2004-01-26	<	.5000	150.000	0.500	0.500	UG/L
34030	BENZENE	1989-06-08	<	.0000	1.000	0.500	0.500	UG/L
34030	BENZENE	1989-11-08	<	.0000	1.000	0.500	0.500	UG/L
34030	BENZENE	2000-01-31	<	.0000	1.000	0.500	0.500	UG/L
34030	BENZENE	2004-01-26	<	.5000	1.000	0.500	0.500	UG/L
34301	MONOCHLOROBENZENE	1989-06-08	<	.0000	70.000	0.500	0.500	UG/L
34301	MONOCHLOROBENZENE	1989-11-08	<	.0000	70.000	0.500	0.500	UG/L
34301	MONOCHLOROBENZENE	2000-01-31	<	.0000	70.000	0.500	0.500	UG/L
34301	MONOCHLOROBENZENE	2004-01-26	<	.5000	70.000	0.500	0.500	UG/L
34311	CHLOROETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
34311	CHLOROETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
34311	CHLOROETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
34311	CHLOROETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
34371	ETHYL BENZENE	1989-06-08	<	.0000	700.000	0.500	0.500	UG/L
34371	ETHYL BENZENE	1989-11-08	<	.0000	700.000	0.500	0.500	UG/L
34371	ETHYL BENZENE	2000-01-31	<	.0000	700.000	0.500	0.500	UG/L
34371	ETHYL BENZENE	2004-01-26	<	.5000	300.000	0.500	0.500	UG/L
34391	HEXACHLOROBUTADIENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
34391	HEXACHLOROBUTADIENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
34391	HEXACHLOROBUTADIENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
34391	HEXACHLOROBUTADIENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
34413	BROMOMETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
34413	BROMOMETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
34413	BROMOMETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
34413	BROMOMETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
34418	CHLOROMETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
34418	CHLOROMETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
34418	CHLOROMETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
34418	CHLOROMETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
34423	DICHLOROMETHANE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34423	DICHLOROMETHANE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
34423	DICHLOROMETHANE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34423	DICHLOROMETHANE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34475	TETRACHLOROETHYLENE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34475	TETRACHLOROETHYLENE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
34475	TETRACHLOROETHYLENE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34475	TETRACHLOROETHYLENE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34488	TRICHLOROFLUOROMETHANE FREON 11	1989-06-08	<	.0000	150.000	5.000	5.000	UG/L
34488	TRICHLOROFLUOROMETHANE FREON 11	1989-11-08	<	.0000	150.000	5.000	5.000	UG/L
34488	TRICHLOROFLUOROMETHANE FREON 11	2000-01-31	<	.0000	150.000	5.000	5.000	UG/L
34488	TRICHLOROFLUOROMETHANE FREON 11	2004-01-26	<	.5000	150.000	5.000	5.000	UG/L
34496	1,1-DICHLOROETHANE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34496	1,1-DICHLOROETHANE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
34496	1,1-DICHLOROETHANE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34496	1,1-DICHLOROETHANE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34501	1,1-DICHLOROETHYLENE	1989-06-08	<	.0000	6.000	0.500	0.500	UG/L
34501	1,1-DICHLOROETHYLENE	1989-11-08	<	.0000	6.000	0.500	0.500	UG/L
34501	1,1-DICHLOROETHYLENE	2000-01-31	<	.0000	6.000	0.500	0.500	UG/L
34501	1,1-DICHLOROETHYLENE	2004-01-26	<	.5000	6.000	0.500	0.500	UG/L
34506	1,1,1-TRICHLOROETHANE	1989-06-08	<	.0000	200.000	0.500	0.500	UG/L
34506	1,1,1-TRICHLOROETHANE	1989-11-08	<	.0000	200.000	0.500	0.500	UG/L
34506	1,1,1-TRICHLOROETHANE	2000-01-31	<	.0000	200.000	0.500	0.500	UG/L
34506	1,1,1-TRICHLOROETHANE	2004-01-26	<	.5000	200.000	0.500	0.500	UG/L
34511	1,1,2-TRICHLOROETHANE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34511	1,1,2-TRICHLOROETHANE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
34511	1,1,2-TRICHLOROETHANE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34511	1,1,2-TRICHLOROETHANE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34516	1,1,2,2-TETRACHLOROETHANE	1989-06-08	<	.0000	1.000	0.500	0.500	UG/L
34516	1,1,2,2-TETRACHLOROETHANE	1989-11-08	<	.0000	1.000	0.500	0.500	UG/L
34516	1,1,2,2-TETRACHLOROETHANE	2000-01-31	<	.0000	1.000	0.500	0.500	UG/L
34516	1,1,2,2-TETRACHLOROETHANE	2004-01-26	<	.5000	1.000	0.500	0.500	UG/L
34531	1,2-DICHLOROETHANE	1989-06-08	<	.0000	0.500	0.500	0.500	UG/L
34531	1,2-DICHLOROETHANE	1989-11-08	<	.0000	0.500	0.500	0.500	UG/L
34531	1,2-DICHLOROETHANE	2000-01-31	<	.0000	0.500	0.500	0.500	UG/L
34531	1,2-DICHLOROETHANE	2004-01-26	<	.5000	0.500	0.500	0.500	UG/L
34536	1,2-DICHLOROBENZENE	1989-06-08	<	.0000	600.000	0.500	0.500	UG/L
34536	1,2-DICHLOROBENZENE	1989-11-08	<	.0000	600.000	0.500	0.500	UG/L
34536	1,2-DICHLOROBENZENE	2000-01-31	<	.0000	600.000	0.500	0.500	UG/L
34536	1,2-DICHLOROBENZENE	2004-01-26	<	.5000	600.000	0.500	0.500	UG/L
34541	1,2-DICHLOROPROPANE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34541	1,2-DICHLOROPROPANE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
34541	1,2-DICHLOROPROPANE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34541	1,2-DICHLOROPROPANE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34546	TRANS-1,2-DICHLOROETHYLENE	1989-06-08	<	.0000	10.000	0.500	0.500	UG/L
34546	TRANS-1,2-DICHLOROETHYLENE	1989-11-08	<	.0000	10.000	0.500	0.500	UG/L
34546	TRANS-1,2-DICHLOROETHYLENE	2000-01-31	<	.0000	10.000	0.500	0.500	UG/L
34546	TRANS-1,2-DICHLOROETHYLENE	2004-01-26	<	.5000	10.000	0.500	0.500	UG/L
34551	1,2,4-TRICHLOROBENZENE	1989-06-08	<	.0000	70.000	0.500	0.500	UG/L
34551	1,2,4-TRICHLOROBENZENE	1989-11-08	<	.0000	70.000	0.500	0.500	UG/L
34551	1,2,4-TRICHLOROBENZENE	2000-01-31	<	.0000	70.000	0.500	0.500	UG/L
34551	1,2,4-TRICHLOROBENZENE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34561	1,3-DICHLOROPROPENE (TOTAL)	1989-06-08	<	.0000	0.500	0.500	0.500	UG/L
34561	1,3-DICHLOROPROPENE (TOTAL)	1989-11-08	<	.0000	0.500	0.500	0.500	UG/L
34561	1,3-DICHLOROPROPENE (TOTAL)	2000-01-31	<	.0000	0.500	0.500	0.500	UG/L
34561	1,3-DICHLOROPROPENE (TOTAL)	2004-01-26	<	.5000	0.500	0.500	0.500	UG/L
34566	1,3-DICHLOROBENZENE	1989-06-08	<	.0000	0.000	0.500	600.000	UG/L
34566	1,3-DICHLOROBENZENE	1989-11-08	<	.0000	0.000	0.500	600.000	UG/L
34566	1,3-DICHLOROBENZENE	2000-01-31	<	.0000	0.000	0.500	600.000	UG/L
34566	1,3-DICHLOROBENZENE	2004-01-26	<	.5000	0.000	0.500	600.000	UG/L
34571	1,4-DICHLOROBENZENE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
34571	1,4-DICHLOROBENZENE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
34571	1,4-DICHLOROBENZENE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
34571	1,4-DICHLOROBENZENE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
34576	2-CHLOROETHYLVINYL ETHER	2000-01-31	<	.0000	0.000	1.000	0.000	UG/L
34668	DICHLORODIFLUOROMETHANE (FREON 12)	1989-06-08	<	.0000	0.000	1.000	1.000	UG/L
34668	DICHLORODIFLUOROMETHANE (FREON 12)	1989-11-08	<	.0000	0.000	1.000	1.000	UG/L
34668	DICHLORODIFLUOROMETHANE (FREON 12)	2000-01-31	<	.0000	0.000	1.000	1.000	UG/L
34668	DICHLORODIFLUOROMETHANE (FREON 12)	2004-01-26	<	.5000	0.000	0.500	1000.000	UG/L
34696	NAPHTHALENE	1989-06-08	<	.0000	0.000	0.500	17.000	UG/L
34696	NAPHTHALENE	1989-11-08	<	.0000	0.000	0.500	17.000	UG/L
34696	NAPHTHALENE	2004-01-26	<	.5000	0.000	0.500	17.000	UG/L
38260	FOAMING AGENTS (MBAS)	1984-09-11	<	.0500	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1985-10-01	<	.0500	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1986-08-13	<	.0500	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1987-06-24	<	.0500	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1988-06-23	<	.0200	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1989-06-08	<	.0200	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	1990-06-26	<	.0200	500.000	0.000	500.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
38260	FOAMING AGENTS (MBAS)	1991-06-25	<	.0200	500.000	0.000	500.000	UG/L
38260	FOAMING AGENTS (MBAS)	2005-11-02	<	.0000	0.500	0.000	0.500	MG/L
38260	FOAMING AGENTS (MBAS)	2007-10-01		.0200	0.500	0.000	0.500	MG/L
38260	FOAMING AGENTS (MBAS)	2011-11-02	<	.0000	0.500	0.000	0.500	MG/L
38761	DIBROMOCHLOROPROPANE (DBCP)	2004-01-26	<	1.0000	0.200	0.010	0.010	UG/L
39033	ATRAZINE	1989-06-08	<	1.0000	3.000	1.000	1.000	UG/L
39045	2,4,5-TP (SILVEX)	1985-10-01	<	.1000	50.000	1.000	1.000	UG/L
39045	2,4,5-TP (SILVEX)	1988-06-23	<	.1000	50.000	1.000	1.000	UG/L
39045	2,4,5-TP (SILVEX)	1989-09-27	<	1.0000	50.000	1.000	1.000	UG/L
39055	SIMAZINE	1989-06-08	<	1.0000	4.000	1.000	1.000	UG/L
39175	VINYL CHLORIDE	1989-06-08	<	.0000	0.500	0.500	0.500	UG/L
39175	VINYL CHLORIDE	1989-11-08	<	.0000	0.500	0.500	0.500	UG/L
39175	VINYL CHLORIDE	2000-01-31	<	.0000	0.500	0.500	0.500	UG/L
39175	VINYL CHLORIDE	2004-01-26	<	.5000	0.500	0.500	0.500	UG/L
39180	TRICHLOROETHYLENE	1989-06-08	<	.0000	5.000	0.500	0.500	UG/L
39180	TRICHLOROETHYLENE	1989-11-08	<	.0000	5.000	0.500	0.500	UG/L
39180	TRICHLOROETHYLENE	2000-01-31	<	.0000	5.000	0.500	0.500	UG/L
39180	TRICHLOROETHYLENE	2004-01-26	<	.5000	5.000	0.500	0.500	UG/L
39340	LINDANE	1985-10-01	<	.1000	0.200	0.200	0.200	UG/L
39340	LINDANE	1988-06-23	<	.1000	0.200	0.200	0.200	UG/L
39340	LINDANE	1989-09-27	<	.4000	0.200	0.200	0.200	UG/L
39390	ENDRIN	1985-10-01	<	.1000	2.000	0.100	0.100	UG/L
39390	ENDRIN	1988-06-23	<	.0100	2.000	0.100	0.100	UG/L
39390	ENDRIN	1989-09-27	<	.0100	2.000	0.100	0.100	UG/L
39400	TOXAPHENE	1985-10-01	<	1.0000	3.000	1.000	1.000	UG/L
39400	TOXAPHENE	1988-06-23	<	.5000	3.000	1.000	1.000	UG/L
39400	TOXAPHENE	1989-09-27	<	.5000	3.000	1.000	1.000	UG/L
39480	METHOXYCHLOR	1985-10-01	<	1.0000	40.000	10.000	10.000	UG/L
39480	METHOXYCHLOR	1988-06-23	<	1.0000	40.000	10.000	10.000	UG/L
39480	METHOXYCHLOR	1989-09-27	<	10.0000	40.000	10.000	10.000	UG/L
39730	2,4-D	1985-10-01	<	1.0000	70.000	10.000	10.000	UG/L
39730	2,4-D	1988-06-23	<	1.0000	70.000	10.000	10.000	UG/L
39730	2,4-D	1989-09-27	<	10.0000	70.000	10.000	10.000	UG/L
46491	METHYL-TERT-BUTYL-ETHER (MTBE)	2000-01-31	<	.0000	13.000	3.000	3.000	UG/L
46491	METHYL-TERT-BUTYL-ETHER (MTBE)	2004-01-26	<	.5000	13.000	3.000	3.000	UG/L
70300	TOTAL DISSOLVED SOLIDS	1984-09-11		85.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1985-10-01		89.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1986-08-13		93.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1987-06-24		114.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1988-06-23		131.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1989-06-08		96.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1990-06-26		120.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	1991-06-25		140.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	2005-11-02		92.0000	1000.000	0.000	500.000	MG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
70300	TOTAL DISSOLVED SOLIDS	2007-10-01		122.0000	1000.000	0.000	500.000	MG/L
70300	TOTAL DISSOLVED SOLIDS	2011-11-02		107.0000	1000.000	0.000	500.000	MG/L
71814	LANGELIER INDEX AT SOURCE TEMP.	2005-11-02	-	.5900	0.000	0.000	0.000	
71814	LANGELIER INDEX AT SOURCE TEMP.	2011-11-02	-	.4900	0.000	0.000	0.000	
71830	HYDROXIDE ALKALINITY	1989-06-08	<	1.0000	0.000	0.000	0.000	MG/L
71830	HYDROXIDE ALKALINITY	1990-06-26	<	1.0000	0.000	0.000	0.000	MG/L
71830	HYDROXIDE ALKALINITY	1991-06-25	<	1.0000	0.000	0.000	0.000	MG/L
71830	HYDROXIDE ALKALINITY	2005-11-02	<	.0000	0.000	0.000	0.000	MG/L
71830	HYDROXIDE ALKALINITY	2011-11-02	<	.0000	0.000	0.000	0.000	MG/L
71850	NITRATE (AS NO3)	1984-09-11		.5700	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1985-10-01		1.3700	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1986-08-13	<	.2200	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1987-06-24		.0900	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1988-06-23		1.4600	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1989-06-08	<	.1000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1990-06-26	<	.1000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1991-06-25		.2100	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1997-01-28	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1998-03-30	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1998-04-30	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1998-07-28	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	1999-10-18	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2001-03-19	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2004-01-07	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2005-11-02	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2006-03-06	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2007-04-08	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2008-10-07	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2009-07-20	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2010-11-30	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2011-08-30	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2012-08-27	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2013-08-29	<	.0000	45.000	2.000	23.000	MG/L
71850	NITRATE (AS NO3)	2014-08-20	<	.0000	45.000	2.000	23.000	MG/L
71900	MERCURY	1984-09-11	<	1.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	1985-10-01	<	1.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	1986-08-13	<	.5000	2.000	1.000	2.000	UG/L
71900	MERCURY	1987-06-24	<	.5000	2.000	1.000	2.000	UG/L
71900	MERCURY	1988-06-23	<	.2000	2.000	1.000	2.000	UG/L
71900	MERCURY	1989-06-08	<	1.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	1990-06-26	<	1.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	1991-06-25	<	.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	2005-11-02	<	.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	2007-10-01	<	.0000	2.000	1.000	2.000	UG/L
71900	MERCURY	2016-08-23	<	1	2.000	1.000	2.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
77035	TERT-BUTYL ALCOHOL (TBA)	2004-01-26	<	5.0000	0.000	2.000	12.000	UG/L
77093	CIS-1,2-DICHLOROETHYLENE	1989-06-08	<	.0000	6.000	0.500	0.500	UG/L
77093	CIS-1,2-DICHLOROETHYLENE	1989-11-08	<	.0000	6.000	0.500	0.500	UG/L
77093	CIS-1,2-DICHLOROETHYLENE	2000-01-31	<	.0000	6.000	0.500	0.500	UG/L
77093	CIS-1,2-DICHLOROETHYLENE	2004-01-26	<	.5000	6.000	0.500	0.500	UG/L
77128	STYRENE	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
77128	STYRENE	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
77128	STYRENE	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
77128	STYRENE	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
77135	O-XYLENE	1989-06-08	<	.0000	1750.000	0.500	1750.000	UG/L
77135	O-XYLENE	1989-11-08	<	.0000	1750.000	0.500	1750.000	UG/L
77135	O-XYLENE	2000-01-31	<	.0000	1750.000	0.500	1750.000	UG/L
77135	O-XYLENE	2004-01-26	<	.5000	1750.000	0.500	1750.000	UG/L
77168	1,1-DICHLOROPROPENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77168	1,1-DICHLOROPROPENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77168	1,1-DICHLOROPROPENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77168	1,1-DICHLOROPROPENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77170	2,2-DICHLOROPROPANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77170	2,2-DICHLOROPROPANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77170	2,2-DICHLOROPROPANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77170	2,2-DICHLOROPROPANE	2004-01-26	<	2.0000	0.000	0.500	0.500	UG/L
77173	1,3-DICHLOROPROPANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77173	1,3-DICHLOROPROPANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77173	1,3-DICHLOROPROPANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77173	1,3-DICHLOROPROPANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77222	1,2,4-TRIMETHYLBENZENE	1989-06-08	<	.0000	0.000	0.500	330.000	UG/L
77222	1,2,4-TRIMETHYLBENZENE	1989-11-08	<	.0000	0.000	0.500	330.000	UG/L
77222	1,2,4-TRIMETHYLBENZENE	2000-01-31	<	.0000	0.000	0.500	330.000	UG/L
77222	1,2,4-TRIMETHYLBENZENE	2004-01-26	<	.5000	0.000	0.500	330.000	UG/L
77223	ISOPROPYLBENZENE	1989-06-08	<	.0000	0.000	0.500	770.000	UG/L
77223	ISOPROPYLBENZENE	1989-11-08	<	.0000	0.000	0.500	770.000	UG/L
77223	ISOPROPYLBENZENE	2000-01-31	<	.0000	0.000	0.500	770.000	UG/L
77223	ISOPROPYLBENZENE	2004-01-26	<	.5000	0.000	0.500	770.000	UG/L
77224	N-PROPYLBENZENE	1989-06-08	<	.0000	0.000	0.500	260.000	UG/L
77224	N-PROPYLBENZENE	1989-11-08	<	.0000	0.000	0.500	260.000	UG/L
77224	N-PROPYLBENZENE	2000-01-31	<	.0000	0.000	0.500	260.000	UG/L
77224	N-PROPYLBENZENE	2004-01-26	<	.5000	0.000	0.500	260.000	UG/L
77226	1,3,5-TRIMETHYLBENZENE	1989-06-08	<	.0000	0.000	0.500	330.000	UG/L
77226	1,3,5-TRIMETHYLBENZENE	1989-11-08	<	.0000	0.000	0.500	330.000	UG/L
77226	1,3,5-TRIMETHYLBENZENE	2000-01-31	<	.0000	0.000	0.500	330.000	UG/L
77226	1,3,5-TRIMETHYLBENZENE	2004-01-26	<	.5000	0.000	0.500	330.000	UG/L
77350	SEC-BUTYLBENZENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77350	SEC-BUTYLBENZENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77350	SEC-BUTYLBENZENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77350	SEC-BUTYLBENZENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77353	TERT-BUTYLBENZENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
77353	TERT-BUTYLBENZENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77353	TERT-BUTYLBENZENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77353	TERT-BUTYLBENZENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77443	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	2018-02-14	<	0000000000	0.005	0.005	0.005	UG/L
7744X	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	1989-06-08	<	.0000	0.000	0.500	0.005	UG/L
7744X	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	1989-11-08	<	.0000	0.000	0.500	0.005	UG/L
7744X	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	2000-01-31	<	.0000	0.000	0.500	0.005	UG/L
7744X	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	2004-01-26	<	.5000	0.000	0.005	0.005	UG/L
7744X	1,2,3-TRICHLOROPROPANE (1,2,3-TCP)	2004-01-26	<	.0000	0.000	0.005	0.005	UG/L
77562	1,1,1,2-TETRACHLOROETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77562	1,1,1,2-TETRACHLOROETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77562	1,1,1,2-TETRACHLOROETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77562	1,1,1,2-TETRACHLOROETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77596	DIBROMOMETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77596	DIBROMOMETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77596	DIBROMOMETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77596	DIBROMOMETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77613	1,2,3-TRICHLOROBENZENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
77613	1,2,3-TRICHLOROBENZENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
77613	1,2,3-TRICHLOROBENZENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
77613	1,2,3-TRICHLOROBENZENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
77651	ETHYLENE DIBROMIDE (EDB)	2004-01-26	<	.5000	0.050	0.020	0.020	UG/L
78132	P-XYLENE	2000-01-31	<	.0000	1750.000	0.500	1750.000	UG/L
81551	XYLENES (TOTAL)	1989-06-08	<	.0000	1750.000	0.500	0.500	UG/L
81551	XYLENES (TOTAL)	1989-11-08	<	.0000	1750.000	0.500	0.500	UG/L
81551	XYLENES (TOTAL)	2000-01-31	<	.0000	1750.000	0.500	0.500	UG/L
81551	XYLENES (TOTAL)	2004-01-26	<	.5000	1750.000	0.500	0.500	UG/L
81555	BROMOBENZENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
81555	BROMOBENZENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
81555	BROMOBENZENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
81555	BROMOBENZENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
81595	METHYL ETHYL KETONE	2004-01-26	<	5.0000	0.000	5.000	0.000	UG/L
81596	METHYL ISOBUTYL KETONE	2004-01-26	<	5.0000	0.000	5.000	120.000	UG/L
81611	TRICHLOROTRIFLUOROETHANE (FREON 113)	1989-06-08	<	.0000	1200.000	10.000	10.000	UG/L
81611	TRICHLOROTRIFLUOROETHANE (FREON 113)	1989-11-08	<	.0000	1200.000	10.000	10.000	UG/L
81611	TRICHLOROTRIFLUOROETHANE (FREON 113)	2004-01-26	<	.5000	1200.000	10.000	10.000	UG/L
81710	M-XYLENE	2000-01-31	<	.0000	1750.000	0.500	1750.000	UG/L
81855	ASBESTOS	2006-03-06	<	.0000	7.000	0.200	7.000	MFL
81855	ASBESTOS	2015-08-24		0000000000	7.000	0.200	7.000	MFL

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
82079	TURBIDITY, LABORATORY	1985-10-01		.3000	5.000	0.100	5.000	NTU
82079	TURBIDITY, LABORATORY	1987-06-24		.1900	5.000	0.100	5.000	NTU
82079	TURBIDITY, LABORATORY	1988-06-23		.4500	5.000	0.100	5.000	NTU
82079	TURBIDITY, LABORATORY	1989-06-08		.7000	5.000	0.100	5.000	NTU
82079	TURBIDITY, LABORATORY	1990-06-26		.1000	5.000	0.100	5.000	NTU
82080	TOTAL TRIHALOMETHANES	1989-06-08	<	.0000	100.000	0.500	0.500	UG/L
82080	TOTAL TRIHALOMETHANES	1989-11-08	<	.0000	100.000	0.500	0.500	UG/L
82080	TOTAL TRIHALOMETHANES	2000-01-31	<	.0000	100.000	0.500	0.500	UG/L
82080	TOTAL TRIHALOMETHANES	2004-01-26	<	.5000	100.000	0.500	0.500	UG/L
82383	AGGRSSIVE INDEX (CORROSIVITY)	2005-11-02		11.3000	0.000	0.000	0.000	
82383	AGGRSSIVE INDEX (CORROSIVITY)	2011-11-02		11.3000	0.000	0.000	0.000	
A-008	2-CHLOROTOLUENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
A-008	2-CHLOROTOLUENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
A-008	2-CHLOROTOLUENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
A-008	2-CHLOROTOLUENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
A-009	4-CHLOROTOLUENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
A-009	4-CHLOROTOLUENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
A-009	4-CHLOROTOLUENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
A-009	4-CHLOROTOLUENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
A-010	N-BUTYLBENZENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
A-010	N-BUTYLBENZENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
A-010	N-BUTYLBENZENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
A-010	N-BUTYLBENZENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
A-011	P-ISOPROPYLTOLUENE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
A-011	P-ISOPROPYLTOLUENE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
A-011	P-ISOPROPYLTOLUENE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
A-011	P-ISOPROPYLTOLUENE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
A-012	BROMOCHLOROMETHANE	1989-06-08	<	.0000	0.000	0.500	0.500	UG/L
A-012	BROMOCHLOROMETHANE	1989-11-08	<	.0000	0.000	0.500	0.500	UG/L
A-012	BROMOCHLOROMETHANE	2000-01-31	<	.0000	0.000	0.500	0.500	UG/L
A-012	BROMOCHLOROMETHANE	2004-01-26	<	.5000	0.000	0.500	0.500	UG/L
A-014	M,P-XYLENE	1989-06-08	<	.0000	1750.000	0.500	1750.000	UG/L
A-014	M,P-XYLENE	1989-11-08	<	.0000	1750.000	0.500	1750.000	UG/L
A-014	M,P-XYLENE	2000-01-31	<	.0000	1750.000	0.500	1750.000	UG/L
A-014	M,P-XYLENE	2004-01-26	<	.5000	1750.000	0.500	1750.000	UG/L
A-031	PERCHLORATE	2008-01-02	<	4.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2008-07-12	<	4.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2009-11-23	<	.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2010-11-30	<	.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2011-08-30	<	.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2012-08-27	<	4.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2013-08-29		4.4000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2014-08-20	<	4.0000	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2015-08-24	<	4	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2016-08-23	<	4	6.000	4.000	4.000	UG/L

Storet Number	Group/Constituent Identification	Sampling Date	XMOD	Result	MCL	DLR	Trigger	Unit
A-031	PERCHLORATE	2017-08-23	<	4	6.000	4.000	4.000	UG/L
A-031	PERCHLORATE	2018-08-22	<	4	6.000	4.000	4.000	UG/L
A-033	ETHYL-TERT-BUTYL ETHER	2000-01-31	<	.0000	0.000	3.000	0.000	UG/L
A-033	ETHYL-TERT-BUTYL ETHER	2004-01-26	<	.5000	0.000	3.000	0.000	UG/L
A-034	TERT-AMYL-METHYL ETHER (TAME)	2000-01-31	<	.0000	0.000	3.000	0.000	UG/L
A-034	TERT-AMYL-METHYL ETHER (TAME)	2004-01-26	<	.5000	0.000	3.000	0.000	UG/L
A-044	CHROMIUM (TOTAL CR-CRVI SCREEN)	2001-12-28		5.0000	0.000	1.000	0.000	UG/L
A-044	CHROMIUM (TOTAL CR-CRVI SCREEN)	2002-04-10		7.0000	0.000	1.000	0.000	UG/L
A-044	CHROMIUM (TOTAL CR-CRVI SCREEN)	2002-06-24		6.0000	0.000	1.000	0.000	UG/L
A-072	GROSS ALPHA MDA95	2008-10-07		1.4000	3.000	0.000	0.000	PCI/L
A-072	GROSS ALPHA MDA95	2009-01-13		1.4000	3.000	0.000	0.000	PCI/L
A-072	GROSS ALPHA MDA95	2009-04-08		1.4000	3.000	0.000	0.000	PCI/L
A-072	GROSS ALPHA MDA95	2009-07-20		1.4000	3.000	0.000	0.000	PCI/L
A-072	GROSS ALPHA MDA95	2018-08-22		0.625	3.000	0.000	0.000	PCI/L