RECLAMATION

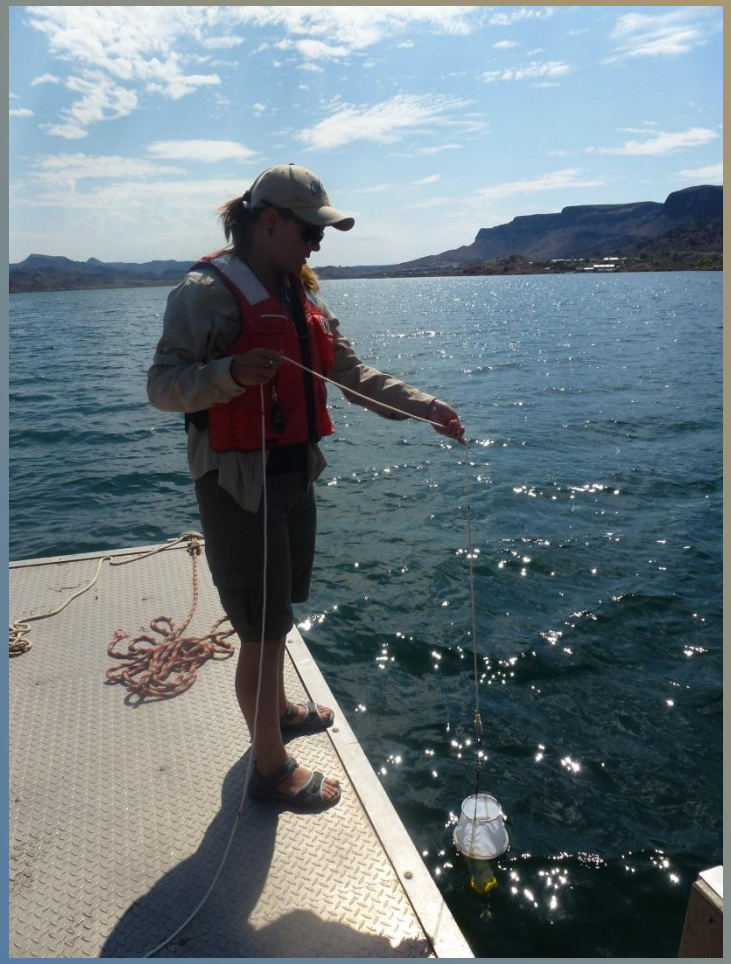
Managing Water in the West

Lake Havasu Water Quality and Quagga Mussel Monitoring Program

U.S. Department of the Interior
Bureau of Reclamation

Contents

- General Overview & Project History
- Purpose
- Data Summary
- Path Forward
- Questions



RECLAMATION

Study Timeline History Overview

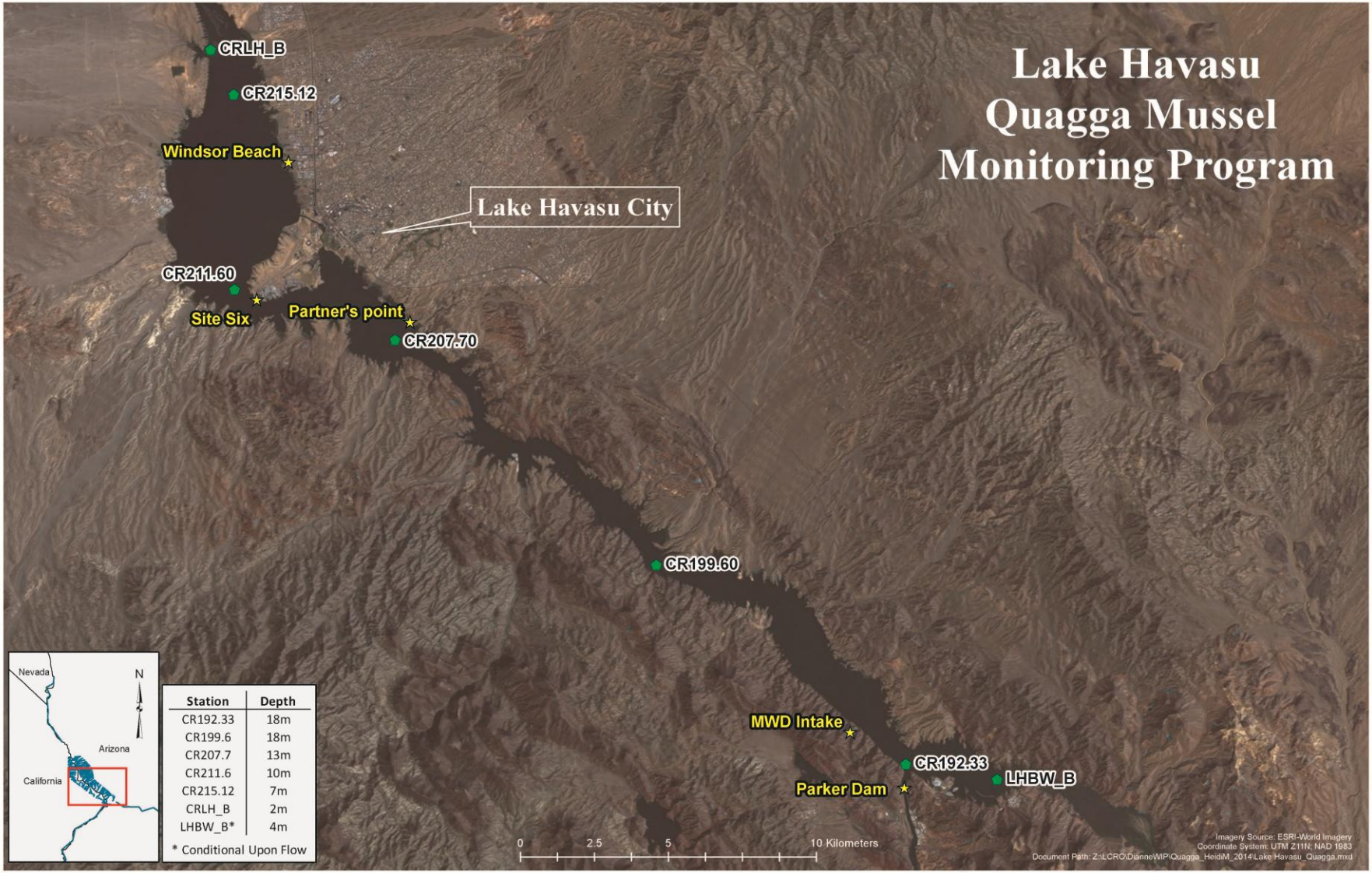
- 2009 → quagga veliger study
  - Bi-monthly sample collection
- 2013 → shift in focus to additional water quality parameters
  - Addition of phytoplankton, total phosphorus, chlorophyll
- 2014 → Nitrogen added to the program for analysis and the Colorado River Inflow and Bill Williams locations added
- 2015 →Meta and Hypolimnion depths added
  - LCR Regional Lab analyzing anions/cations, TDS

RECLAMATION

Methods

- **Zooplankton**
  - Plankton net tows (x2)
  - Lugols preservative
  - Samples sent to BSA Environmental for analysis
- **Phytoplankton**
  - 0-5m composite sample using a pool hose
  - Lugols preservative
  - Samples sent to BSA Environmental for analysis
- **Chlorophyll**
  - 0-5m composite sample using a pool hose
  - Filtered and frozen
  - Samples sent to Alpha Labs (formerly Sierra Foothill Laboratory) for analysis
- **Phosphorous**
  - 0-5m composite sample using a pool hose
  - Sulfuric acid preservative
  - Samples sent to Alpha Labs (formerly Sierra Foothill Laboratory) for analysis
- **Nitrogen**
  - 0-5m composite sample using a pool hose
  - Samples sent to Alpha Labs (formerly Sierra Foothill Laboratory) for analysis
- **Water quality profile**
  - Eureka probe (pH, Conductivity, water temp, DO%, DO mg/L, Turbidity)

RECLAMATION



Station	Depth
CR192.33	18m
CR199.6	18m
CR207.7	13m
CR211.6	10m
CR215.12	7m
CRLH_B	2m
LHBW_B*	4m

* Conditional Upon Flow

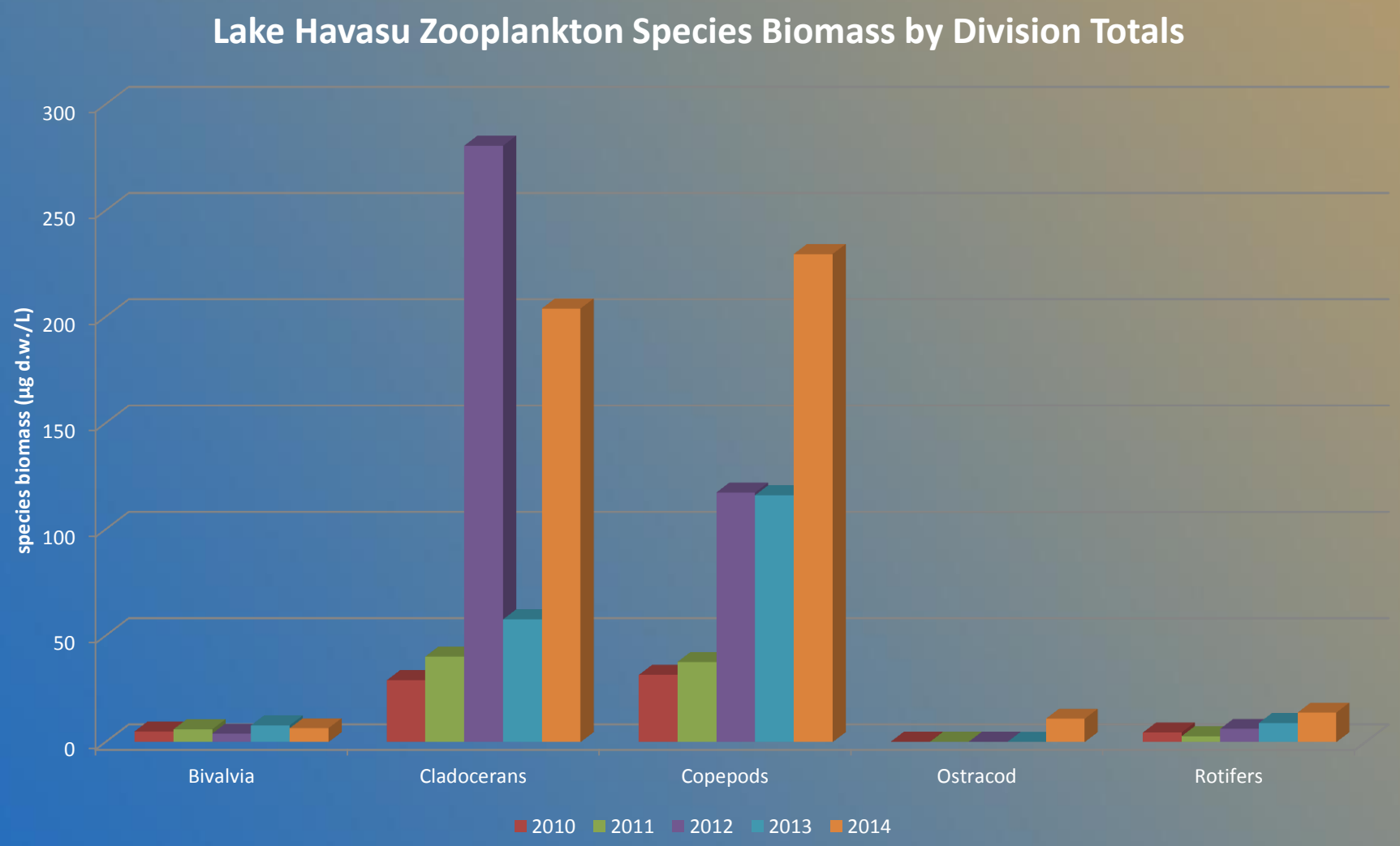
RECLAMATION

Zooplankton Average Biomass Summary Table

Sample Year	Average Zoops Biomass (no veligers) (ug/L)	Average Veliger Biomass (ug/L)	Ratio Zooplankton:Veliger
2010 (n=5)	0.208	0.174	0.0838
2011 (n=5)	0.276	0.249	0.9022
2012 (n=5)	0.938	0.137	0.1461
2013 (n=6)	0.533	0.281	0.5272
2014 (n=6)	1.367	0.251	0.1836

RECLAMATION

Zooplankton Division Biomass



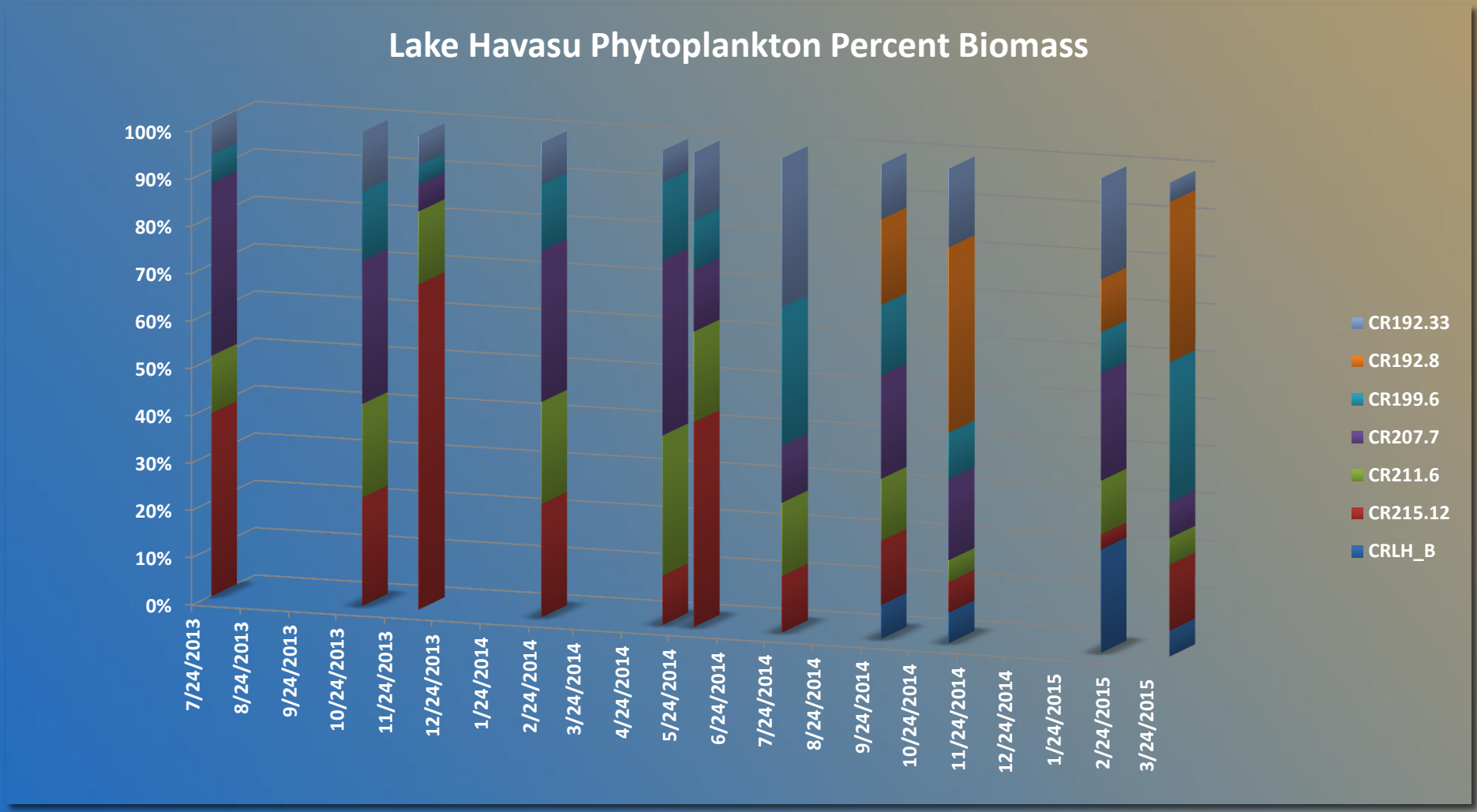
RECLAMATION

Zooplankton Biomass Summary

- Desirable divisions (i.e., Cladocerans, Copapods) are persisting in Lake Havasu
- Veliger numbers remaining steady with seasonal variability
- Annual fluctuations occurring between divisions
  - i.e., Cladocerans, Rotifers

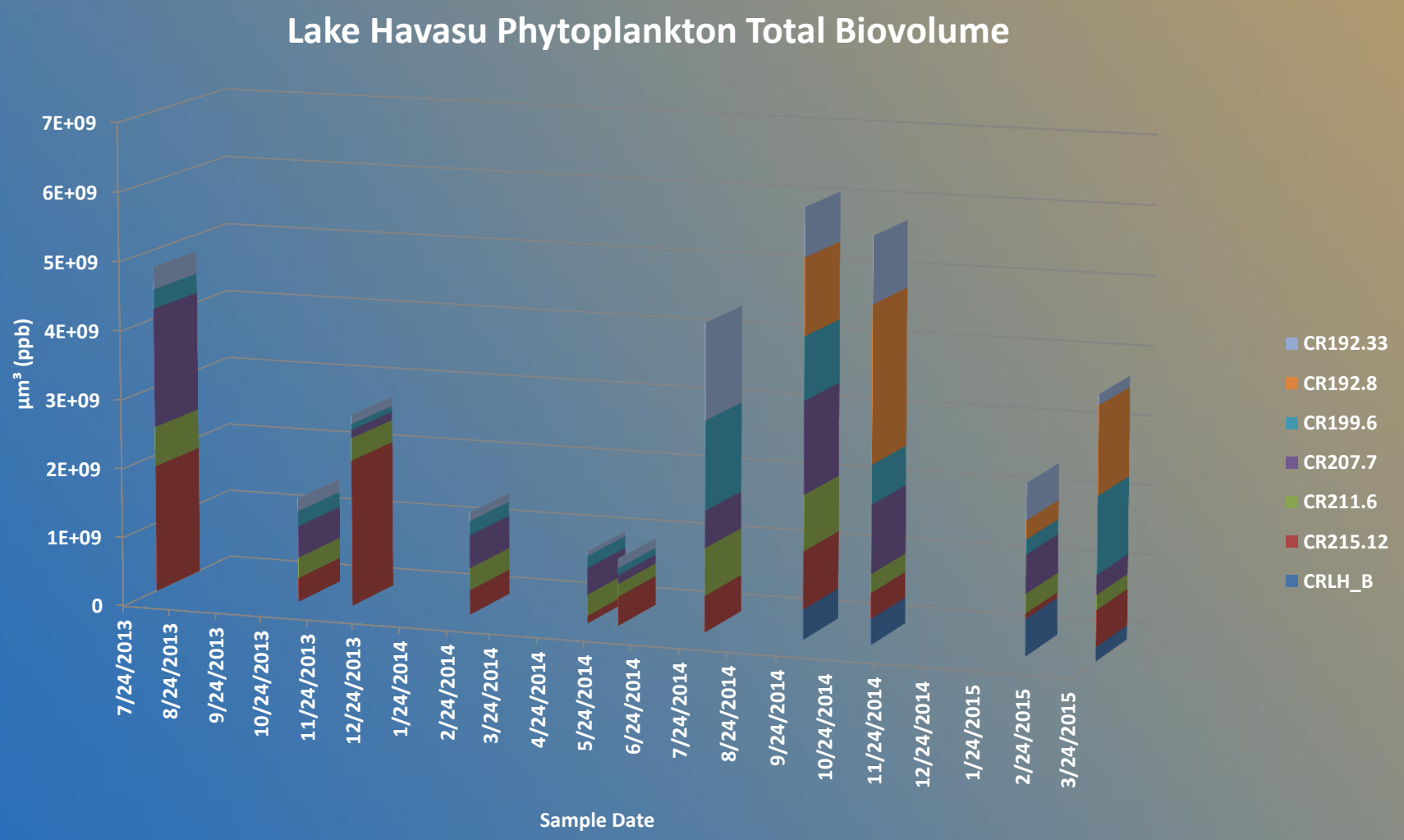
RECLAMATION

Phytoplankton Averages



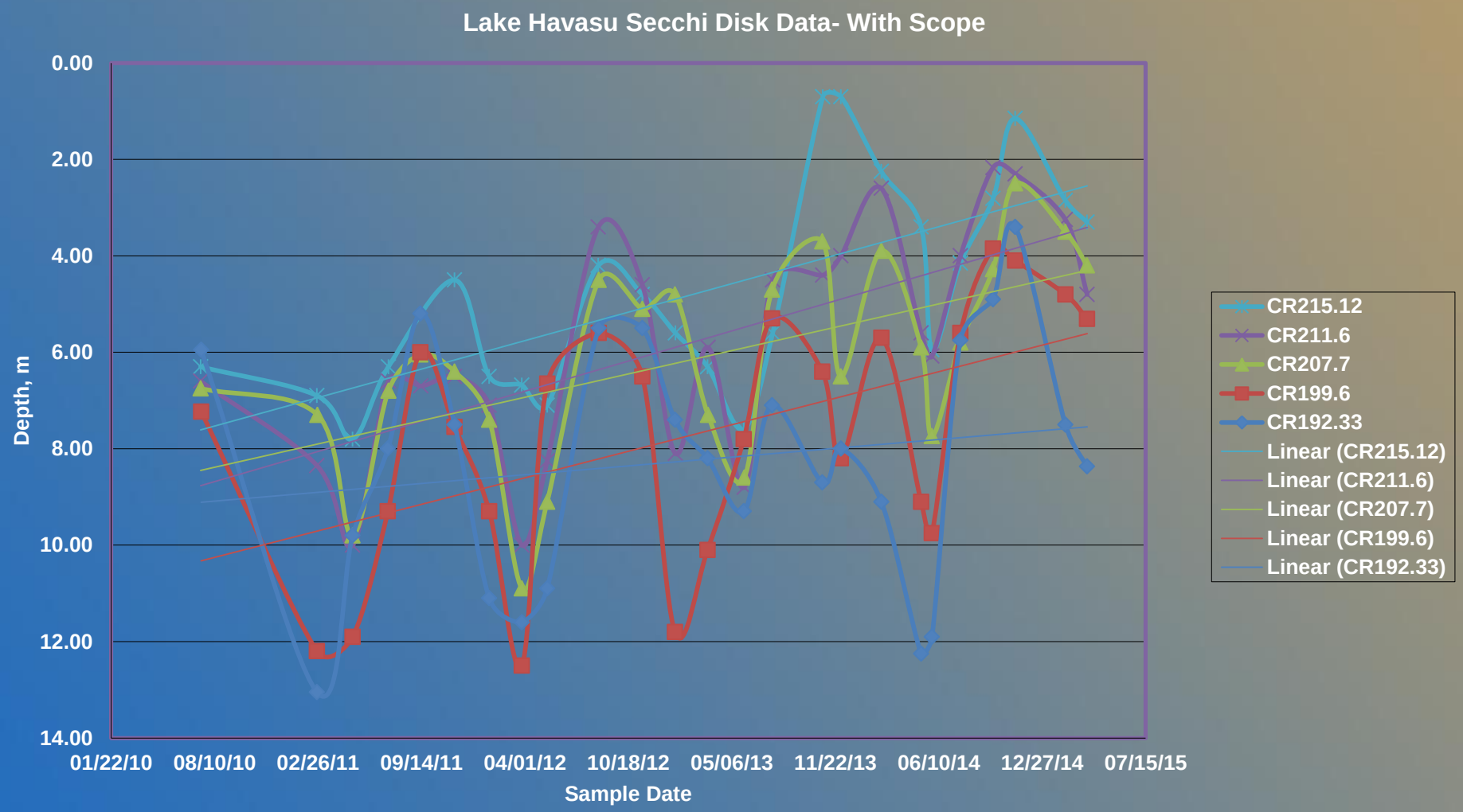
RECLAMATION

Phytoplankton Biovolume



RECLAMATION

Secchi Depth (with scope)

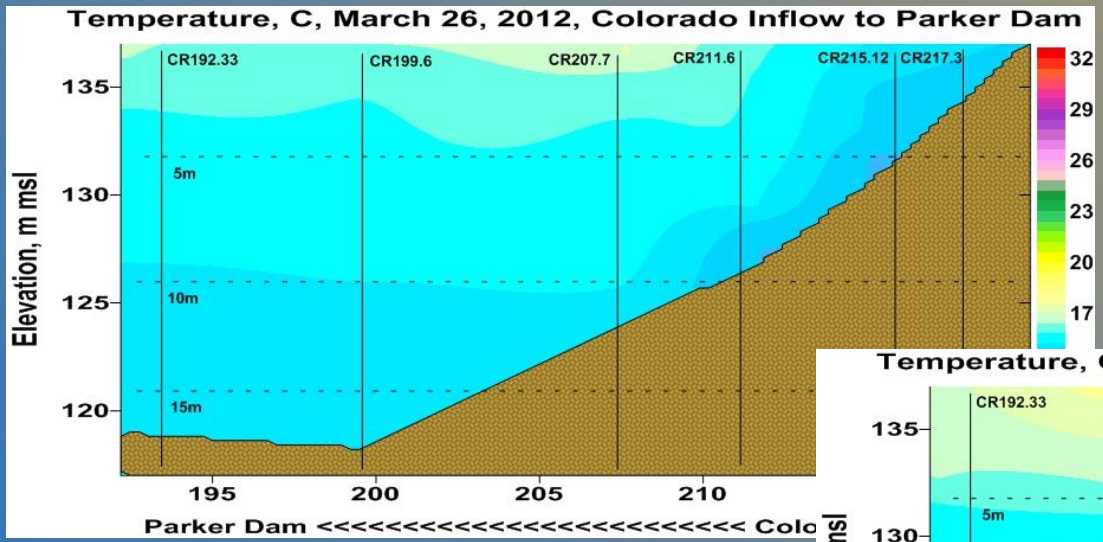


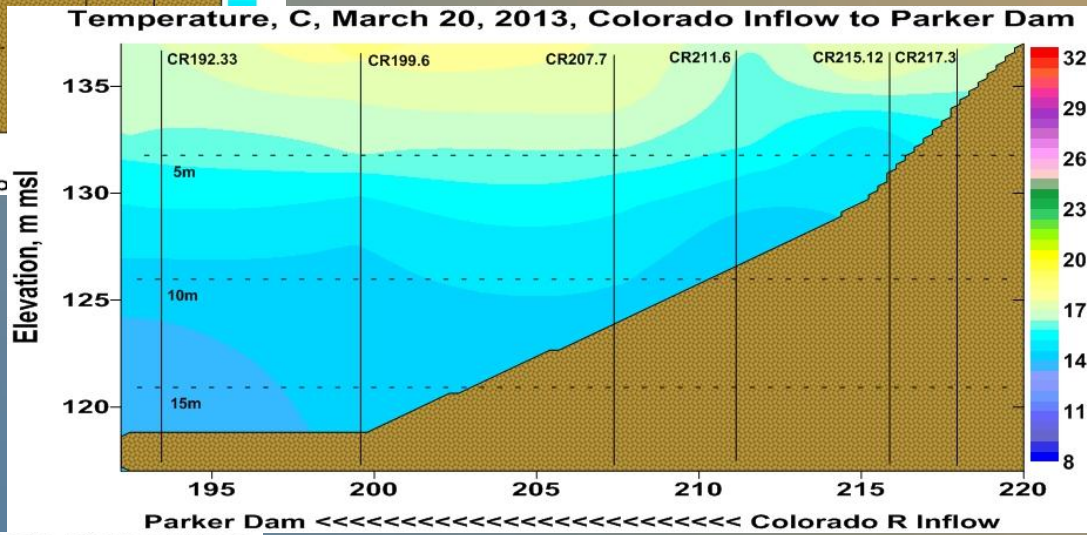
RECLAMATION

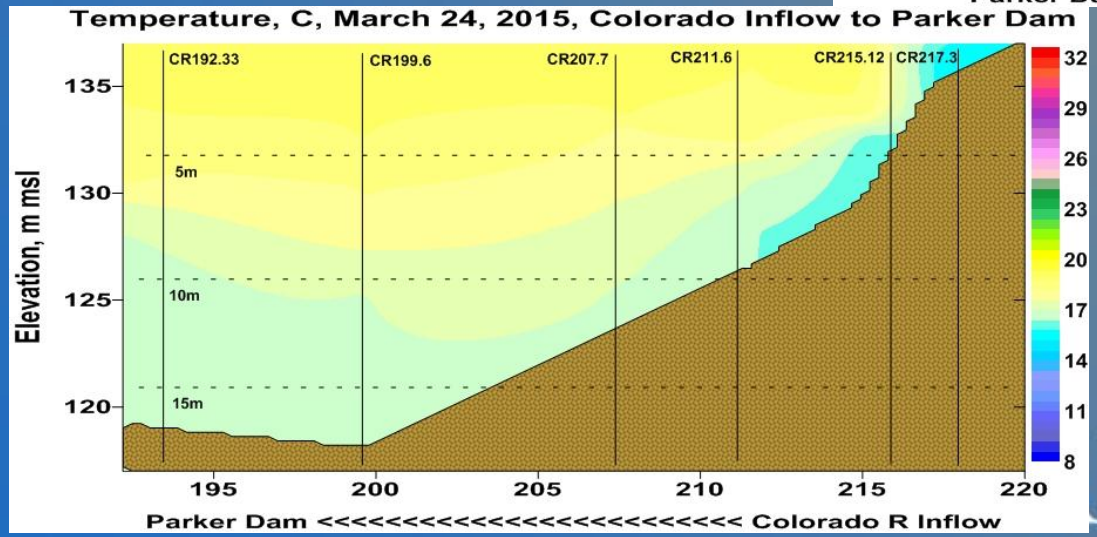
Multi-Probe Water Quality Profile Yearly Averages

	Temp deg C	pH units	SpCond uS/cm	HDO mg/l	Samples (n)
2011	19.43081	8.344723	945.4155	9.319745	5
2012	18.55715	8.285041	902.0053	9.286646	5
2013	18.19018	8.083587	895.2505	9.342699	6
2014	22.53068	8.275872	984.4499	8.139818	6

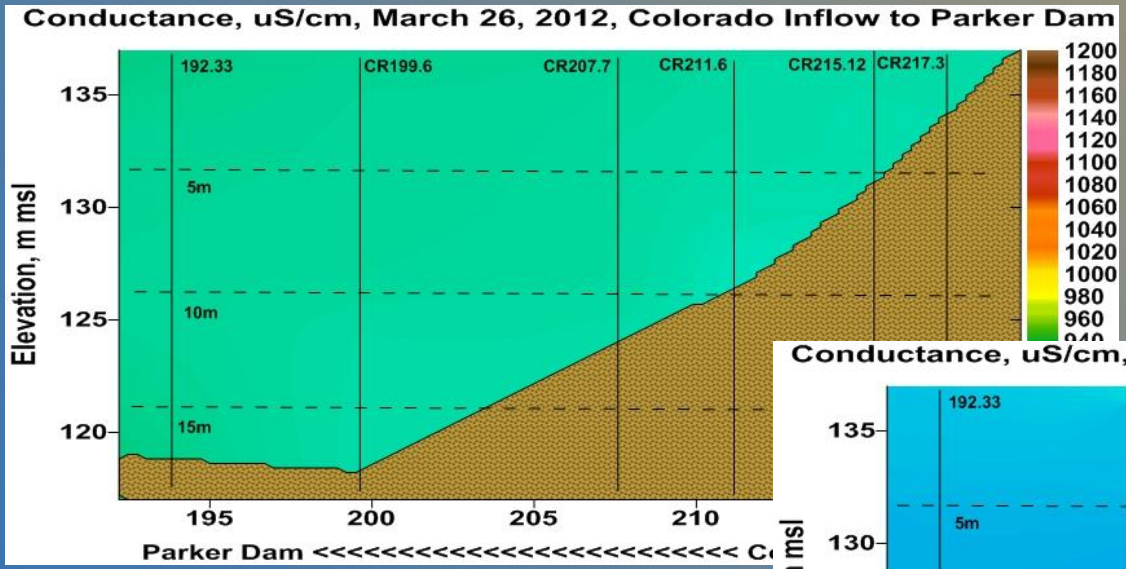
RECLAMATION

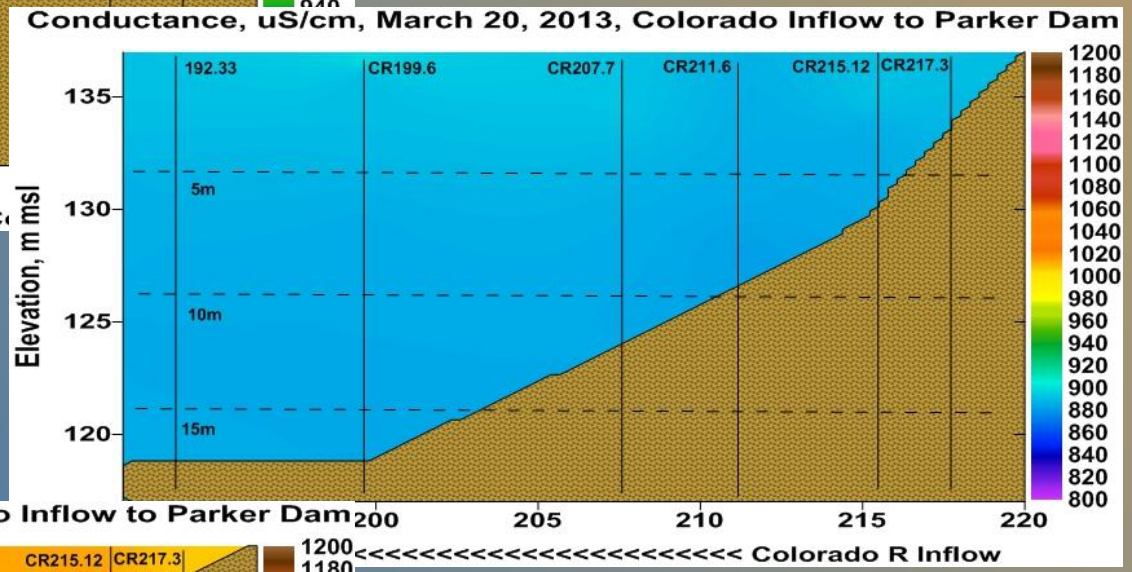

Temperature, C, March 26, 2012, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<< Colo
32
29
26
23
20
17

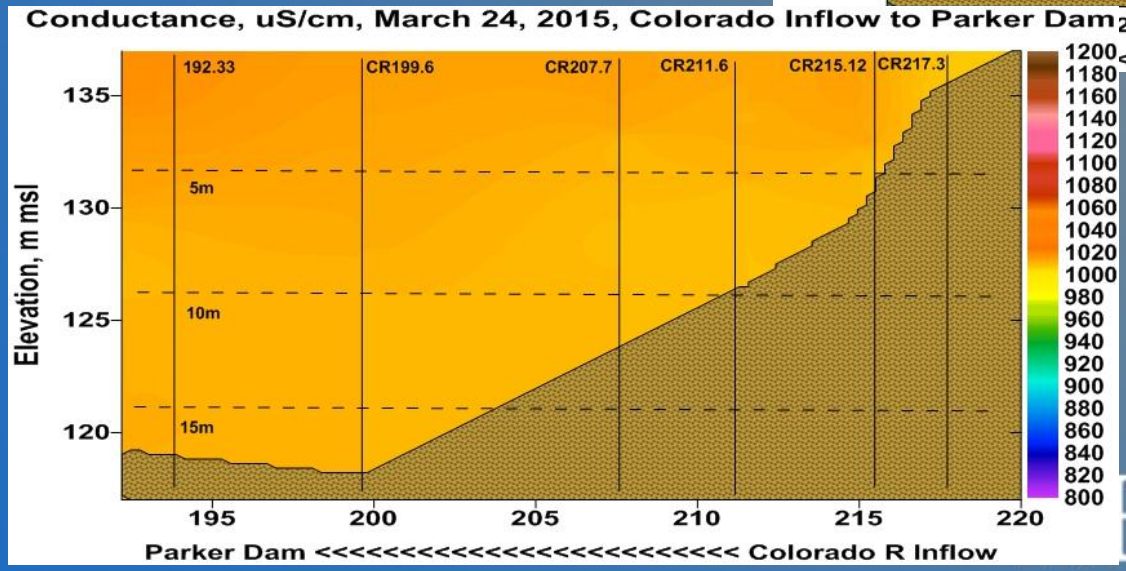

Temperature, C, March 20, 2013, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
215
220
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
32
29
26
23
20
17
14
11
8


Temperature, C, March 24, 2015, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
215
220
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
32
29
26
23
20
17
14
11
8

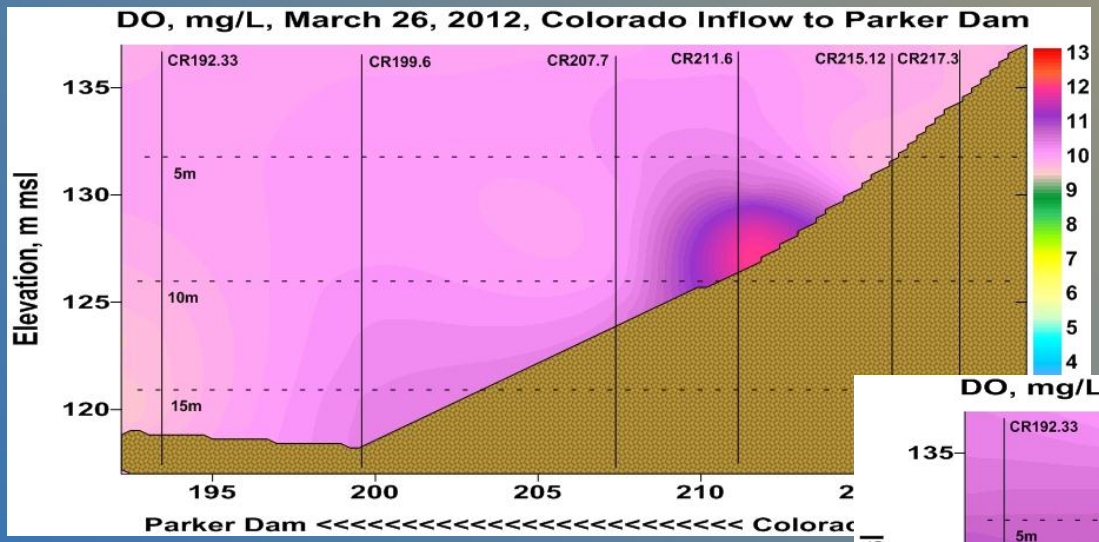
ECLAMATION

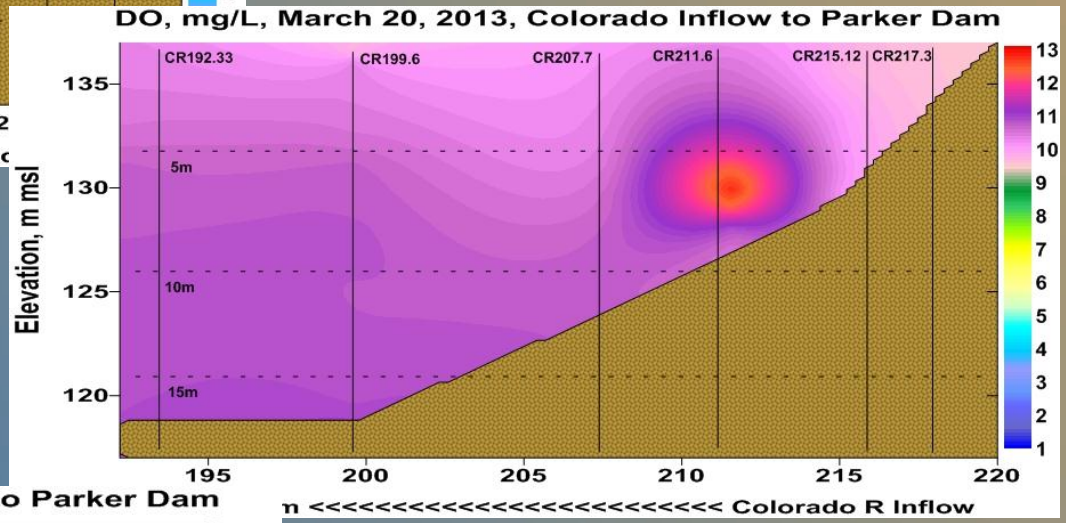

Conductance, uS/cm, March 26, 2012, Colorado Inflow to Parker Dam
192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<<
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960

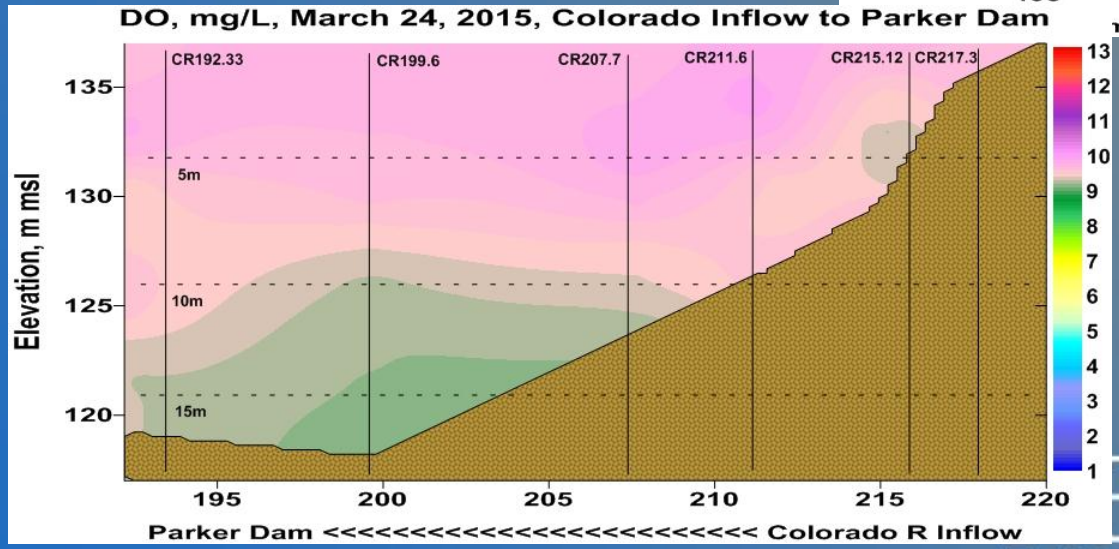

Conductance, uS/cm, March 20, 2013, Colorado Inflow to Parker Dam
192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
200
205
210
215
220
<<<<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960
940
920
900
880
860
840
820
800


Conductance, uS/cm, March 24, 2015, Colorado Inflow to Parker Dam
192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
215
220
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
1200
1180
1160
1140
1120
1100
1080
1060
1040
1020
1000
980
960
940
920
900
880
860
840
820
800

ECLAMATION


DO, mg/L, March 26, 2012, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<<< Colorac
13
12
11
10
9
8
7
6
5
4


DO, mg/L, March 20, 2013, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
215
220
n <<<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
13
12
11
10
9
8
7
6
5
4
3
2
1


DO, mg/L, March 24, 2015, Colorado Inflow to Parker Dam
CR192.33
CR199.6
CR207.7
CR211.6
CR215.12
CR217.3
5m
10m
15m
Elevation, m msl
135
130
125
120
195
200
205
210
215
220
Parker Dam <<<<<<<<<<<<<<<<<<<<<<<<<<<< Colorado R Inflow
13
12
11
10
9
8
7
6
5
4
3
2
1

ECLAMATION

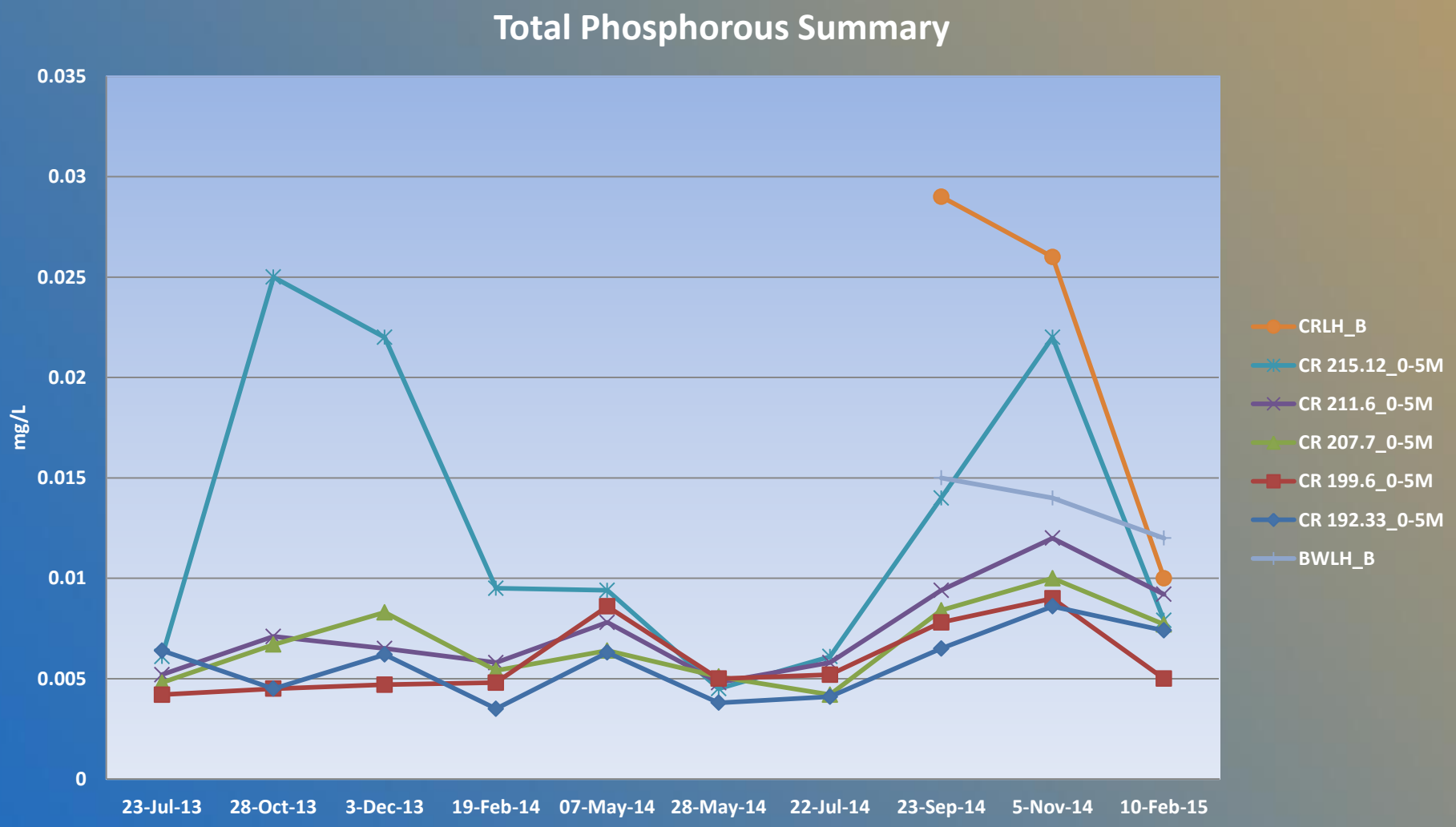
Average Chlorophyll & Total Phosphorous Data

N=10
* = 3

Sample Site River Mile	Chlorophyll a, Corrected (mg/m3 (ppb)) Green	Phosphate, Total, as (P mg/L)
CRLH_B*	1.30	0.029
CR215.12	2.09	0.012
CR211.6	2.06	0.0066
CR207.7	2.11	0.0062
CR199.6	2.08	0.0056
CR192.8*	4.7	0.015
CR192.33	2.19	0.0052

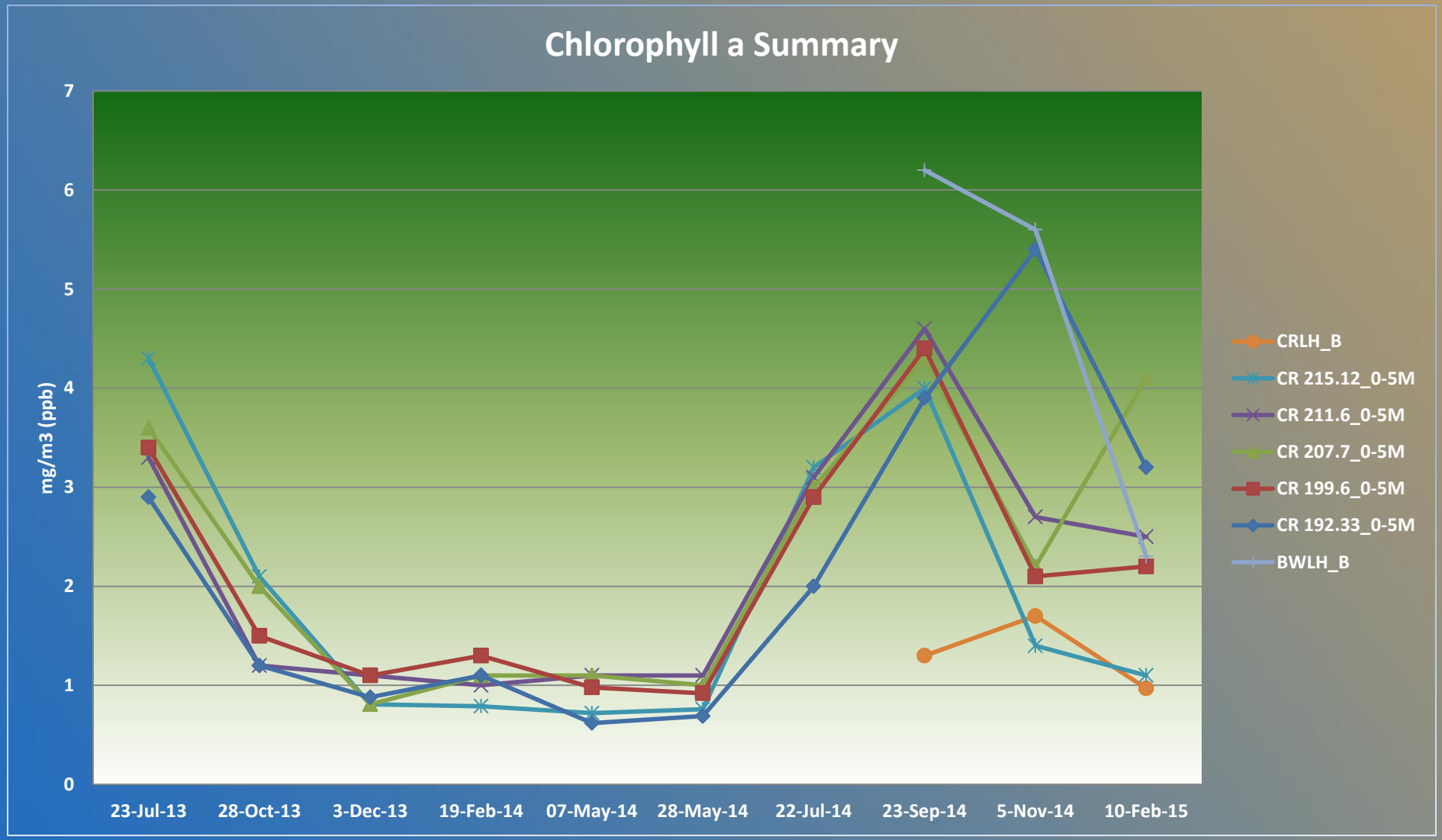
RECLAMATION

Total Phosphorous



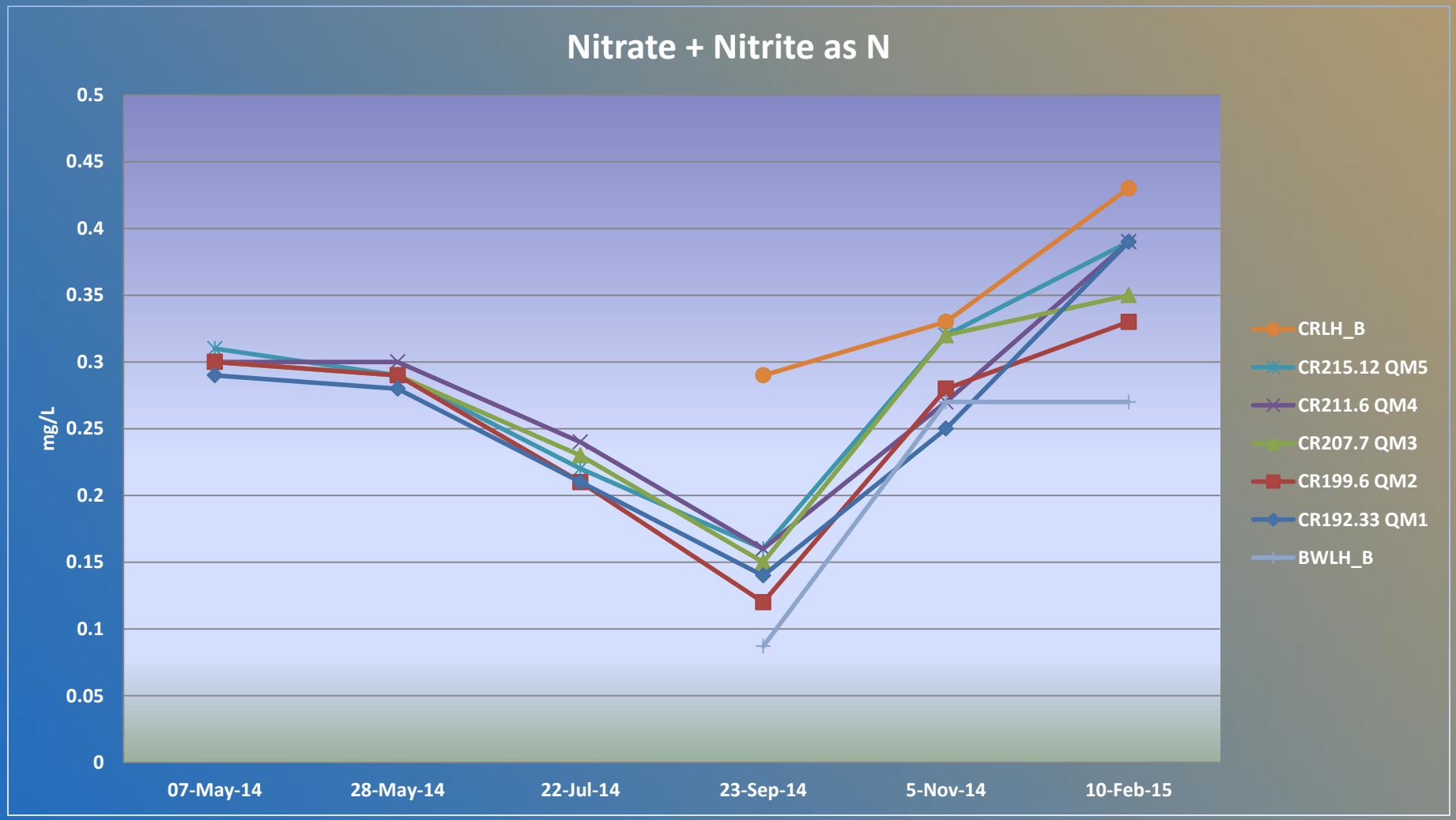
RECLAMATION

Chlorophyll a



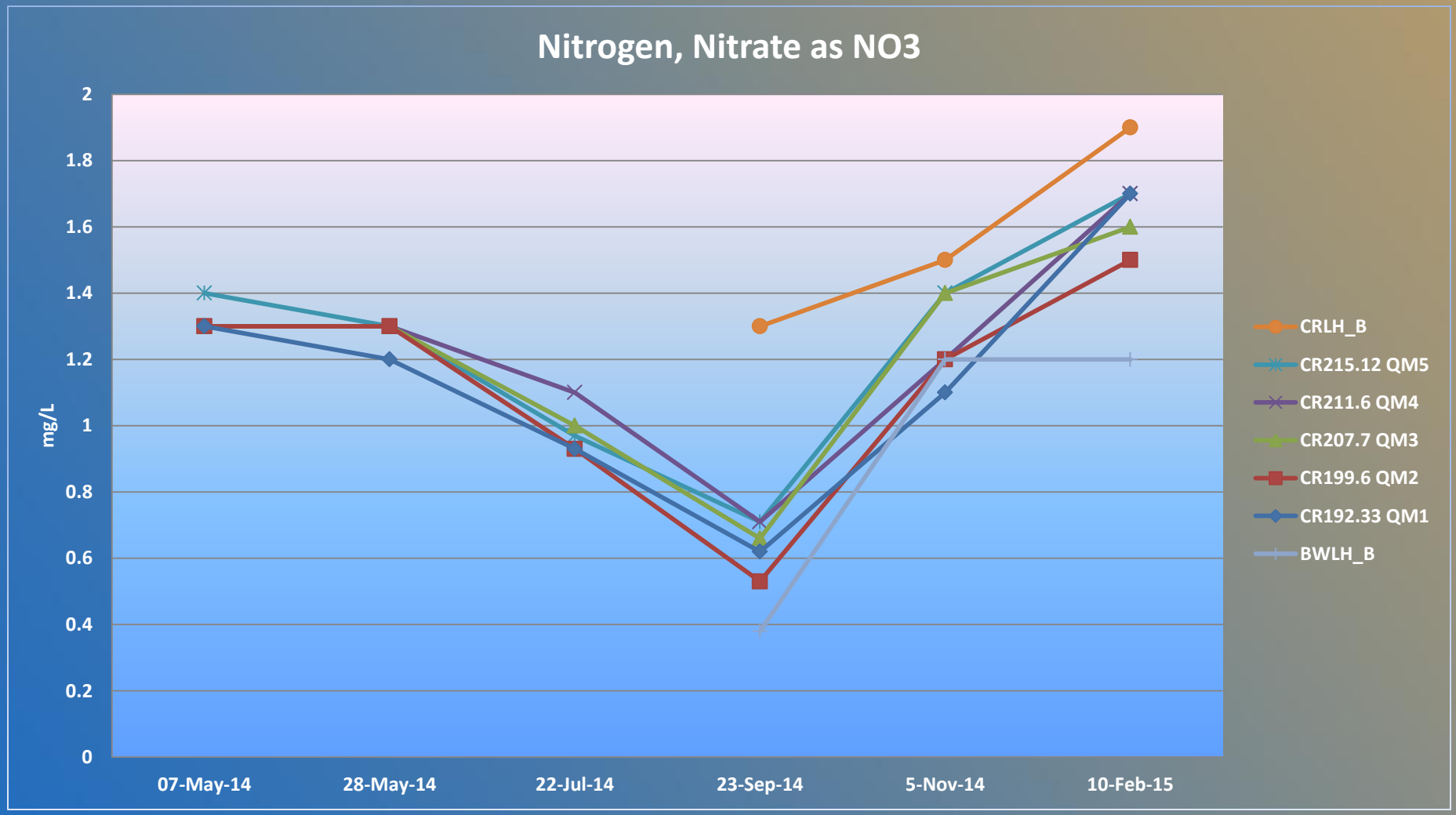
RECLAMATION

Nitrate + Nitrite as N



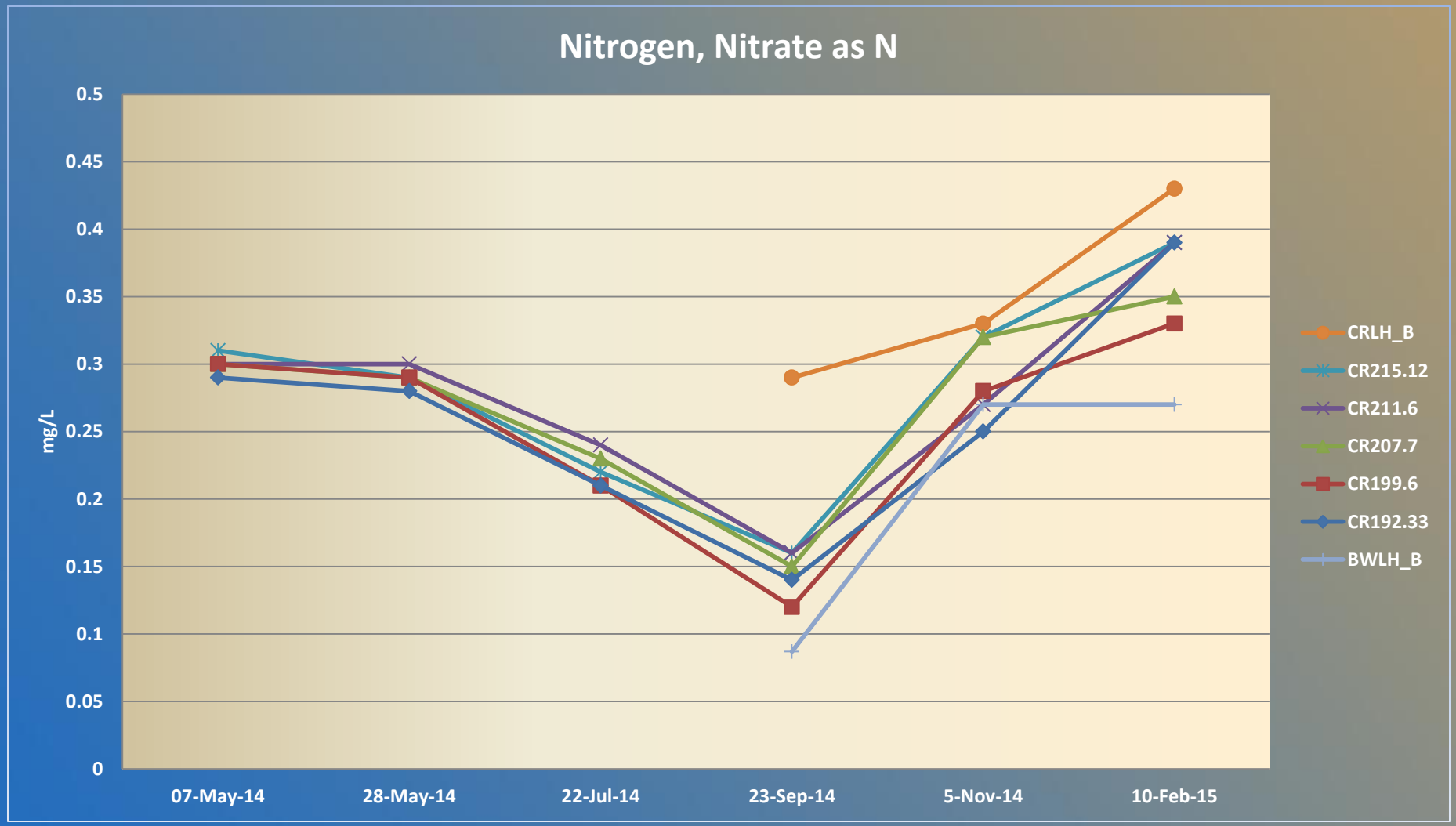
RECLAMATION

Nitrogen, Nitrate as NO3



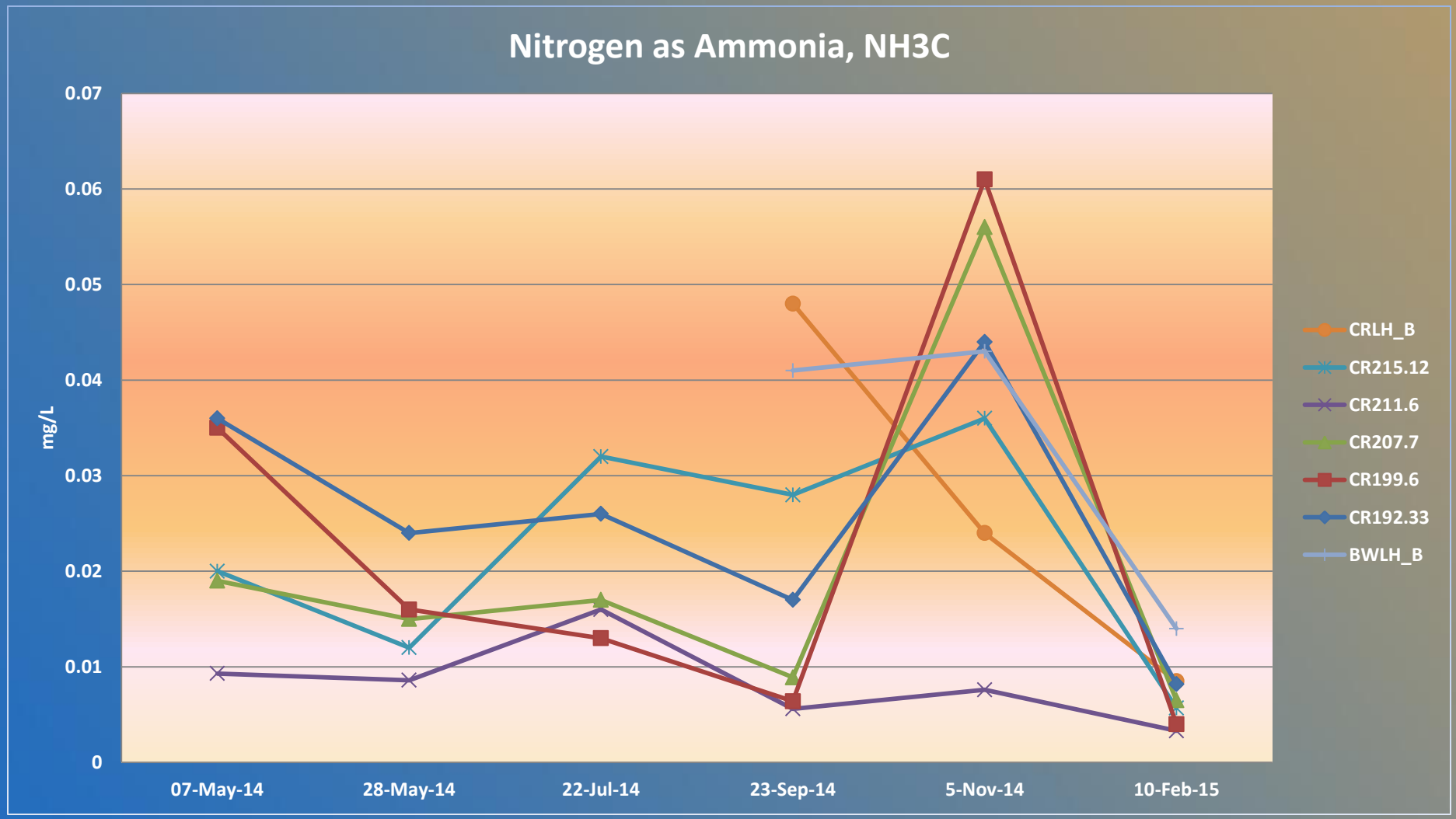
RECLAMATION

Nitrogen, Nitrate as N



RECLAMATION

Nitrogen, Ammonia-N



RECLAMATION

Future & Path forward

- No conclusions can be made at this time regarding Lake Havasu – preliminary data only
- Reclamation will continue to monitor the lake and add additional sampling parameters when possible in the future

RECLAMATION

Acknowledgements

- Reclamation - Lower Colorado Region
  - Multi-Species Conservation Program
  - Resources Management Office
- BSA Environmental, Inc
- Alpha Labs (aka Sierra Foothill Laboratory, Inc)
- Bureau of Land Management – Partner's Point
- Lake Havasu City
- National Park Service
- US Fish & Wildlife Service
- Arizona Game & Fish Department

RECLAMATION

Questions?

Photo courtesy of http://www.underwatertimes.com/news3/quagga_mussel.jpg

Heidi McMaster
US Bureau of Reclamation
PO Box 61470
Boulder City, NV 89006
702-293-8560
hmcmaster@usbr.gov

RECLAMATION