

December 6, 2011

To: H. B. Fleming
Attn: David Gifford
From: BECC Company
D.C. Blakeman President
Subject: Brewer Water Pollution Control Facility Final Report of Sound Monitoring
Bulkhead Replacement Project
Monitoring Dates: September 12 & 20; November 15 & 17, 2011

Construction Location



Introduction:

BECC Company was contracted to monitor the installation of the pile driving during the installation of the Bulkhead Replacement at the Brewer Water Pollution Control Facility. The bulkhead was installed by the pile driving contractor H. B. Fleming, Inc. Upon reviewing the specifications BECC using InstanTel instrumentation monitored the initial installation of the Spud H piles on September 12, 2011. The acoustic records were higher than the engineers requested therefore Fleming designed bubble curtains and BECC monitored on the 20th of September after which records were forwarded. NOAA and the engineers requested additional monitoring which took place on November the 15th and 17th 2011. The records were then sent forward upon the completion of the monitoring. All of the records are based on the following formula:

The atmospheric pressure is not the same as the sound pressure.
The standard **atmospheric pressure** is 101,325 pascals = 1,013.25 hPa = 101.325 kPa
• 1,000,000 μPa = 1 Pa = 1 $\text{N/m}^2 \equiv$ **94 dBSPL** and 1 bar = 10^5 Pa
1 kPa = 10^3 Pa = 1000 Pa = 1,000 $\text{N/m}^2 \equiv$ **154 dBSPL**

Monitoring Records September 12, 2011 AM Readings



General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility
Brewer Maine

Construction Activity

Acoustic Monitoring Trial

*BECC Company
28 LedgeWood Drive
Yarmouth, ME 04096*

Time	Activity
10:20:50	Start Monitoring The monitoring of the Spud H Piles.

Seismograph Unit BlastMate II

Serial# **BA7197** Calibrated July 2011

Mode/Settings **Advanced Module Continuous**

Vibration Consultant

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Activity
10:37:40	0.411	146.26	Base Line
10:50:37	2.88	163.16	Spud Pile
10:52:27	3.70	165.34	Spud Pile
11:08:02	2.47	161.83	Spud Pile
11:27:39	1.64	154.28	Spud Pile
11:28:46	1.85	159.32	Spud Pile
11:28:12	1.03	154.24	Spud Pile
11:29:15	0.617	150.50	Spud Pile

Seismologist

Date_ September 12, 2011 Weather/Comments Partially cloudy temps in the 70's_

All readings were 30 feet from the Spud Pile. The hydrophone was set at half the depth of the water.

Monitoring Records September 12, 2011 PM Readings



General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility
Brewer Maine

Construction Activity

Acoustic Monitoring Trial

BECC Company
28 Ledgewood Drive
Yarmouth, ME 04096

Site Sketch

Time Activity

14:00 Start Monitoring Afternoon Sheet Pile installation Acoustic Test

Seismograph Unit BlastMate III
Serial# BA7197 Calibrated July 2011
Mode/Settings Advanced Module Continuous
Vibration Consultant

D.C. Blakeman

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Activity
14:09:22	0.411	146.26	Base Line Test
14:10:09	5.750	169.17	Sheet Piles
14:15:36	3.910	165.82	Sheet Piles
14:16:11	4.320	166.69	Sheet Piles
14:16:25	4.520	167.82	Sheet Piles
14:18:15	10.300	174.24	Sheet Piles
14:21:06	6.560	170.34	Sheet Piles
14:21:31	8.250	173.30	Sheet Piles

Seismologist

D.C. Blakeman

Date_ September 12, 2011 Weather/Comments: Partially Cloudy Temp 70's

All readings were 30 feet from the Spud Pile. The hydrophone was set at half the depth of the water.



Monitoring Records September 20, 2011



General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility

Construction Activity

Acoustic Monitoring Trial

BECC Company

28 Ledgewood Drive

Yarmouth, ME 04096

WWW.becccompany.com

Time	Activity
9:00	Start Project Monitoring
14:00	End Project Monitoring

Seismograph Unit BlastMate III
 Serial# BA7197 Calibrated July 2011
 Mode/Settings Advanced Module Continuous
 Vibration Consultant

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
09:18:09	4.11	165.25	33' from pile driving / 35 Feet
09:20:22	3.08	163.75	33' from pile driving / 35 Feet
09:22:12	2.88	163.17	33' from pile driving / 35 Feet
09:35:45	1.85	159.32	Mid River from pile driving / 25 Feet
09:37:32	1.85	159.32	Mid River from pile driving / 25 Feet
09:38:40	1.44	157.15	Mid River from pile driving / 25 Feet
09:40:14	1.03	154.24	Mid River from pile driving / 25 Feet
09:41:52	1.23	155.78	Mid River from pile driving / 25 Feet
13:28:04	0.617	89.93	450' from Pile Driving / 34' deep (*Cold H2O)
13:37:30	1.44	157.15	33' from pile driving / 27 Feet
13:38:53	1.64	158.28	33' from pile driving / 27 Feet

Note: the reading @ 13:28:04 has been determined as an anomaly due to a cold water inversion

Seismologist/Vibration Consultant

Date: September 20, 2011



Monitoring Records November 15, 2011



General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility

Construction Activity

Acoustic Monitoring Trial

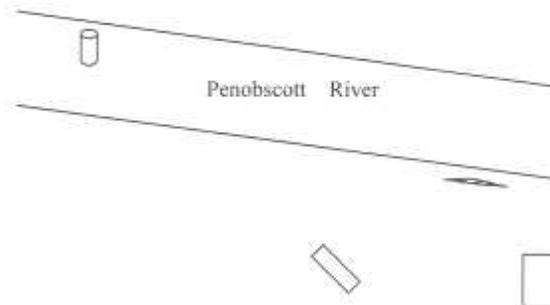
BECC Company

28 LedgeWood Drive

Yarmouth, ME 04096

WWW.becccompany.com

Time	Activity
11:30am	Arrival
4:00pm	Departure



Seismograph Unit BlastMate III
 Serial# BA7197 Calibrated July 2011
 Mode/Settings Advanced Module Continuous
Vibration Consultant

D.C. Blakeman

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
Baseline 14:32	.21	140.4237	5ft from bottom/ 25ft deep/ 1290ft away
Baseline 14:34	.16	138.0617	" "
Sheet 14:38	.21	140.4237	" "
Sheet 14:39	.18	139.0848	" "
Sheet 14:40	.14	136.9019	" "
Sheet 14:42	.14	136.9019	" "



Seismologist/Vibration Consultant

D.C. Blakeman

Date: 11/15/11



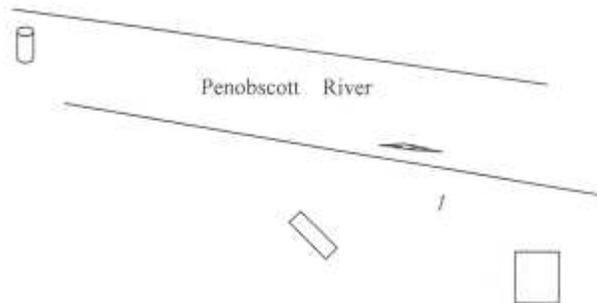
Monitoring Records November 17, 2011 Sheet 1



General Contractor
 H. B. Fleming
Job Location
 Brewer Water Pollution Control Facility
Construction Activity
 Acoustic Monitoring Trial

BECC Company
 28 LedgeWood Drive
 Yarmouth, ME 04096
 WWW.becccompany.com

Time	Activity
10:00	Arrival
1:00	Departure



Seismograph Unit **BlastMate III**
 Serial# **BA7197** Calibrated **July 2011**
 Mode/Settings **Advanced Module Continuous**
Vibration Consultant

D.C. Blakeman
 D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
Baseline 11:18	.760	151.5956	3ft off bottom/20ft/ 1290'away
Baseline 11:20	.555	148.8652	" "
Baseline 11:21	.411	146.2562	" "
Baseline 11:23	.411	146.2562	" "
Sheet 11:25	.699	150.8689	" "
Sheet 11:39	1.01	154.0658	" "
Sheet 11:41	.555	148.8652	" "
Sheet 11:46	.411	146.2562	10ft off bottom/20ft/ 1290'away
Baseline 11:48	.493	147.8363	" "
Sheet 11:52	.473	147.4766	" "
Sheet 11:55	.534	148.5302	" "

D.C. Blakeman
Hydrophone TBuck Trl Outbuilding Sheet Being Driven
 Seismologist/Vibration Consultant

Date:11/17/11

Monitoring Records November 17, 2011 Sheet 2

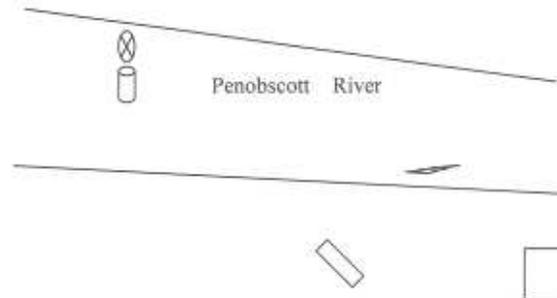


General Contractor

H. B. Fleming
Job Location
 Brewer Water Pollution Control Facility
Construction Activity
 Acoustic Monitoring Trial

BECC Company
 28 LedgeWood Drive
 Yarmouth, ME 04096
 WWW.becccompany.com

Time	Activity
10:00	Arrival
1:00	Departure



Seismograph Unit **BlastMate III**
 Serial# **BA7197** Calibrated **July 2011**
 Mode/Settings **Advanced Module Continuous**
 Vibration Consultant

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
Baseline 12:05	.206	160.2567	7 1/2ft off bottom/15'/ 1143' away
Baseline 12:07	.0822	152.2768	" "
Sheet 12:08	.144	157.14664	" "
Sheet 12:10	.144	157.14664	" "
Sheet 12:11	.123	155.7775	" "
Sheet 12:12	.206	160.2567	" "
Sheet 12:14	.0822	152.2768	" "



Seismologist/Vibration Consultant

Date: 11/17/11

Monitoring Records November 17, 2011 Sheet 3

General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility

Construction Activity

Acoustic Monitoring Trial

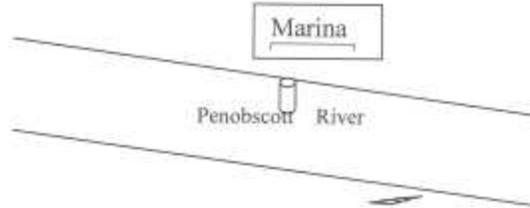
BECC Company

28 LedgeWood Drive

Yarmouth, ME 04096

WWW.becccompany.com

Time	Activity
10:00	Arrival
1:00	Departure



Seismograph Unit **BlastMate III**
Serial# **BA7197** Calibrated **July 2011**
Mode/Settings **Advanced Module Continuous**
Vibration Consultant

D.C. Blakeman

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
Baseline 12:21	.534	148.5302	7 1/2ft off bottom/15ft/ 780' away
Baseline 12:23	.0617	129.7851	" "
Baseline 12:24	.0411	126.2562	" "
Baseline 12:26	.0617	129.7851	" "
Sheet 12:38	.226	141.0615	" "
Sheet 12:39	.144	137.1466	" "
Sheet 12:41	.206	140.2567	" "
Sheet 12:42	.308	143.7504	" "



Seismologist/Vibration Consultant

D.C. Blakeman

Date: 11/17/11

Monitoring Records November 17, 2011 Sheet 4



General Contractor

H. B. Fleming

Job Location

Brewer Water Pollution Control Facility

Construction Activity

Acoustic Monitoring Trial

Time Activity

10:00 Arrival

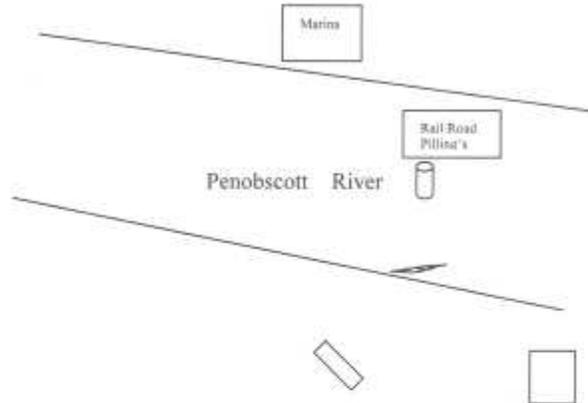
1:00 Departure

BECC Company

28 LedgeWood Drive

Yarmouth, ME 04096

WWW.becccompany.com



Seismograph Unit **BlastMate III**
Serial# **BA7197** Calibrated **July 2011**
Mode/Settings **Advanced Module Continuous**
Vibration Consultant

D.C. Blakeman

D.C. Blakeman, Becc Company

Time Interval	V/K Pa	dB RMS/(SPL)	Hydrophone Placement/Water Depth
Baseline 12:50	.0411	126.2562	8 1/2ft off bottom/17ft/ 615' away
Baseline 12:52	.0822	132.2768	" "
Baseline 12:54	.0617	129.7851	" "
Baseline 12:55	.0411	126.2562	" "
Sheet 13:08	.164	138.2762	" "
Sheet 13:10	.164	138.2762	" "
Sheet 13:11	.144	137.1466	" "
Sheet 13:13	.166	138.3815	" "



Seismologist/Vibration Consultant

D.C. Blakeman

Date: 11/17/11



Sound Pressure Results & Analysis:

The specifications set forth at this project were testing for the sound pressure that impacts the essential fish habitats. Ms. Johanna Riley Evans requested an Acoustic Monitoring Trial Plan to be approved by NOAA National Marine Fisheries Service. The tests were in compliance with the "NON-FISHING IMPACTS TO ESSENTIAL FISH HABITAT AND RECOMMENDED CONSERVATION MEASURES" published in August 2003 Version 1. In addition to NOAA's publications the following publications have been researched for validation of our results:

- 1) Road Ecology Center UC Davis: Assessing the impact of pile driving upon fish published on 08-29-2005 by Anthony Hawkins, Loughine Ltd., Kincaig, Blais, Aberdeen
- 2) Arizona Game and Fish Department, Habitat Branch: Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage published in November 2008
- 3) American Association of Stat Highway and Transportation Officials (AASHTO), Center for Environmental Excellence: Chapter 7; 7.2 Avoiding and Minimizing Impacts to Fish and Wildlife Copyright 2009
- 4) Wired Science: Noise Pollution Could Frustrate Fish by Brandon Keim on Pune 2, 2010
- 5) Effects of Sound on Fish; published on January 28, 2005, August 23, 2005 (Revised Appendix B): Authors Mardi C. Hastings, Ph.D. & Arthur N. Popper, Ph.D. Subconsultants to Jones & Stokes Under California Department of Transportation
- 6) Department of Biology, Center for Comparative and Evolutionary Biology of Hearing, University of Maryland: The effects of human-generated sound on fish published 2009 by Authors Mardi C. Hastings, Ph.D. & Arthur N. Popper, Ph.D.

The final analyses of the tests completed by BECC Company are based on the above publications.

Results:

All tests completed on September 12, 2011 without a bubble curtain and were at tested at 30 feet from the pile driving operation. The sound pressure exceeded the dB in the specifications determined by the Olver Specifications. These varied between 150.50 dB SPL and 174.24 dB SPL as seen on pages 2 & 3.

All tests completed on September 20, 2011 were tested with the bubble curtain in place. The results of the tests @ 33 feet were 165.25, 163.75, 163.17, 157.15 & 158.28 dB SPL. (See page 4) The differences in these readings were the tide direction. It is apparent the brackish water in rivers and the particles which vary within the tide make a marked difference in the sound pressure. This is explained better in the technical versions of the publication above. This also has a major impact on the distance from the pile driving operation. The best example of this is the results of the sound pressure taken from the middle of the river. Those results varied from 154.24 to 159.32 dB SPL the river depth being 10 feet shallower.

Pages 5, 6, 7, 8 & 9 contain the results of testing which varied for 1290 feet from the pile driving on pages 5 & 6 to 615 feet from the pile driving on page 9. The other profound variable on the 15th and 17th of November was the depth of the water and the testing depth of the hydrophone. In both cases the baselines did not collate with the pile driving. On each testing sheet the baseline had instances that read higher dB SPL's than the pile driving results. We can refer again to the publication spoke of the particle differentiations which disperse the sound pressures due to volume and density.

Conclusion:

Dr. Popper best stated in his publication in *Integrative Zoology* 2009; 4: 43-52 and we quote:

Integrative Zoology 2009; 4: 43-52

doi: 10.1111/j.1749-4877.2008.00134.x

REVIEW

The effects of human-generated sound on fish

Arthur N. POPPER¹ and Mardi C. HASTINGS²

¹Department of Biology, University of Maryland, College Park, USA and ²Applied Research Laboratory, The Pennsylvania State University, State College, USA

Abstract

There is growing international concern about the effects of human-generated sound on fish and other aquatic organisms. However, because of a striking paucity of well-designed and controlled experimental data, very little is actually known about the effects of these sounds on fish. Findings suggest that human-generated sounds, even from very high intensity sources, might have no effect in some cases or might result in effects that range from small and temporary shifts in behavior all the way to immediate death. At this point, however, it is nearly impossible to extrapolate from results with one sound source, one fish species, or even fish of one size to other sources, species, or fish sizes. The present paper briefly discusses the potential effects of sound on fish, describes some of the more recent well-controlled experimental studies, and points out areas for future study that will be needed before a real understanding of the effects of sound on fish can be developed.

Key words: anthropogenic sound, behavior, hearing, noise, sound.

In our particular testing for the Replacement Bulkhead at the Brewer Water Pollution Control Facility we found that there were way too many variables between the pile driving at the bulkhead and the fish traffic areas. Therefore the pile driving would not affect the fish. The variables were: distance, particle disbursement in the waters, underground (river) pipelines, riverside construction (i.e. vibratory rollers, heavy equipment etc.), sunken boats like the one next to the manmade island by the marina, water temperature inversion and so forth.

We conclude that the tests accurately documents the sound pressure results done on this project.

Reference Publications

**NON-FISHING IMPACTS TO
ESSENTIAL FISH HABITAT AND
RECOMMENDED CONSERVATION
MEASURES**

**National Marine Fisheries Service (NOAA Fisheries)
Alaska Region
Northwest Region
Southwest Region**

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**August 2003
Version 1**

¹Listed in alphabetical order.

Effects of Sound on Fish

by

Mardi C. Hastings,¹ Ph.D.

&

Arthur N. Popper,¹ Ph.D.

Subconsultants to Jones & Stokes Under
California Department of Transportation Contract No. 43A0139, Task Order 1

Funding Provided by the California Department of Transportation

Prime Contractor:
Jones & Stokes
2600 V Street
Sacramento, CA 95818

January 28, 2005
August 23, 2005 (Revised Appendix B)

¹ Any opinions or positions expressed in this report are those of the authors' and do not necessarily represent the opinions or positions of their employers, the State of California, the State of Maryland, or the United States Government

Guidelines for Bridge Construction or Maintenance to Accommodate Fish & Wildlife Movement and Passage

Arizona Game and Fish Department, Habitat Branch

November 2008

- [Introduction/Background](#)
- [General Recommendations](#)
- [General Bridge Structure Design](#)
- [Large Mammals](#)
- [Medium Mammals](#)
- [Small Mammals](#)
- [Bats](#)
- [Amphibians & Reptiles](#)
- [Fish](#)
- [Multiple Animal Type Use](#)
- [Post Construction & Monitoring](#)
- [References](#)





Title:

Assessing the impact of pile driving upon fish

Author:

Hawkins, Anthony, Loughine Ltd., Kincaig, Blairs, Aberdeen

Publication Date:

08-29-2005

Publication Info:

Road Ecology Center, John Muir Institute of the Environment, UC Davis

Permalink:

<http://escholarship.org/uc/item/28n858z1>

Additional Info:

Hawkins A. 2006. Assessing the impact of pile driving upon fish. IN: Proceedings of the 2005 International Conference on Ecology and Transportation, Eds. Irwin CL, Garrett P, McDermott KP. Center for Transportation and the Environment, North Carolina State University, Raleigh, NC: p. 22. (Abstract)

The effects of human-generated sound on fish

Arthur N. POPPER¹ and Mardi C. HASTINGS²

¹Department of Biology, University of Maryland, College Park, USA and ²Applied Research Laboratory, The Pennsylvania State University, State College, USA

Abstract

There is growing international concern about the effects of human-generated sound on fish and other aquatic organisms. However, because of a striking paucity of well-designed and controlled experimental data, very little is actually known about the effects of these sounds on fish. Findings suggest that human-generated sounds, even from very high intensity sources, might have no effect in some cases or might result in effects that range from small and temporary shifts in behavior all the way to immediate death. At this point, however, it is nearly impossible to extrapolate from results with one sound source, one fish species, or even fish of one size to other sources, species, or fish sizes. The present paper briefly discusses the potential effects of sound on fish, describes some of the more recent well-controlled experimental studies, and points out areas for future study that will be needed before a real understanding of the effects of sound on fish can be developed.



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Chapter 7

Bridge Maintenance

7.2. Avoiding and Minimizing Impacts to Fish and Wildlife

The federal Endangered Species Act drives much planning for how to avoid impacts to species listed as threatened or endangered. Floodplains are protected by federal Executive Order 11988, the Rivers and Harbors Act, and the Clean Water Act. State laws and community expectations impose additional requirements. State DOTs are developing many creative approaches to meet these demands and their own environmental stewardship commitments. DOT and state DOT-DNR cooperative initiatives to identify and develop standards and methods for improving fish passage are discussed in Chapter 3.5 on Culvert and Fish Passage Design Practices. Other enhancement practices for bridges are discussed in the following section, 7.3.

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Chapter 7

Bridge Maintenance

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7.2 [Avoiding and Minimizing Impacts to Fish and Wildlife](#)

7.3 [Enhancements to Bridges and Stream Access](#)

7.4 [Bridge Painting/Coating/Sealing and Containment Stewardship Practices](#)

[Wired Science](#)
[News for Your Neurons](#)

Noise Pollution Could Frustrate Fish

By [Brandon Keim](#)  June 2, 2010 | 6:36 pm | Categories: [Animals](#), [Environment](#)
[@9brandon](#) · 3,892 followers



After years of growing concern about the effects of marine noise on whales, scientists are finally asking what noise could do to fish. Whether they're harmed isn't yet known, but it's certainly a possibility.

The oceans are an increasingly clamorous place, with boat motors and sonar and explosions and construction creating a din at frequencies used by fish.

"If you're walking down the street and someone is jackhammering, you walk across the street and go around. What happens to a fish?" said University of Maryland aquatic noise specialist Arthur Popper. "How fish respond to sound is the big question for all of us."

Popper co-authored a review of the field's patchy, question-filled literature in the June *Trends in Ecology and Evolution*, marking a shift in thinking about ocean noise.



Transportation-and Construction-Vibration
Guidance Manual
Jones & Stokes

Contract No. 43A0049
Task Order No. 18

**Transportation- and Construction-Induced Vibration
Guidance Manual**

**California Department of Transportation
Environmental Program
Environmental Engineering
Noise, Vibration, and Hazardous Waste Management Office**

Prepared for:

California Department of Transportation
Noise, Vibration, and Hazardous Waste Management Office
1120 N Street, Room 4301 (MS27)
Sacramento, CA 94274
Contact: Jim Andrews
916/653-9554

Prepared by:

Jones & Stokes
2600 V Street
Sacramento, CA 95818
Contact: David Buehler, P.E.
916/737-3000

June 2004

Revised Addendum January 4, 2012

The following should clarify the measurement variation from the initial report logs.

SECTION 02212 - ACOUSTIC MONITORING REPORT

PROJECT: <u>BREWER BULKHEAD REPLACEMENT</u>	
NO. <u>0219</u>	
SHOP DRAWING REVIEW	
ENGINEER'S REVIEW	
<input type="checkbox"/> REVIEWED	<input checked="" type="checkbox"/> REVISE & RESUBMIT
<input type="checkbox"/> FURNISH AS NOTED	<input type="checkbox"/> REJECTED
<p><small>Corrections or comments made on the shop drawings during this review do not relieve contractor from compliance with requirements of the drawings and specifications. This check is only for review of the general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his or her work with that of all other trades; and performing all work in a safe and satisfactory manner.</small></p>	
OLIVER ASSOCIATES, INC.	Date Received: <u>12/16/11</u>
Reviewed By: <u>NWD</u>	Date Reviewed: <u>12/19/11</u>
Spec. Section: <u>02212</u>	Submittal #: <u>24A</u>

- Please have BECC clarify why measurements previously emailed for November 15 & 17 are different (20 dB lower) in report.

ARRA BUY AMERICAN VERIFICATION		
During Submittal Review	<u>Initials</u>	<u>Date</u>
Is Certification From Vendor Included?	<u>N/A</u>	_____
Checked Product in Field	<u>Y / N</u>	_____
	_____	_____

The initial report which was supplied to the engineers on site was calculated over the phone and given to them at the end of the work on the 17th of November. On the 18th the reports were simply transferred into a typed log and sent to H. B. Flemming on the 22nd via email. The final report was compiled and finished on the 6th of December. During the research and review we found a calculation error was made on the 15th and 17th. We were errent in putting this into our report. The calucation error was a desimal point error taken over the phone. We noticed this and reviewed the advanced software calculations and corrected the proper dB SEL's on the December 6th report.

Chuck Blakeman

D. C. "Chuck" Blakeman
President BECC Co.

