# APPENDIX 5D
## Biological Evaluation of Benthic Toxicity in Surface Sediment

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# APPENDIX 5D
# BIOLOGICAL EVALUATION OF BENTHIC TOXICITY IN SURFACE SEDIMENT

Regulatory criteria for evaluating freshwater sediment are provided under Sediment Management Standards (SMS), which includes Sediment Cleanup Objectives (SCO) and Cleanup Screening Levels (CSL) for both chemical and biological endpoints. The SCO criteria correspond to sediment concentrations or biological responses below which adverse effects (acute or chronic) to benthic invertebrates or human health are unlikely. The CSL criteria correspond to concentrations or effects thresholds above which adverse effects are anticipated, and represent the maximum allowed chemical concentrations and biological effects for use in establishing cleanup levels. Chemical concentrations or biological effects falling between the SCO and CSL represent potential minor adverse effects.

Biological tests measuring effects on survival and growth in several species were used to determine whether sediment is toxic to benthic organisms (see Section 5.2.3 of the remedial investigation [RI] text). Biological test results are considered definitive with respect to compliance with SMS criteria and override chemical exceedances that predict a biological effect.

The approach to evaluating benthic toxicity in surface sediment includes (1) a screening for chemical exceedances of SMS criteria that are protective of the benthic community (i.e., SCO and CSL chemical criteria); (2) an assessment of adverse effects to benthic organisms using laboratory toxicity tests and comparison to SCO and CSL biological criteria; and (3) an evaluation of areal extent of benthic toxicity using geographic information system (GIS) interpolation techniques. All three of these evaluations were conducted to delineate the spatial extent of benthic toxicity. Under SMS rules, biological test results override chemistry results because they reflect actual impacts whereas chemical criteria predict impacts and are derived from biological effects data from many different sites that may not be similar to the site being investigated.

## 1.1. Biological Evaluation

RETEC performed bioassays on sediment collected as part of three investigations conducted in March and October 2002 and April 2005. Biological endpoints that met quality assurance and control criteria and that are recommended for freshwater sediment in the current SMS guidance (Ecology 2019) in compliance with Washington Administrative Code (WAC) 173-204-563(3) were included in this evaluation. Tests conducted using Area of Investigation (AOI) sediment included:

- Amphipod (*Hyalella azteca*)
  - 10-day survival
  - 10-day growth
  - 28-day survival
  - 28-day growth
- Midge (*Chironomus tentans*)
  - 10-day survival
  - 10-day growth
  - 20-day survival
  - 20-day growth

The 2002 data for sample locations LU-1 through LU-10 are represented by split samples collected by Washington State Department of Ecology (Ecology) in March of that year and analyzed by RETEC using the 10-day amphipod mortality and 10-day midge mortality and growth tests. Samples analyzed by Ecology in March 2002 were rejected by the agency due to quality assurance/quality control (QA/QC) issues. Ecology

resampled sediment in July 2002, but again there were QA/QC issues affecting data quality[1] for the midge endpoints and therefore these results were not included in this biological evaluation. Although the 28-day amphipod survival and growth endpoint data (July 2002 Ecology sampling event) were considered valid, this test series was not included in the evaluation because this was the only investigation using this test and 10-day amphipod survival results (March 2002 sampling event) were also available for the same sample locations. The only location that failed any 28-day endpoint was the amphipod survival endpoint at LU-2; the location of LU-2 is uncertain as described below.

The October 2002 test results include the 10-day amphipod mortality and growth tests, and both the 10- and 20-day midge mortality and growth tests. Amphipod 10-day growth results from October 2002 were not used due to insufficient coverage within the AOI (this was the only investigation that conducted this test). The April 2005 test results include the 10-day amphipod mortality and the 20-day midge mortality and growth tests.

SMS classification (passing, failing SCO, or failing CSL) was based on numerical and statistical thresholds included in SMS regulation (Table 1 below). Classification of a sampling location included the one-hit/two-hit rule when aggregating test results (i.e., a single CSL or two SCO failures at a location equal a CSL failure).

**TABLE 1. SMS BIOLOGICAL CRITERIA (SCUM TABLE 8-4; ECOLOGY 2019)**

| Test/Endpoint | Control Performance | Reference Performance | Decision Criteria (SCO)[a] | Decision Criteria (CSL)[a] |
|---|---|---|---|---|
| Amphipod 10-day mortality[b] | Mortality < 20% | Mortality <25% | Test – Reference > 15% | Test – Reference > 25% |
| Amphipod 28-day mortality[b] | Mortality < 20% | Mortality <30% | Test – Reference > 10% | Test – Reference > 25% |
| Amphipod 28-day growth | Mean weight at test end > 0.15 mg/ind dw | Mean weight at test end > 0.15 mg/ind dw | Test/Reference biomass < 0.75 | Test/Reference biomass < 0.6 |
| Midge 10-day mortality[b] | Mortality < 30% | Mortality <30% | Test – Reference > 20% | Test – Reference > 30% |
| Midge 10-day growth | Mean weight at test end > 0.48 mg/ind afdw | Reference/control > 0.8 | Test/Reference biomass < 0.8 | Test/Reference biomass < 0.7 |
| Midge 20-day mortality[b] | Mortality < 32% | Mortality <35% | Test – Reference > 15% | Test – Reference > 25% |
| Midge 20-day growth | Mean weight at test end > 0.6 mg/ind afdw | Reference/control > 0.8 | Test/Reference biomass < 0.75 | Test/Reference biomass < 0.6 |

Notes:

[a] All results must be statistically significantly different from reference in addition to failing numeric criterion.

[b] Bioassay data (Table 5D-1) are reported as percent survival. For comparison to the mortality endpoint, subtract percent survival from 100.

afdw = ash-free dry weight dw = dry weight mg/ind = milligrams per individual organism

[1] QA/QC issues included exceedances of temperature thresholds during field collection and transport, exceedance of holding times prior to test initiation, intermittent dissolved oxygen suppression during testing and reference toxicant responses outside of control limits.

The resulting cumulative SMS classifications (i.e., across all bioassay results at a given location) are provided in Table 5D-1 (including those endpoints not used) and depicted in RI Figure 5-12. Green dots on the figure indicate no SCO exceedances; a yellow dot indicates a single SCO exceedance; and a red dot indicates a single CSL exceedance or more than one SCO exceedance.

Within the selected data set, 31 out of 42 sampling locations from within or immediately adjacent to the AOI boundary passed SMS biological criteria; 10 of the 12 failing locations are considered CSL failures. Within the AOI, the SMS biological failures were distributed in the lakeshore and on/near the lake slope zone of the lake, except for the western portion of the AOI where bioassay failures extended well into the lake bottom zone. The locations of two samples (LU-1 and LU-2) were uncertain[2]. In the case of LU-2, the substrate type and depth do not match the reported locations. These sampling locations were relocated in the field and were likely collected closer to the shore than locations indicated by the coordinates provided by Ecology.

## 1.2. Toxicity Interpolation

The RI current conditions data set includes over 100 surface sediment sampling locations; bioassays were conducted using a subset (n=42) of those samples. Following Ecology input, the bioassay response data for several tests/endpoints discussed below were used to interpolate areas of benthic toxicity. This section describes the approach used.

The bioassay data set includes a mix of test organisms and endpoints with differing durations, such that there is no sampling location where every test was conducted. However, three endpoints (with some substitutions discussed below) had sufficient coverage to interpolate bioassay responses:

- Amphipod mortality. This endpoint is represented by 10-day exposure results for all samples. The 2002 Texas A&M University (TAMU) study also ran a 28-day exposure test, but results are not used in the interpolation as discussed in Section 1.1.
- Midge mortality. This data set is a mix of 10-day and 20-day test results. Two data sets were created for interpolation: one set to represent the 10-day test, using the October 2005 20-day test results as a surrogate for the 10-day test and one set to represent the 20-day test results with the March 2002 10-day test results used as a surrogate for the 20-day results.
- Midge growth. This data set is a mix of 10-day and 20-day results, As with the midge mortality results, two data sets were created for interpolation to represent 10- and 20-day test results.

Toxicity responses for each endpoint for a given sample were calculated for comparison to the individual test criterion. Initially reported survival data were first converted to mortality by subtracting the percent survival from 100 percent; the mortality toxicity response was then calculated by subtracting the average percent mortality in the associated reference sample from the average percent mortality in the test sample. Mortality toxicity responses are positive or negative, depending on the difference between test and reference samples. The growth endpoint toxicity response is expressed as a ratio (average growth in the test sample divided by the average growth in the reference sample). Contours for mortality and growth endpoints are directly comparable to the numeric portion of their respective SMS biological decision criteria

[2] LU coordinates are those that were proposed prior to field work. LU-1 and LU-2 were moved, and only proposed coordinates were reported.

(see Table 5D-2). Cases where tests failed the numeric threshold of the SMS criteria but passed the statistical significance test are noted on applicable figures and Tables 5D-1 and 5D-2.

GIS interpolations used the inverse-distance weighted (IDW) algorithm with a reach of 500 feet. Interpolation maps were then created for each of the three endpoints (Figures 5D-1 [amphipod mortality], 5D-2 through 5D-4 [midge mortality] and 5D-5 through 5D-7 [midge growth]). For the midge mortality and growth endpoints, two sets of interpolation maps were made—one for comparison to 20-day SMS criteria (Figures 5D-2 and 5D-5) and one for comparison to 10-day SMS criteria (Figures 5D-3 and 5D-6); a third set of maps combined the exceedance areas to represent composite areas of toxicity based on either the 10-day or 20-day results and criteria (Figures 5D-4 and 5D-7). If a test result passed its numeric criterion or failed its numeric criterion but was not significantly different from its associated reference sample, it was not included as an area of benthic toxicity (Figures 5D-2, 5D-5, and 5D-6). Contours are the numeric SCO and CSL criteria for a given endpoint.

The amphipod 10-day mortality data set only included 10-day exposure tests. Figure 5D-1 shows the areas of benthic toxicity for amphipods based on the mortality endpoint using the SMS 10-day SCO criterion (i.e., the more conservative SCO criterion was used to define the extent of benthic toxicity).

Midge mortality results are mapped on Figures 5D-2 (displaying interpolations compared to 20-day SCO and CSL test criteria) and 5D-3 (compared to 10-day criteria); a composite map delineating benthic toxicity areas based on midge mortality for either test result is provided on Figure 5D-4.

Similarly, midge growth results are mapped on Figure 5D-5 (compared to 20-day criteria) and Figure 5D-6 (compared to 10-day criteria) with a combined result provided in Figure 5D-7.

The SCO areas of benthic toxicity for the three endpoints (Figure 5D-1 for amphipod mortality, Figure 5D-4 for midge mortality, and Figure 5D-7 for midge growth) were combined to create an overall area of benthic toxicity map (Figure 5D-8) based on all the endpoints evaluated.

As discussed above in Section 1.1 “Biological Evaluation,” the sample locations where bioassays were conducted are color-coded as no exceedance, SCO exceedance or a CSL exceedance based on individual bioassay results on each map; composite maps are color coded according to the combined results. Locations with no bioassay failures per SMS rules were not included in areas of benthic toxicity, regardless of the interpolation results. Discrepancies between the actual bioassay results and the individual test interpolations occurred at several locations where the bioassay response failed the numeric criterion for a test but passed the statistical criterion (i.e., was not statistically significantly different from reference). Those locations are noted on the applicable maps.

Although used in the interpolation, bioassay failure locations outside of the AOI were not included within the areas of benthic toxicity (see Figure 5D-8). Spatial clustering of bioassay responses (Appendix 4B) identified a group of sampling locations near the western boundary where the responses were primarily due to elevated metals in the sediment (referred to as the shipyard cluster). Two locations just southwest of the AOI boundary (NLU13[2002] and NLU13[2005]) were part of the extended shipyard cluster. Concentrations of metals were elevated at these two locations relative to other AOI surface sediment and, although PAHs were present, the concentrations of TPAH were less than concentrations associated with

toxicity due manufactured gas plant (MGP) sources[3]. Because toxicity was more likely due to metals from the adjacent shipyard, these two samples were not included in the area of Gas Works Park Site (GWPS)-related benthic toxicity. One sampling location outside of the eastern boundary of the AOI and proximal to non-GWPS sources (NLU01) also exceeded biological criteria. This exceedance is separated from the AOI by several no-exceedance locations and is, therefore, not included in the area of GWPS-related benthic toxicity.

## REFERENCES

Washington State Department of Ecology (Ecology). 2019. Sediment Cleanup User's Manual (SCUM). Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC. Publication No. 12-09-057. Revised December 2019.

[3] A no-adverse effect level (170 milligrams per kilogram [mg/kg]) and a minor adverse effect threshold (290 mg/kg) were developed for TPAH based on bioassay responses measured in site sediment as part of the CSD (Appendix 4B).

# Table 5D-1

## Bioassay Results

### Gas Works Park Site

### Seattle, Washington

| Survey Name | Investigation | Sample ID | Within the AOI? | Assigned Reference Station | Amphipod (*Hyalella azteca*) 10-day | | Amphipod (*Hyalella azteca*) 28-day | | Midge (*Chironomus tentans*) 10-day | | Midge (*Chironomus tentans*) 20-day | | Microtox® luminescence | Final SMS Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Survival[a] | Growth[b] | Survival[a] | Growth[b] | Survival[a] | Growth[b] | Survival[a] | Growth[b] | 15 min[c] | |
| TAMU02 | RETEC Split Samples (March 2002) | LU-1[d] | Y | Ref-1 | 92 | | | | 80 | **1.74** | | | 40 | CSL |
| TAMU02 | RETEC Split Samples (March 2002) | LU-2[d] | Y | Ref-1 | 94 | | | | 70 | **2.09** | | | 38 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-3 | Y | Ref-1 | 99 | | | | 84 | **1.86** | | | 53 | SCO |
| TAMU02 | RETEC Split Samples (March 2002) | LU-4 | Y | Ref-1 | 98 | | | | 78 | 2.25 | | | 61 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-5 | Y | Ref-1 | 100 | | | | 90 | 2.36 | | | 96 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-6 | Y | Ref-1 | 98 | | | | 68 | 2.49 | | | 93 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-7 | Y | Ref-1 | 99 | | | | 82 | 2.92 | | | 14 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-8 | N | Ref-1 | 99 | | | | 84 | 2.45 | | | 48 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-9 | N | Ref-1 | 100 | | | | 72 | 2.92 | | | 66 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-10 | N | Ref-1 | 98 | | | | 78 | 2.75 | | | 60 | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-11 | N | Ref-1 | -- | | | | -- | -- | | | -- | -- |
| TAMU02 | RETEC Split Samples (March 2002) | Ref-1 | N | -- | 93 | | | | 82 | 2.57 | | | Varied by batch | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | Control | n/a | -- | 99 | | | | 86 | 2.25 | | | Varied by batch | Pass |
| TAMU02 | Ecology Resamples (July 2002) | LU-1[d] | Y | Ref-2 | | | 86 | 0.132 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-2[d] | Y | Ref-2 | | | 42 | 0.166 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-3 | Y | Ref-2 | | | 92 | 0.102 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-4 | Y | Ref-2 | | | 92 | 0.162 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-5 | Y | Ref-2 | | | 100 | 0.142 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-6 | Y | Ref-2 | | | 96 | 0.130 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-7 | Y | Ref-2 | | | 98 | 0.102 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-8 | N | Ref-2 | | | 98 | 0.136 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-9 | N | Ref-2 | | | 94 | 0.152 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-10 | N | Ref-2 | | | 96 | 0.156 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | LU-11 | N | Ref-2 | | | 92 | 0.144 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | Ref-1 | N | -- | | | -- | -- | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | Ref-2 | N | -- | | | 98 | 0.114 | | | R | R | | [e] |
| TAMU02 | Ecology Resamples (July 2002) | Control | n/a | -- | | | 80 | 0.088 | | | R | R | | [e] |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU01 | N | Ref-NLU21 | 81 | 0.045 | | | **52** | **0.24** | **32** | 2.01 | | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU02 | N | Ref-NLU21 | 92 | 0.074 | | | **58** | 0.98 | 86 | 2.69 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU04 | Y | Ref-NLU21 | 96 | 0.092 | | | 78 | 1.23 | 96 | 2.79 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU05 | Y | Ref-NLU21 | 87 | 0.044 | | | 72 | 0.82 | 84 | 1.74 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU06 | Y | Ref-NLU21 | 91 | 0.079 | | | 82 | 1.10 | 90 | 2.94 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU07 | Y | Ref-NLU21 | 94 | 0.075 | | | 78 | 0.84 | 88 | 2.78 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU08 | Y | Ref-NLU21 | 95 | 0.083 | | | 82 | 1.20 | 94 | 2.68 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU10 | Y | Ref-NLU21 | 96 | 0.089 | | | 76 | 1.00 | 92 | 2.84 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU12 | Y | Ref-NLU21 | 92 | 0.11 | | | 80 | 0.83 | 90 | 3.40 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU13 | N | Ref-NLU21 | 84 | **0.055** | | | 74 | **0.52** | 66 | 2.29 | | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU14 | Y | Ref-NLU21 | 95 | 0.076 | | | 74 | 0.71 (NS) | 96 | 2.72 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU15 | N | Ref-NLU21 | 97 | 0.079 | | | 80 | 0.92 | 92 | 2.43 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU16 | Y | Ref-NLU21 | 92 | 0.068 | | | 66 | **0.45** | **60** | 1.86 | | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU17 | Y | Ref-NLU21 | 83 | 0.042 (NS) | | | 62 | **0.30** | **44** | **1.66** | | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | Ref-NLU21 | N | -- | 81 | 0.058 | | | 78 | 0.93 | 80 | 2.32 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | Ref-NLU22 | N | -- | 70 | 0.039 | | | 76 | 0.83 | 64 | 2.02 | | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | Control | n/a | -- | 90 | 0.039 | | | 72 | 1.28 | 82 | 2.50 | | Pass |

| Survey Name | Investigation | Sample ID | Within the AOI? | Assigned Reference Station | Amphipod *(Hyalella azteca)* 10-day | | Amphipod *(Hyalella azteca)* 28-day | | Midge *(Chironomus tentans)* 10-day | | Midge *(Chironomus tentans)* 20-day | | Microtox® luminescence | Final SMS Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Survival[a] | Growth[b] | Survival[a] | Growth[b] | Survival[a] | Growth[b] | Survival[a] | Growth[b] | 15 min[c] | |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU13 | N | Ref 2 | 84 | | | | | | **54** | **1.18** | 65 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU51 | Y | Ref 1 | **0** | | | | | | **0** | N/A | 50 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU55 | Y | Ref 1 | **51** | | | | | | **54** | **0.77** | 44 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU55-diluted | Y | Ref 1 | 74 | | | | | | **48** | 1.82 | 32 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU64 | Y | Ref 1 | 89 | | | | | | 86 | 2.34 | 72 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU66 | Y | Ref 2 | 92 | | | | | | 72 | 2.57 | 72 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU69 | Y | Ref 2 | 87 | | | | | | 96 | 2.30 | 72 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU73 | Y | Ref 1 | 89 | | | | | | 92 | 1.94 | 71 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU76 | N | Ref 1 | 82 | | | | | | 94 | 1.71 | 73 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU81 | N | Ref 2 | 90 | | | | | | 82 | 2.64 | 68 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU82 | N | Ref 1 | 79 | | | | | | 76 (NS) | 2.25 | 56 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU83 | Y | Ref 2 | 94 | | | | | | 84 | 2.33 | 70 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU84 | Y | Ref 2 | 98 | | | | | | 88 | 2.18 | 91 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU85 | Y | Ref 2 | 95 | | | | | | 82 | 2.36 | 101 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU86 | Y | Ref 2 | 87 | | | | | | 62 (NS) | **1.25** | 80 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU87 | Y | Ref 2 | 94 | | | | | | 88 | 2.25 | 71 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU117 | Y | Ref 1 | **0** | | | | | | **34** | 1.62 | 54 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU117-diluted | Y | Ref 1 | **30** | | | | | | **40** | 1.90 | 46 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLUEPA5 | Y | Ref 2 | 88 | | | | | | 88 | 2.17 | 96 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLUEPA19 | Y | Ref 1 | 97 | | | | | | 82 | 2.14 | 101 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | Ref-1 | N | -- | 84 | | | | | | 92 | 1.97 | Varied by batch | n/a |
| NLUBio05 | RETEC Phase3 (April 2005) | Ref-2 | N | -- | 86 | | | | | | 80 | 2.46 | Varied by batch | n/a |
| NLUBio05 | RETEC Phase3 (April 2005) | Control | n/a | -- | 98 | | | | | | 82 | 1.54 | Varied by batch | n/a |

**Notes:**

[a] survival = mean %

[b] growth = mean weight/larva, mg dw

[c] 15-min reading = mean light units after 15 minutes of exposure

[d] sample location highly uncertain

[e] July 2002 data not included in evaluation. March data used to represent these areas. See text for further discussion.

Shading = failure of SCO numeric criteria

Shading = failure of CSL numeric criteria

**Bold** = significant different from reference

n/a = not applicable

N/A = not applicable; high mortality precludes interpretation of growth; assumed to fail growth endpoint

NS = not significantly difference from reference

R = data rejected because of data quality issues

# Table 5D-2

## Toxicity Responses

### Gas Works Park Site

### Seattle, Washington

| Survey Name | Investigation | Sample ID | Within the AOI? | Assigned Reference Station | Amphipod *(Hyalella azteca)* 10-day | | Midge *(Chironomus tentans)* 10-day | | Midge *(Chironomus tentans)* 20-day | | Final SMS Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mortality[a] (>15 or 25%) | Growth[b] (<0.75 or 0.6) | Mortality[a] (> 20 or 30%) | Growth[b] (<0.8 or 0.7) | Mortality[a] (>15 or 25%) | Growth[b] (<0.75 or 0.6) | |
| TAMU02 | RETEC Split Samples (March 2002) | LU-1[d] | Y | Ref-1 | 1 | | 2 | **0.67** | | | CSL |
| TAMU02 | RETEC Split Samples (March 2002) | LU-2[d] | Y | Ref-1 | -1 | | 12 | **0.81** | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-3 | Y | Ref-1 | -6 | | -2 | **0.72** | | | SCO |
| TAMU02 | RETEC Split Samples (March 2002) | LU-4 | Y | Ref-1 | -5 | | 4 | 0.88 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-5 | Y | Ref-1 | -7 | | -8 | 0.92 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-6 | Y | Ref-1 | -5 | | 14 | 0.97 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-7 | Y | Ref-1 | -6 | | 0 | 1.14 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-8 | N | Ref-1 | -6 | | -2 | 0.95 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-9 | N | Ref-1 | -7 | | 10 | 1.14 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-10 | N | Ref-1 | -5 | | 4 | 1.07 | | | Pass |
| TAMU02 | RETEC Split Samples (March 2002) | LU-11 | N | Ref-1 | -- | | -- | -- | | | -- |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU01 | N | Ref-NLU21 | 0 | 0.78 | **26** | **0.25** | **48** | 0.87 | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU02 | N | Ref-NLU21 | -11 | 1.28 | **20** | 1.06 | -6 | 1.16 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU04 | Y | Ref-NLU21 | -15 | 1.59 | 0 | 1.32 | -16 | 1.20 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU05 | Y | Ref-NLU21 | -6 | 0.76 | 6 | 0.88 | -4 | 0.75 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU06 | Y | Ref-NLU21 | -10 | 1.36 | -4 | 1.18 | -10 | 1.27 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU07 | Y | Ref-NLU21 | -13 | 1.29 | 0 | 0.90 | -8 | 1.20 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU08 | Y | Ref-NLU21 | -14 | 1.43 | -4 | 1.29 | -14 | 1.16 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU10 | Y | Ref-NLU21 | -15 | 1.53 | 2 | 1.07 | -12 | 1.23 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU12 | Y | Ref-NLU21 | -11 | 1.90 | -2 | 0.89 | -10 | 1.46 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU13 | N | Ref-NLU21 | -3 | 0.95 | 4 | **0.55** | 14 | 0.99 | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU14 | Y | Ref-NLU21 | -14 | 1.31 | 4 | 0.76 (NS) | -16 | 1.17 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU15 | N | Ref-NLU21 | -16 | 1.36 | -2 | 0.98 | -12 | 1.05 | Pass |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU16 | Y | Ref-NLU21 | -11 | 1.17 | 12 | **0.48** | **20** | 0.80 | CSL |
| RETEC02-Grabs | RETEC Phase 2 (October 2002) | NLU17 | Y | Ref-NLU21 | -2 | 0.72 (NS) | 16 | **0.32** | **36** | **0.72** | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU13 | N | Ref 2 | 2 | | | | **26** | **0.48** | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU51 | Y | Ref 1 | **84** | | | | **92** | N/A | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU55 | Y | Ref 1 | **33** | | | | **38** | **0.39** | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU55-diluted | Y | Ref 1 | 10 | | | | **44** | 0.92 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU64 | Y | Ref 1 | -5 | | | | 6 | 1.19 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU66 | Y | Ref 2 | -6 | | | | 8 | 1.04 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU69 | Y | Ref 2 | -1 | | | | -16 | 0.93 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU73 | Y | Ref 1 | -5 | | | | 0 | 0.99 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU76 | N | Ref 1 | 2 | | | | -2 | 0.87 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU81 | N | Ref 2 | -4 | | | | -2 | 1.07 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU82 | N | Ref 1 | 5 | | | | 16 (NS) | 1.14 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU83 | Y | Ref 2 | -8 | | | | -4 | 0.95 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU84 | Y | Ref 2 | -12 | | | | -8 | 0.89 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU85 | Y | Ref 2 | -9 | | | | -2 | 0.96 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU86 | Y | Ref 2 | -1 | | | | 18 (NS) | **0.51** | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU87 | Y | Ref 2 | -8 | | | | -8 | 0.91 | Pass |

| Survey Name | Investigation | Sample ID | Within the AOI? | Assigned Reference Station | Amphipod *(Hyalella azteca)* 10-day | | Midge *(Chironomus tentans)* 10-day | | Midge *(Chironomus tentans)* 20-day | | Final SMS Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Mortality[a] (>15 or 25%) | Growth[b] (<0.75 or 0.6) | Mortality[a] (> 20 or 30%) | Growth[b] (<0.8 or 0.7) | Mortality[a] (>15 or 25%) | Growth[b] (<0.75 or 0.6) | |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU117 | Y | Ref 1 | **84** | | | | **58** | 0.83 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLU117-diluted | Y | Ref 1 | **54** | | | | **52** | 0.97 | CSL |
| NLUBio05 | RETEC Phase3 (April 2005) | NLUEPA5 | Y | Ref 2 | -2 | | | | -8 | 0.88 | Pass |
| NLUBio05 | RETEC Phase3 (April 2005) | NLUEPA19 | Y | Ref 1 | -13 | | | | 10 | 1.09 | Pass |

**Notes:**

[a] mortality = mean % difference from reference

[b] growth = ratio of mean test to mean reference growth

[c] 15-min reading = mean light units after 15 minutes of exposure

[d] sample location highly uncertain

[e] July 2002 data not included in evaluation. March data used to represent these areas. See text for further discussion.

Shading = failure of SCO numeric criteria

Shading = failure of CSL numeric criteria

**Bold** = significant different from reference

N/A = not applicable; high mortality precludes interpretation of growth; assumed to fail growth endpoint

NS = not significantly difference from reference

R = data rejected because of data quality issues

Gas Works Park

Lake Union

NLU15 -16
NLU16 -11
NLU86 -1
NLU17 -2
NLU87 -8
NLU13 [2002] -3
2 NLU13[2005]
NLU14 -14
NLU12 -11
NLU84 -12
LU-1† 1
LU-3 -6
NLU83 -8
LU-4 -5
NLU85 -9
LU-8 -6
LU-9 -7
NLU117 84
NLU64 -5
NLU66 -6
LU-2† -1
NLU10 -15
LU-5 -7
LU-6 -5
LU-10 -5
NLU08 -14
LU-7 -6
NLUEPA19 -13
NLU51 84
NLU07 -13
NLU06 -10
NLU05 -7
NLUEPA5 -2
NLU55 33
NLU04 -15
NLU69 -1
NLU73 -5
NLU76 2
NLU81 -4
NLU02 -11
NLU01 0
NLU82 5

## Legend

- Area of Investigation
- Shoreline (OHWM)

**Bioassay Test Duration**

- 10 days

**Biological Criteria Screening Levels (Amphipod 10 Day Mortality)**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

**Interpolated Biological Data**

- No Exceedance
- Sediment Cleanup Objective Exceedance >15%
- Cleanup Screening Level Exceedance >25%

## Notes:

1. Toxicity response = test mortality - reference mortality.
2. †LU-1 and LU-2 locations are uncertain.
3. ArcGIS IDW interpolation settings: Power=6, Neighbors=8, Reach=500ft.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250

Feet

**Bioassay IDW Interpolation Amphipod 10-day Mortality**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-1**

Path: P:\00\186846\GIS\MXD\Phase01\T16350\186846_01_F5D-1x_RevisedBioassayInterpolation_Amphipod.mxd Map Revised: 01 December 2021 maugust

Gas Works Park

Lake Union

NLU15 -12
NLU16 20
NLU86 #* 18
NLU17 36
NLU13 [2002] 14
26
NLU13[2005]
NLU87 -8
NLU84 -8
NLU12 -10
NLU14 -16
LU-1 † 2
LU-3 -2
NLU83 -4
LU-4 4
NLU85 -2
LU-2 † 12
NLU10 -12
LU-5 -8
LU-8 -2
LU-9 10
LU-10 4
NLU64 6
NLU117 58
NLU66 8
LU-6 14
NLU08 -14
LU-7 0
NLUEPA19 10
NLU05 -4
NLUEPA5 -8
NLU51 92
NLU06 -10
NLU07 -8
NLU73 0
NLU55 38
NLU04 -16
NLU69 -16
NLU76 -2
NLU81 -2
NLU01 48
NLU02 -6
NLU82 # 16

*Area around NLU86 is considered a "no exceedance" area (see Note 3) and is not retained in the midge mortality SCO composite (Figure 5D-4)

## Legend

- Area of Investigation
- Shoreline (OHWM)

**Bioassay Test Duration**

- 10 days
- 20 days

Biological Criteria Screening Levels
**(Midge 20 Day Mortality)**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

**Interpolated Biological Data**

- No Exceedance
- Sediment Cleanup Objective Exceedance >15%
- Cleanup Screening Level Exceedance >25%

## Notes:

1. Toxicity response = test mortality - reference mortality.
2. † LU-1 and LU-2 locations are uncertain.
3. # Response fails numeric threshold but passes statistical test, therefore test passes.
4. ArcGIS IDW interpolation settings:
   Power=6, Neighbors=8, Reach=500ft.
5. Basemap 2005 USGS aerial photograph. Does not show current conditions.
6. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250
Feet

**Bioassay IDW Interpolation Midge Mortality Using 20-day Test Criteria**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-2**

Path: P:\0018684\GIS\MXD\Phase01\T1635\0018684601_F5D-2x_BioassayInterpolations_20Survival.mxd Map Revised: 01 December 2021 maugust

Gas Works Park

Lake Union

NLU15 -2

NLU13 [2002] 4

NLU13[2005] 26

NLU86 18

NLU87 -8

NLU17 16

NLU16 12

NLU14 4

NLU12 -2

NLU84 -8

LU-1† 2

LU-3 -2

NLU83 -4

LU-4 4

NLU85 -2

LU-8 -2

LU-9 10

NLU64 6

NLU117 58

LU-2† 12

NLU10 2

LU-5 -8

LU-6 14

NLU66 8

NLU08 -4

LU-7 0

NLUEPA19 10

LU-10 4

NLU01 26

NLU82 16

NLU02 20

NLU76 -2

NLU81 -2

NLU73 0

NLU55 38

NLU04 0

NLU69 -16

NLU05 6

NLUEPA5 -8

NLU51 92

NLU06 -4

NLU07 0

## Legend

- Area of Investigation
- Shoreline (OHWM)

**Bioassay Test Duration**

- 10 days
- 20 days

**Biological Criteria Screening Levels (Midge 10 Day Mortality)**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

**Interpolated Biological Data**

- No Exceedance
- Sediment Cleanup Objective Exceedance >20%
- Cleanup Screening Level Exceedance >30%

## Notes:

1. Toxicity response = test mortality - reference mortality.
2. †LU-1 and LU-2 locations are uncertain.
3. ArcGIS IDW interpolation settings: Power=6, Neighbors=8, Reach=500ft.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250

Feet

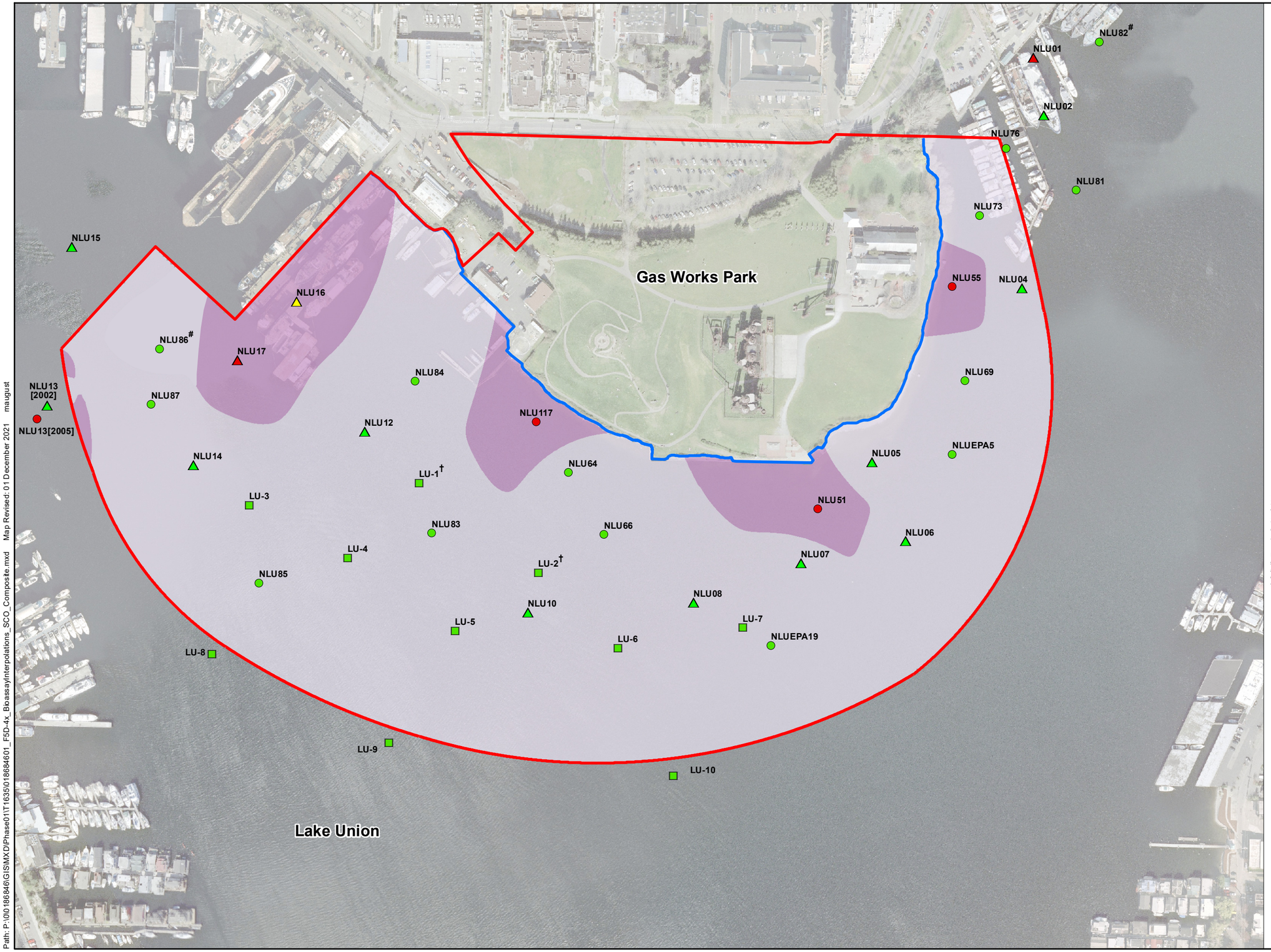
**Bioassay IDW Interpolation Midge Mortality Using 10-day Test Criteria**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-3**

Path: P:\0018684\GIS\MXD\Phase01\T1635\0018684601_F5D-3b_BioassayInterpolations_CH10dayMort.mxd Map Revised: 01 December 2021 maugust




## Legend

- Area of Investigation
- Shoreline (OHWM)

**Bioassay Test Duration**

- 10 days
- 20 days
- 10 & 20 days

**Biological Criteria Screening Levels (Midge 10 and 20 Day Mortality)**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

**Interpolated Biological Data**

- No Exceedance
- Sediment Cleanup Objective Exceedance

## Notes:

1. †LU-1 and LU-2 locations are uncertain.
2. # Response fails numeric threshold but passes statistical test, therefore test passes.
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.
4. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

200 0 200

Feet

**Bioassay IDW Interpolation Midge Mortality SCO Composite**

Gas Works Park Site
Seattle, Washington

GeoEngineers **Figure 5D-4**

Map Revised: 01 December 2021 maugust

Path: P:\0018684\GIS\MXD\Phase01\T1635\0018684601_F5D-4x_BioassayInterpolations_SCO_Composite.mxd

Harbor Patrol

Gas Works Park

Lake Union

NLU15 1.05

NLU16 0.80

NLU86 0.51

NLU17 0.72

NLU13 [2002] 0.99

NLU87 0.91

0.48 NLU13[2005]

NLU84 0.89

NLU12 1.46

NLU117 0.82

NLU14 1.17

LU-1† 0.68

LU-3 0.72

NLU64 1.19

NLU83 0.95

NLU66 1.04

LU-4 0.88

LU-2† 0.81

NLU85 0.96

NLU10 1.23

NLU08 1.16

LU-5 0.92

LU-7 1.14

NLUEPA19 1.09

LU-6 0.97

LU-8 0.95

LU-9 1.14

LU-10 1.07

NLU82 1.14

NLU01 0.87

NLU02 1.16

NLU76 0.87

NLU81 1.07

NLU73 0.99

NLU55 0.39

NLU04 1.20

NLU69 0.93

NLU05* 0.75

NLUEPA5 0.88

NLU51 0.00

NLU06 1.27

NLU07 1.20

*Area around NLU05 is considered a "no exceedance" area and not retained in the midge growth SCO composite (Figure 5D-7)

## Legend

Area of Investigation

Shoreline (OHWM)

**Bioassay Test Duration**

10 days

20 days

**Biological Criteria Screening Levels (Midge 20 Day Growth)**

No Exceedance

Sediment Cleanup Objective Exceedance

Cleanup Screening Level Exceedance

**Interpolated Biological Data**

No Exceedance

Sediment Cleanup Objective Exceedance <0.75

Cleanup Screening Level Exceedance <0.60

Location of Benthic Toxicity Area Uncertain

## Notes:

1. Toxicity response = test growth/reference.
2. †LU-1 and LU-2 locations are uncertain.
3. ArcGIS IDW interpolation settings: Power=6, Neighbors=8, Reach=500ft.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250

Feet

**Bioassay IDW Interpolation Midge Growth Using 20-day Test Criteria**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-5**

Path: P:\00186846\GIS\MXD\Phase01\T1635\01868401_F5D-5_BioassayInterpolations_20Growth.mxd Map Revised: 01 December 2021 maugust

Gas Works Park

Lake Union

NLU15 0.98

NLU16 0.48

NLU86 0.51

NLU17 0.32

NLU13 [2002] 0.55

0.48 NLU13[2005]

NLU87 0.91

NLU14 #* 0.76

NLU84 0.89

NLU12 0.89

LU-1† 0.68

NLU117 0.82

LU-3 0.72

NLU83 0.95

LU-4 0.88

NLU85 0.96

LU-2† 0.81

NLU10 1.07

LU-5 0.92

LU-8 0.95

LU-9 1.14

LU-6 0.97

NLU08 1.29

LU-7 1.14

NLUEPA19 1.09

LU-10 1.07

NLU64 1.19

NLU66 1.04

NLU51 0.00

NLU05 0.88

NLUEPA5 0.88

NLU06 1.18

NLU07 0.90

NLU69 0.93

NLU55 0.39

NLU04 1.32

NLU73 0.99

NLU81 1.07

NLU76 0.87

NLU02 1.06

NLU01 0.25

NLU82 1.14

*Area around NLU14 is considered a "no exceedance" area (see Note 3) and is not retained in the Midge growth SCO composite (Figure 5D-7)

## Legend

Area of Investigation

Shoreline (OHWM)

**Bioassay Test Duration**

10 days

20 days

**Biological Criteria Screening Levels (Midge 10 Day Growth)**

No Exceedance

Sediment Cleanup Objective Exceedance

Cleanup Screening Level Exceedance

**Interpolated Biological Data**

No Exceedance

Sediment Cleanup Objective Exceedance <0.80

Cleanup Screening Level Exceedance <0.70

Location of Benthic Toxicity Area Uncertain

## Notes:

1. Toxicity values are a fraction of reference values.
2. † LU-1 and LU-2 locations are uncertain.
3. # Response fails numeric threshold but passes statistical test, therefore test passes.
4. ArcGIS IDW interpolation settings: Power=6, Neighbors=8, Reach=500ft.
5. Basemap 2005 USGS aerial photograph. Does not show current conditions.
6. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250

Feet

**Bioassay IDW Interpolation Midge Growth Using 10-day Test Criteria**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-6**

Path: P:\00186846\GIS\MXD\Phase01\T1635\01868401_F5D-6b_BioassayInterpolations_CH10dayGrowth.mxd Map Revised: 01 December 2021 maugust

Harbor Patrol

Gas Works Park

Lake Union

NLU82
NLU01
NLU02
NLU76
NLU81
NLU73
NLU15
NLU16
NLU55
NLU04
NLU86
NLU17
NLU84
NLU69
NLU13 [2002]
NLU87
NLU117
NLU12
NLU13[2005]
NLUEPA5
NLU14#
NLU05
LU-1†
NLU64
LU-3
NLU51
NLU83
NLU66
NLU06
LU-4
LU-2†
NLU07
NLU85
NLU08
NLU10
LU-7
LU-5
NLUEPA19
LU-6
LU-8
LU-9
LU-10

## Legend

- Area of Investigation
- Shoreline (OHWM)

**Bioassay Test Duration**

- 10 days
- 20 days
- 10 and 20 days

**Biological Criteria Screening Levels (Midge 10 and 20 Day Growth)**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

**Interpolated Biological Data**

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Location of Benthic Toxicity Area Uncertain

## Notes:

1. †LU-1 and LU-2 locations are uncertain.
2. # Response fails numeric threshold but passes statistical test, therefore test passes.
3. Basemap 2005 USGS aerial photograph. Does not show current conditions.
4. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N
W E
S

250 0 250

Feet

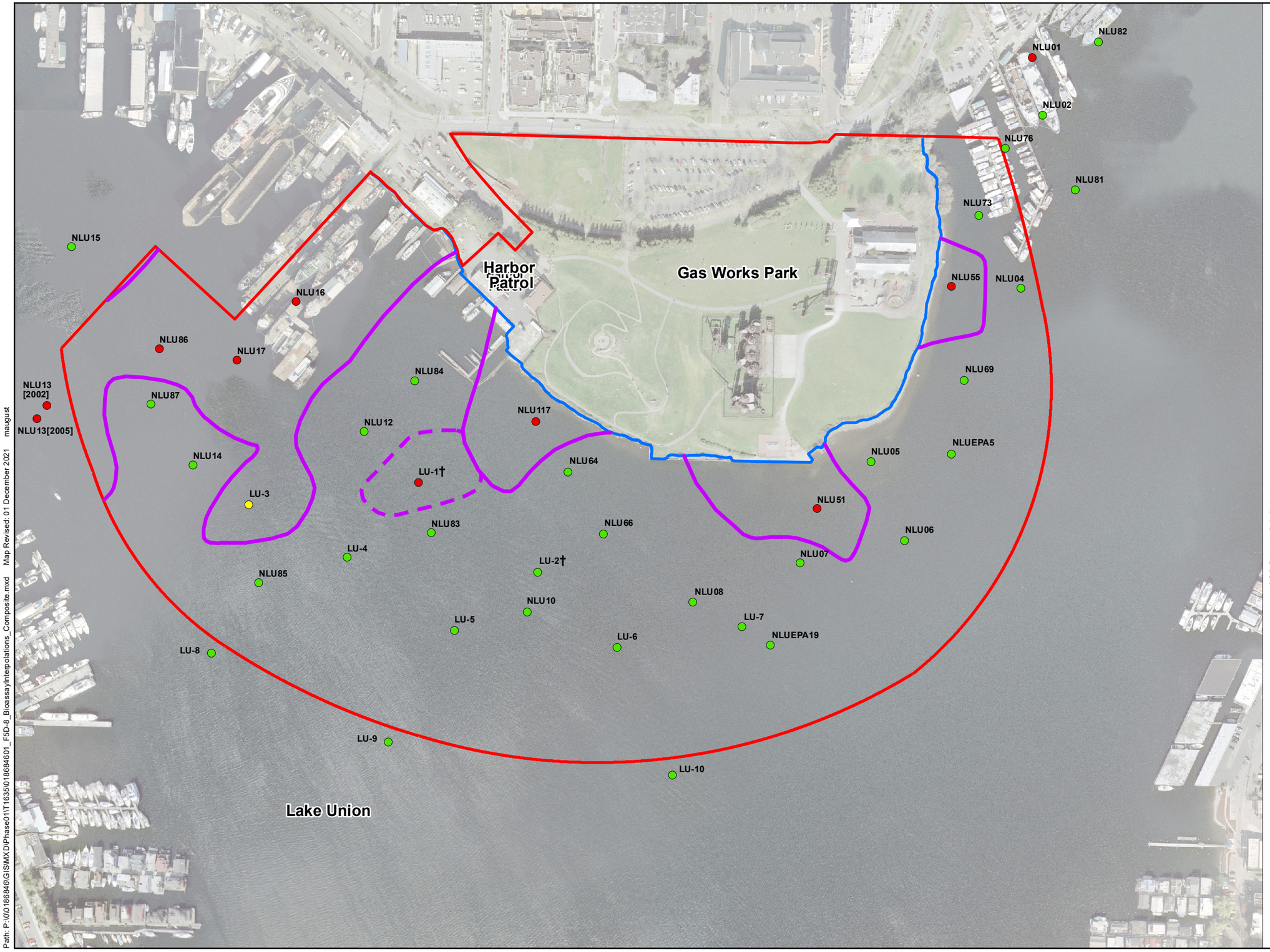
**Bioassay IDW Interpolation Midge Growth SCO Composite**

Gas Works Park Site
Seattle, Washington

GeoEngineers

**Figure 5D-7**

Path: P:\00\186846\GIS\MXD\Phase01\T1635\01868401_F5D-7_BioassayInterpolations_20Growth_SCO_Composite.mxd Map Revised: 01 December 2021 maugust




## Legend

- Area of Investigation
- Shoreline (OHWM)

Biological Criteria Screening Levels (All Endpoints)

- No Exceedance
- Sediment Cleanup Objective Exceedance
- Cleanup Screening Level Exceedance

Interpolated Biological Data

- Areas of Benthic Toxicity
- Location of Benthic Toxicity Area Uncertain

## Notes:

1. See Table 5D-1 for specific exceedances at each station.
2. † LU-1 and LU-2 locations are uncertain.
3. Results provided in Table 5D-1 and 5D-2. Based on 10-day amphipod mortality and 10- and 20-day midge mortality and growth.
4. Basemap 2005 USGS aerial photograph. Does not show current conditions.
5. Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet



N W E S

250 0 250

Feet

**Areas of Benthic Toxicity in Surface Sediment**

Gas Works Park Site
Seattle, Washington

GeoEngineers | **Figure 5D-8**

Path: P:\0\0186846\GIS\MXD\Phase01\T1635\0186846 01_F5D-8_BioassayInterpolations_Composite.mxd Map Revised: 01 December 2021 maugust