PATTLE DELAMORE PARTNERS LTD
Level 2, Radio New Zealand House
51 Chester Street West Christchurch
PO Box 389, Christchurch, New Zealand

Tel: +3 **363 3100** Fax: +3 **363 3101**
Web Site **http://www.pdp.co.nz**
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9 June 2010

Ms Jenny Easton
Tasman District Council
Private Bag 4
RICHMOND 7050

Dear Jenny

GROUNDWATER MONITORING AT FORMER FCC SITE, MAPUA – MAY 2010 SAMPLING UPDATE

The May sampling round has incorporated all the new monitoring bores that have been drilled at the site, which for the more recently drilled bores, represents their third quarterly sampling round. This letter provides our usual summary of the trends in the bores that are routinely monitored and then comments on the patterns across the site in the more recently drilled bores. As recommended in the site audit report, it is proposed that the network of new on-site monitoring bores should be sampled at quarterly intervals for one year. Therefore, at the completion of that 12 month period we will prepare a full groundwater review report which will include recommendations for the ongoing monitoring requirements. Consequently, this current letter should be treated as an interim update on the latest monitoring results.

The groundwater sampling that is the subject of this letter review was carried out by TDC between 3-6 May 2010.

Regularly Sampled Wells

The results in the regularly sampled wells have been compared with the previous sampling that has been carried out at the site, which prior to December 2007 had been arranged by MfE. A series of plots have been attached to this letter to highlight the major trends in those bores that were included in the latest sampling round. Figure 1 shows the location of the sampled boreholes that are referred to in this letter. BH1A and BH2A are upgradient of the eastern groundwater discharge to the Mapua channel. BH5A and BH9A are upgradient of the south-western groundwater discharge into the Waimea Inlet. The bore at 13 Tahi Street is the nearest private bore downgradient of the site.

Earlier sampling that was carried out in January and April 2008 has included three nearby pairs of boreholes: BH1/BH1A, BH5/BH5A and BH9/BH9A. On the plots that follow, the points from these adjacent boreholes have been joined by a vertical line to indicate how similar or different they are. In the plots for the latest sampling round, the only data shown is from boreholes BH1A, BH2A, BH5A, BH9A and 13 Tahi Street. The following comments relate to the trends that are apparent from the most recent round of groundwater monitoring.

- Figure 2 shows nitrate-nitrogen concentrations. Three boreholes have historically shown elevated concentrations: BH2, BH5 and BH9. Since late 2007, concentrations have decreased significantly in BH2 and BH9, which both had concentrations of less than 2 g/m^3 in November 2009. BH5 continued to show elevated concentrations. Since then, all three of these boreholes have shown an increase in nitrate-nitrogen concentrations, but in the latest sampling round, the concentration has again decreased or been relatively stable, although BH2, BH5 and BH9 all currently have nitrate-N concentrations above the Maximum Acceptable Value in the Drinking Water Standards for New Zealand 2005 (Revised 2008). Figure 2a shows the boreholes that have typically displayed lower nitrate-N concentrations. Both BH1 and 13 Tahi Street remain at stable, low concentrations.
- Figure 3 shows ammonia-nitrogen concentrations. The bores with elevated concentrations (BH1 and BH2) have shown a very small increase in BH1 in the latest sampling round, and a larger increase in BH2, although well below the historically high concentrations of April 2008. Those bores with lower ammonia-N concentrations (Figure 3a) show stable concentrations in BH5, BH9 and 13 Tahi Street.
- Figure 4 shows dissolved reactive phosphorous concentrations, which have increased in BH2, but remained stable in other wells.
- Figure 5 shows DDX concentrations. The bores with elevated concentrations showed a decrease, apart from 13 Tahi Street, which continues to be non-detectable.
- Figure 6 shows ADL concentrations. These concentrations continue to show a relatively stable pattern.
- Figure 7 shows electrical conductivity values, which are a general indicator of all the chemicals dissolved in the water. These show a relatively stable pattern, with the exception of an increase in BH2 and BH9, which both increased.
- Figure 8 shows dissolved copper concentrations. Copper was one of the reagents used in the MCD process. The results show stable concentrations.
- Iron was utilised in the MCD process, but has only been sampled since January 2008. The results are shown in Figure 9. Detectable concentrations only occur in BH1A, which continues to show quite variable concentrations.

The most recent sampling round has occurred during a time of lower summertime water levels, as indicated by the plot in Figure 10. Most chemical concentrations have been generally stable, with the exception of ammonia-N in BH2, DRP in BH2, electrical conductivity in BH2 and BH9 and iron in BH1.

Piezometric Survey

The elevation of the groundwater table within the on-site monitoring bores was measured on 3 May 2010, and the resulting contours are plotted in Figure 11. They show that levels are lower than at the time of the last survey in February 2010 resulting in a flatter gradient, but a similar pattern of groundwater flow direction beneath the site, with most of the groundwater discharging either to the Mapua channel to the east, or the Waimea Inlet to the south-west.

Sampling of Additional Wells

The sampling of the additional on-site wells during February 2010 also allows a more detailed picture of the distribution of chemicals within the area to be defined. Figures 12-20 have been prepared to show the patterns that exist.

- **Nitrate-Nitrogen**

  Figure 12 shows the nitrate-nitrogen concentrations, which have been colour coded as follows:

  - green – less than half the Maximum Acceptable Value (MAV) in the Drinking Water Standards (<5.7 mg/L);

- orange – between half the MAV and the full MAV of 11.3 mg/L;
- red – greater than the MAV.

Many of the individual borehole concentrations are lower than the February sampling round, although the general pattern across the site is similar, with low nitrate concentrations generally occurring within the eastern part of the site. More elevated nitrate-nitrogen concentrations occur within the western portion of the site (up to 260 mg/L in BH101, which is significantly less than the 470 mg/L reported in February 2010). This bore is located adjacent to the clay bund around a former landfill area.

Indication of seepage into the Waimea Inlet from nearby boreholes have elevated concentrations (7 mg/L in BH3A and 90 mg/L in BH5A), whereas seepage into the Waimea channel along the eastern side boundary has much lower concentrations (<4 mg/L).

- **Ammonia-Nitrogen**

  Figure 13 shows the ammonia-nitrogen concentrations, which have been colour coded as follows:

  - green – less than the aesthetic guideline value in the Drinking Water Standards (<0.3 mg/L);
  - orange – between the aesthetic guideline value in the Drinking Water Standards and a significantly elevated value of 10 mg/L of aquatic ecosystems;
  - red – above a significantly elevated value of 10 mg/L.

  There has been no consistent change since February 2010, with some bores showing increased concentrations and others showing decrease concentrations. The results show elevated concentrations occur in both the east and west of the site, with the highest concentration of 1,860 mg/L occurring at BH101 (down from 2,100 mg/L in February).

  The seepage samples indicate elevated ammonia-N concentrations in the east entering the Mapua channel, but much lower concentrations in the west adjacent to the Waimea Inlet.

  The ammonia-N concentrations indicate some areas of the site have significantly higher concentrations than the values measured in the regularly monitored bores.

- **Total Nitrogen**

  Figure 14 shows the total Nitrogen concentrations, which have been colour coded as follows:

  - green – less than 1 mg/L, which is above the ANZECC guideline value for marine water of 0.12 mg/L;
  - orange – between 1 and 20 mg/L;
  - red – greater than 20 mg/L.

  As with the ammonia-nitrogen concentrations, there have been variable changes between the boreholes.

  The results indicate that the vast majority of on-site wells have elevated nitrogen concentrations.

- **Dissolved Reactive Phosphorous**

  Phosphorous is the other nutrient (in addition to nitrogen) that contributes to algal growth problems in surface waterways. Diammonium phosphate was used as one of the re-agents used in the remediation process (along with urea).

  Figure 15 shows the DRP concentrations, which have been colour coded as follows:

  - green – less than the ANZECC guideline value for marine water (<0.01 mg/L);
  - orange – between the ANZECC guideline value and one hundred times the ANZECC guideline value;
  - red – more than 100 times above the ANZECC guideline value (>1.0 mg/L).

Concentrations have generally been similar to, or lower than, the concentrations in February 2010. Variable concentrations occur across the site, with some low and non-detectable values, and the bores showing localised high concentrations (up to 440 mg/L at BH101).

The eastern seepage sample showed DRP at 0.059 mg/L (above ANZECC guidelines), and the south-western seepage sample had no detectable DRP (<0.004 mg/L), although boreholes adjacent to the Waimea Inlet have variable concentrations up to 1.45 mg/L in BH5A.

- **DDX**

  Figure 16 shows the DDX concentrations, which have been colour coded as follows:

  - green – close to or less than the laboratory detection limit (<0.00006 mg/L);
  - orange – greater than the laboratory detection limit and below the MAV in the Drinking Water Standards;
  - red – greater than the MAV in the Drinking Water Standards (>0.001 mg/L).

  There have been some changes in the coding of this figure compared to February, with less red points and less green points, and more in the orange mid-range.

  The results show variable DDX concentrations within the site. The variation in concentrations within the site is most likely due to the localised effects of soils with elevated DDX concentrations.

- **ADL**

  Figure 17 shows the ADL concentrations, which have been colour coded as follows:

  - green – close to or less than the laboratory detection limit (<0.000006 mg/L);
  - orange – above the laboratory detection limit but below a value midway between the MAV in the Drinking Water Standards for aldrin and diedlrin and the MAV for lindane;
  - red – elevated concentrations above 0.001 g/m^3.

  As with DDX, the results show variable concentrations within the site, although the pattern from the May sampling round is similar to the February sampling round.

- **Conductivity**

  Figure 18 shows the pattern of electrical conductivity values in the groundwater. This is a general indication of all the chemicals dissolved in the groundwater. The following colour coding has been used:

  - green – typical background values (<30mS/m);
  - orange – moderately elevated values (30-100 mS/m);
  - red – highly elevated values (>100 mS/m).

  This plot demonstrates that generally elevated values that occur beneath the site. Higher values have been recorded in the May 2010 round, particularly along the southern boundary of the site adjacent to the Tahi Street properties.

- **Copper**

  Figure 19 shows the pattern of copper concentrations, which have been colour coded as follows:

  - green – less than the ANZECC guideline value for protection of 95% of species in marine water (<0.0013 mg/L);
  - orange – between the ANZECC guideline value and ten times the ANZECC guideline value;
  - red – greater than 10 times above the ANZECC guideline value.

  Concentrations have generally decreased across the site, with more points in the low (green) category than in February.

The results show low to moderate concentrations generally occur within the groundwater beneath the site, with only two significant hot spots at BH101 and BH108.

Both seepage samples showed copper concentrations below the ANZECC guideline values.

- **Iron**

  Figure 20 shows the pattern of iron concentrations in the groundwater, which have been colour coded as follows:

  - green – below the laboratory detection limit (<0.02 mg/L);
  - orange – above the laboratory detection limit, but below the aesthetic guideline value in the Drinking Water Standards;
  - red – greater than the aesthetic guideline value in the Drinking Water Standards (>0.2 mg/L).

  The results show generally low concentration across the site, although four significantly higher values occurred at BHG and at three eastern sites (BH1A, BH111 and BH112).

Overview

The patterns shown in Figures 12-20 indicate a continuing impact from the site soils on the underlying groundwater. In particular:

- nitrogen (mostly nitrate in the west and ammonia in the east);
- DDX;
- ADL.

Isolated occurrences of elevated concentrations of phosphorous, copper and iron also occur within the site.

In general terms, the pattern of chemical occurrence is similar to the pattern shown in February 2010 and most parameters in the long-term regularly measured wells have shown a stable, or slightly improved groundwater quality, with a few isolated exceptions.

We trust you find these comments helpful. Please contact us if you wish to discuss any of the information contained in this letter.

Yours sincerely

PATTLE DELAMORE PARTNERS LIMITED

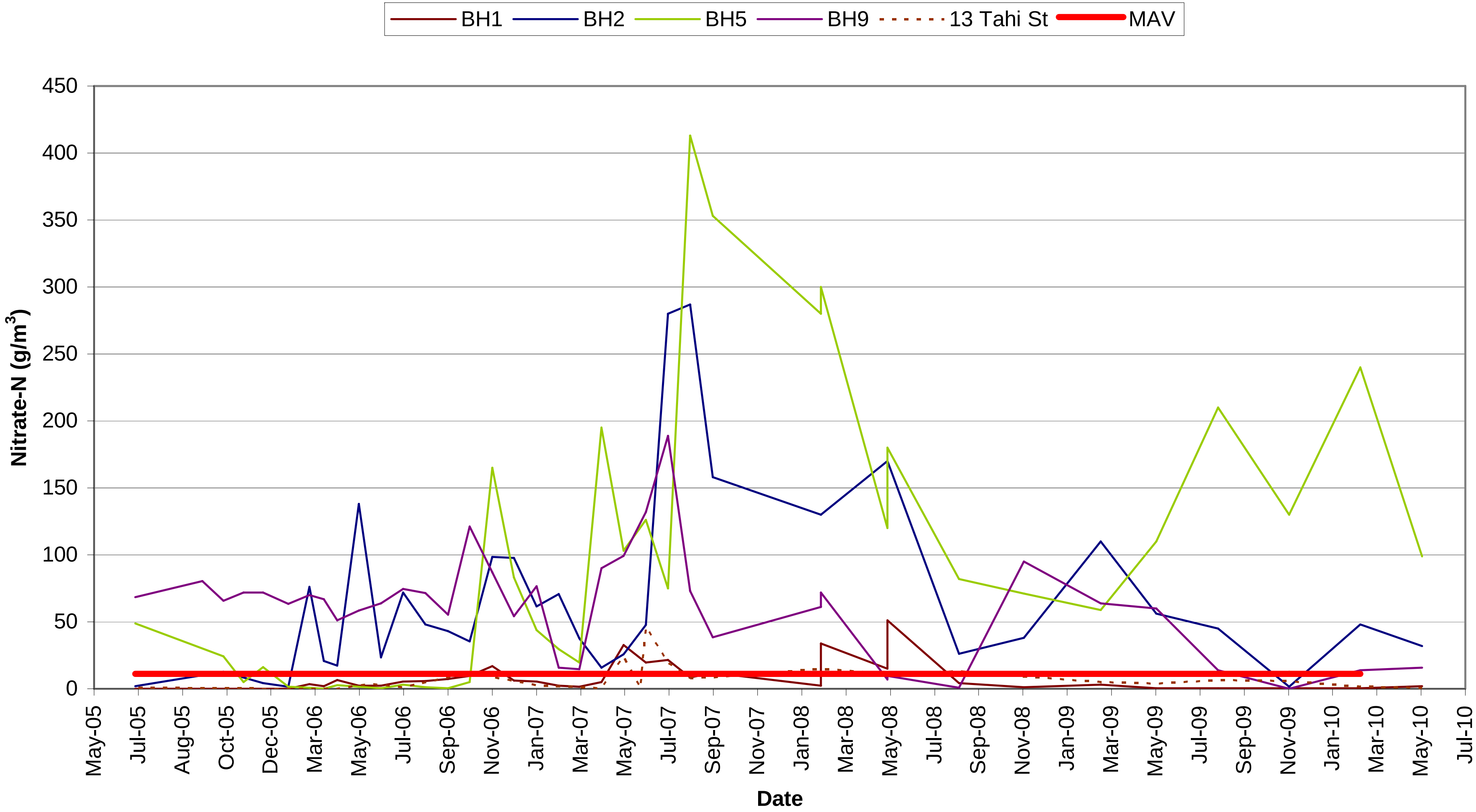
Peter Callander

Encl.

Source: Cadastral information derived from LINZ data.

Figure 1 : LOCATION OF REGULARLY MONITORED WELLS

Figure 2. Nitrate-N
MAV DWSNZ 11.3 NO_3-N g/m^3



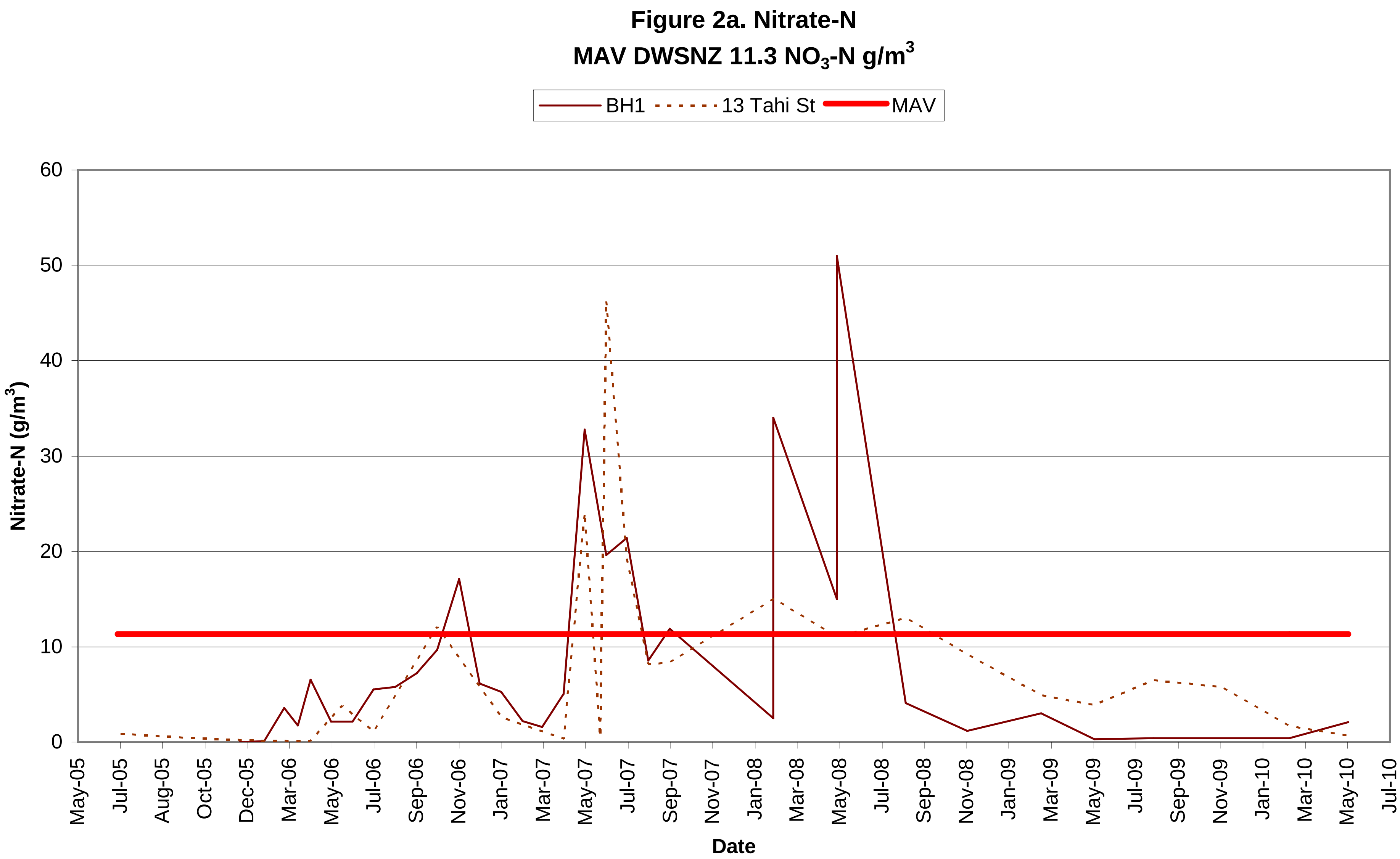


Figure 2a. Nitrate-N
MAV DWSNZ 11.3 NO3-N g/m3
BH1
13 Tahi St
MAV
Nitrate-N (g/m3)
0
10
20
30
40
50
60
May-05
Jul-05
Aug-05
Oct-05
Dec-05
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
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May-10
Jul-10
Date

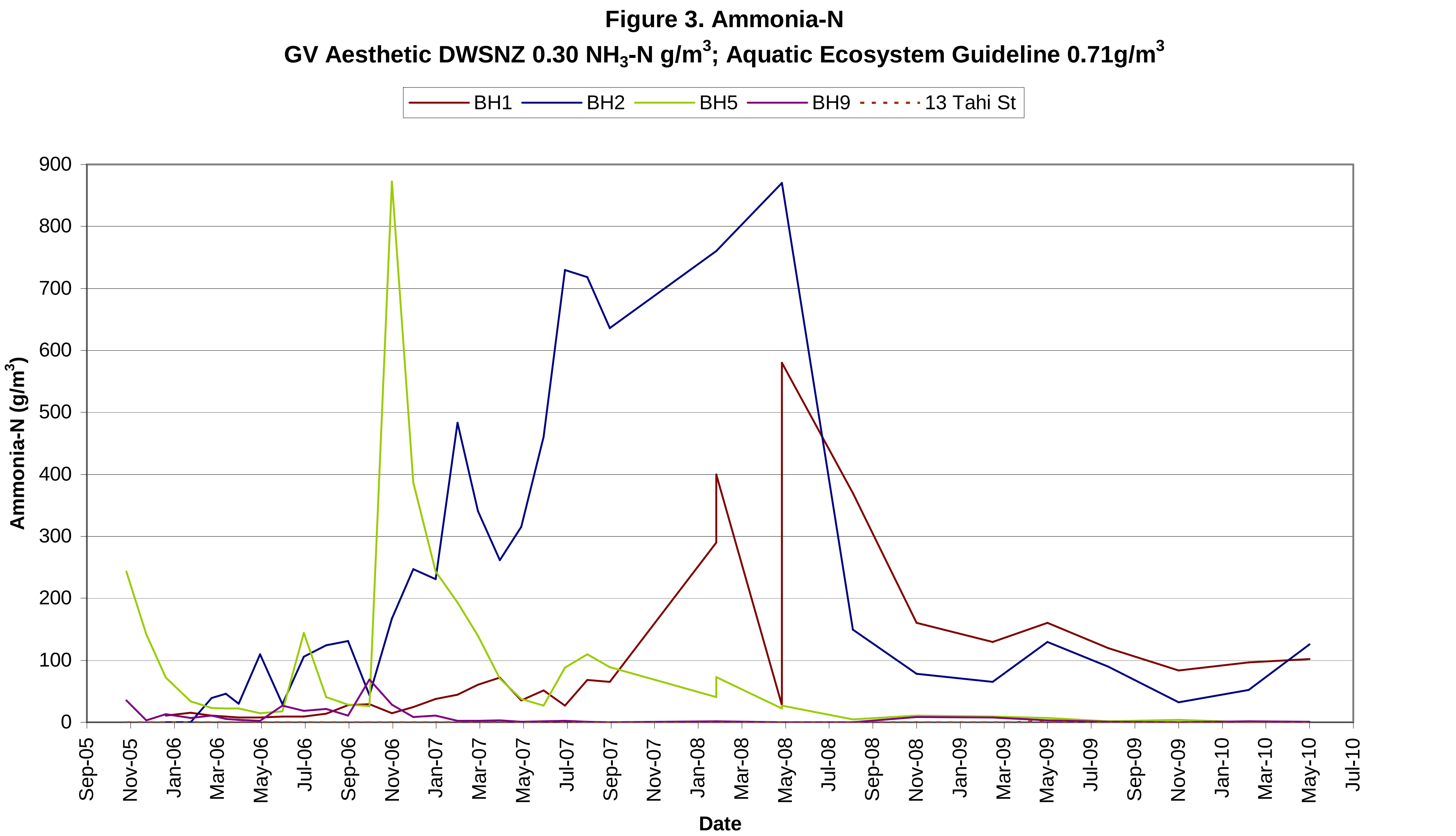
Figure 3. Ammonia-N
GV Aesthetic DWSNZ 0.30 NH3-N g/m3; Aquatic Ecosystem Guideline 0.71g/m3
BH1
BH2
BH5
BH9
13 Tahi St
Ammonia-N (g/m3)
0
100
200
300
400
500
600
700
800
900
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
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May-10
Jul-10
Date

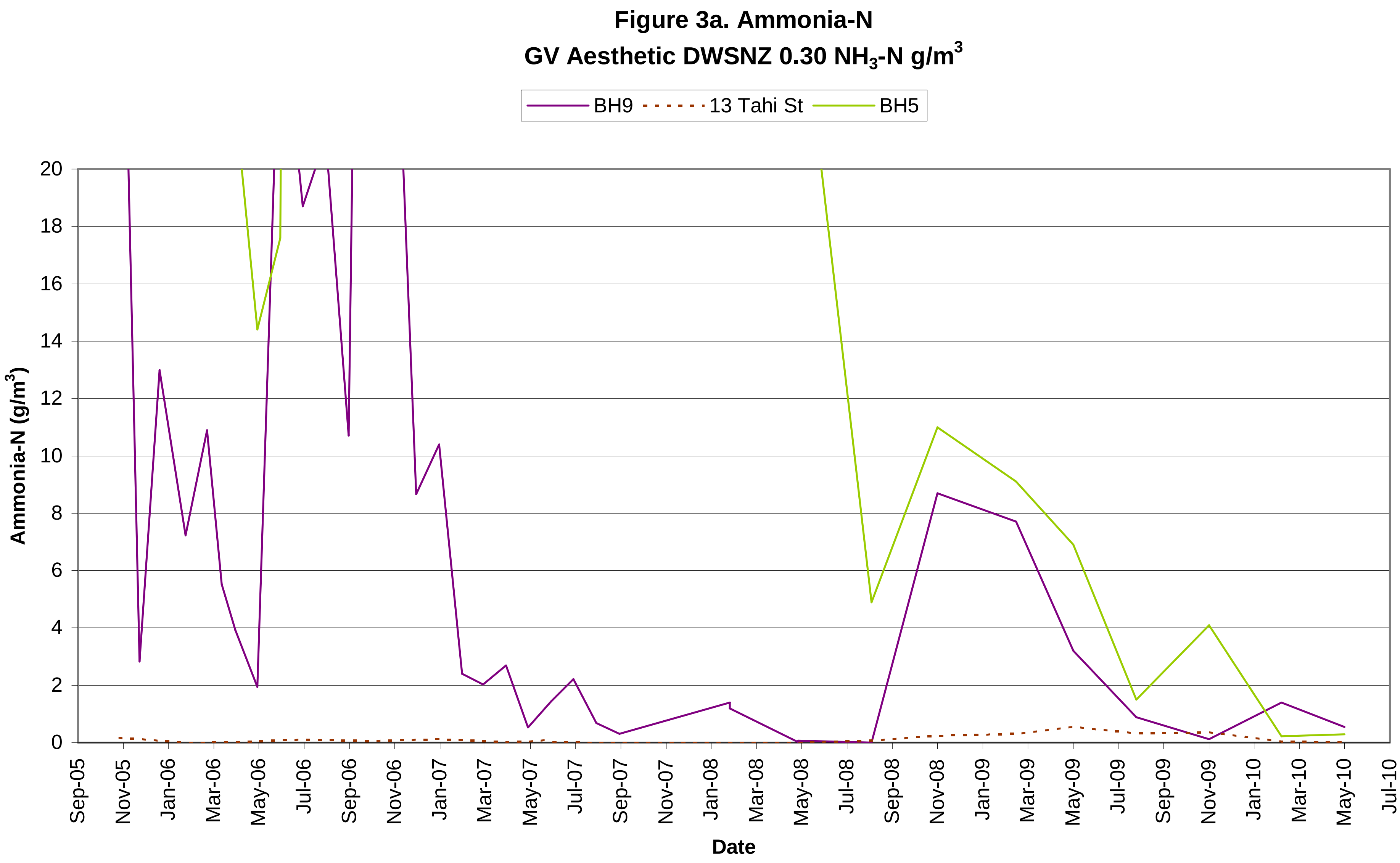
Figure 3a. Ammonia-N
GV Aesthetic DWSNZ 0.30 NH3-N g/m3
BH9
13 Tahi St
BH5
Ammonia-N (g/m3)
0
2
4
6
8
10
12
14
16
18
20
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
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May-09
Jul-09
Sep-09
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Mar-10
May-10
Jul-10
Date

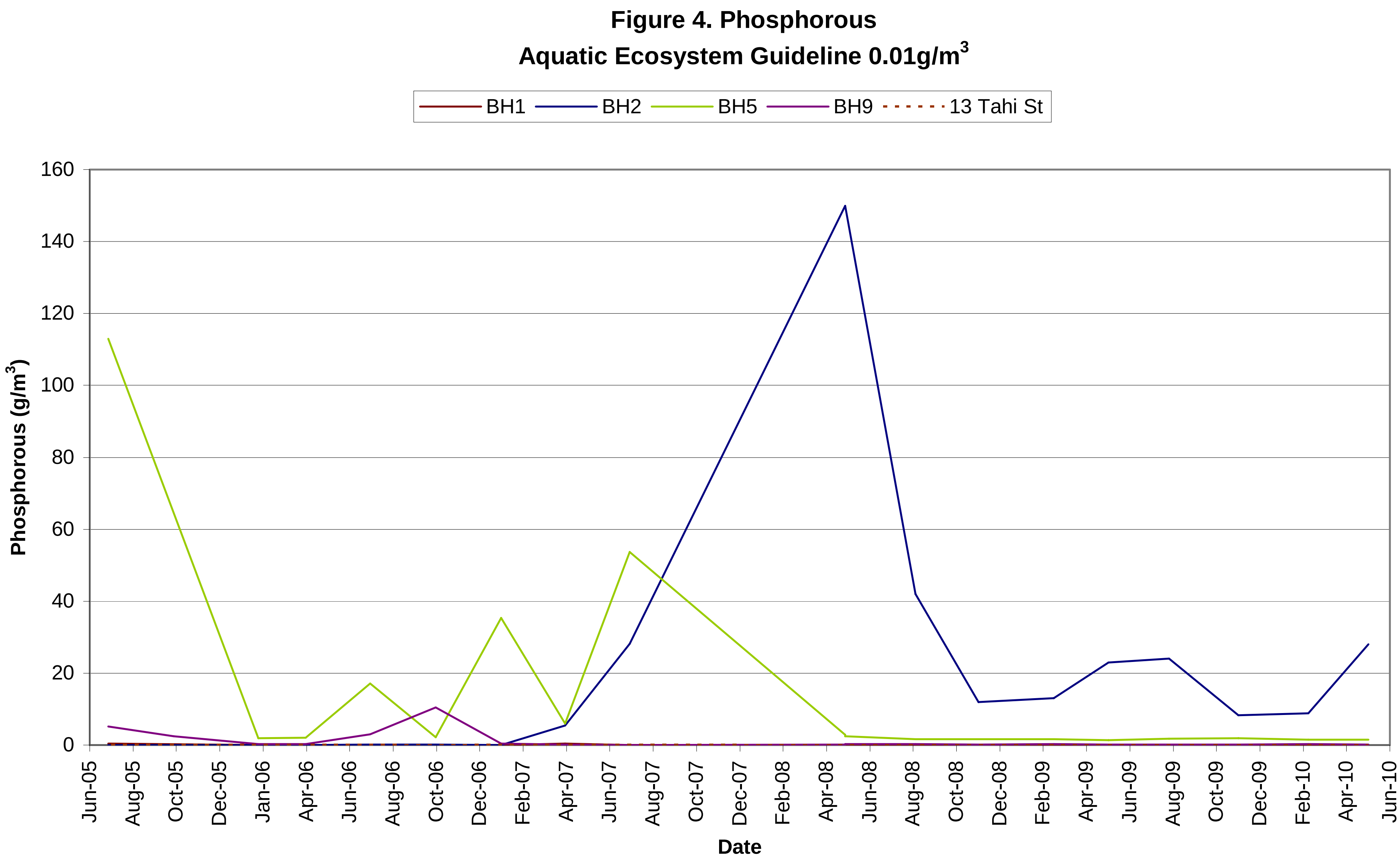
Figure 4. Phosphorous
Aquatic Ecosystem Guideline 0.01g/m3
BH1
BH2
BH5
BH9
13 Tahi St
160
140
120
100
80
60
40
20
0
Phosphorous (g/m3)
Jun-05
Aug-05
Oct-05
Dec-05
Jan-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07
Apr-07
Jun-07
Aug-07
Oct-07
Dec-07
Feb-08
Apr-08
Jun-08
Aug-08
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Apr-09
Jun-09
Aug-09
Oct-09
Dec-09
Feb-10
Apr-10
Jun-10
Date

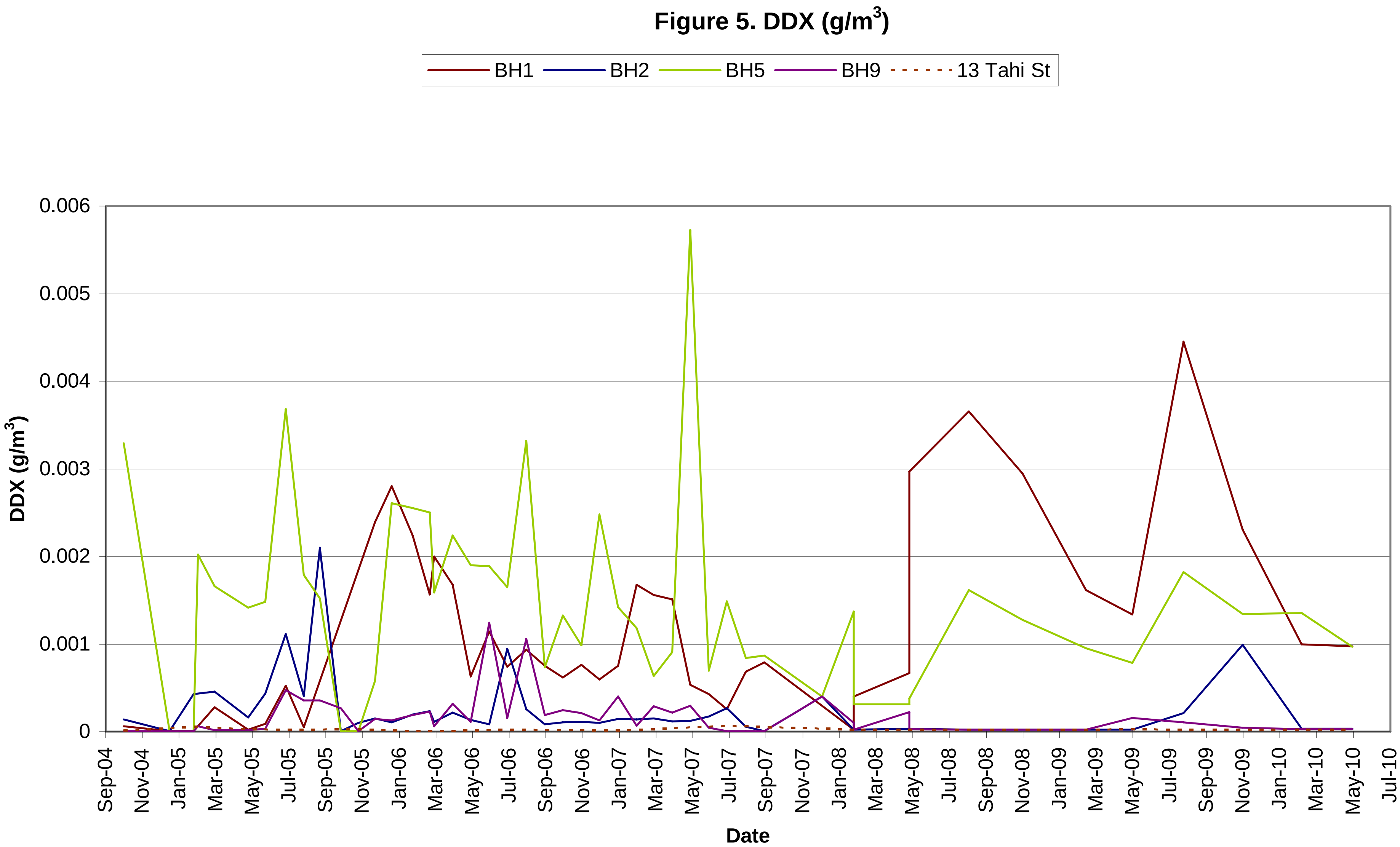
Figure 5. DDX (g/m3)
BH1
BH2
BH5
BH9
13 Tahi St
0.006
0.005
0.004
0.003
0.002
0.001
0
DDX (g/m3)
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
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Jul-09
Sep-09
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Mar-10
May-10
Jul-10
Date

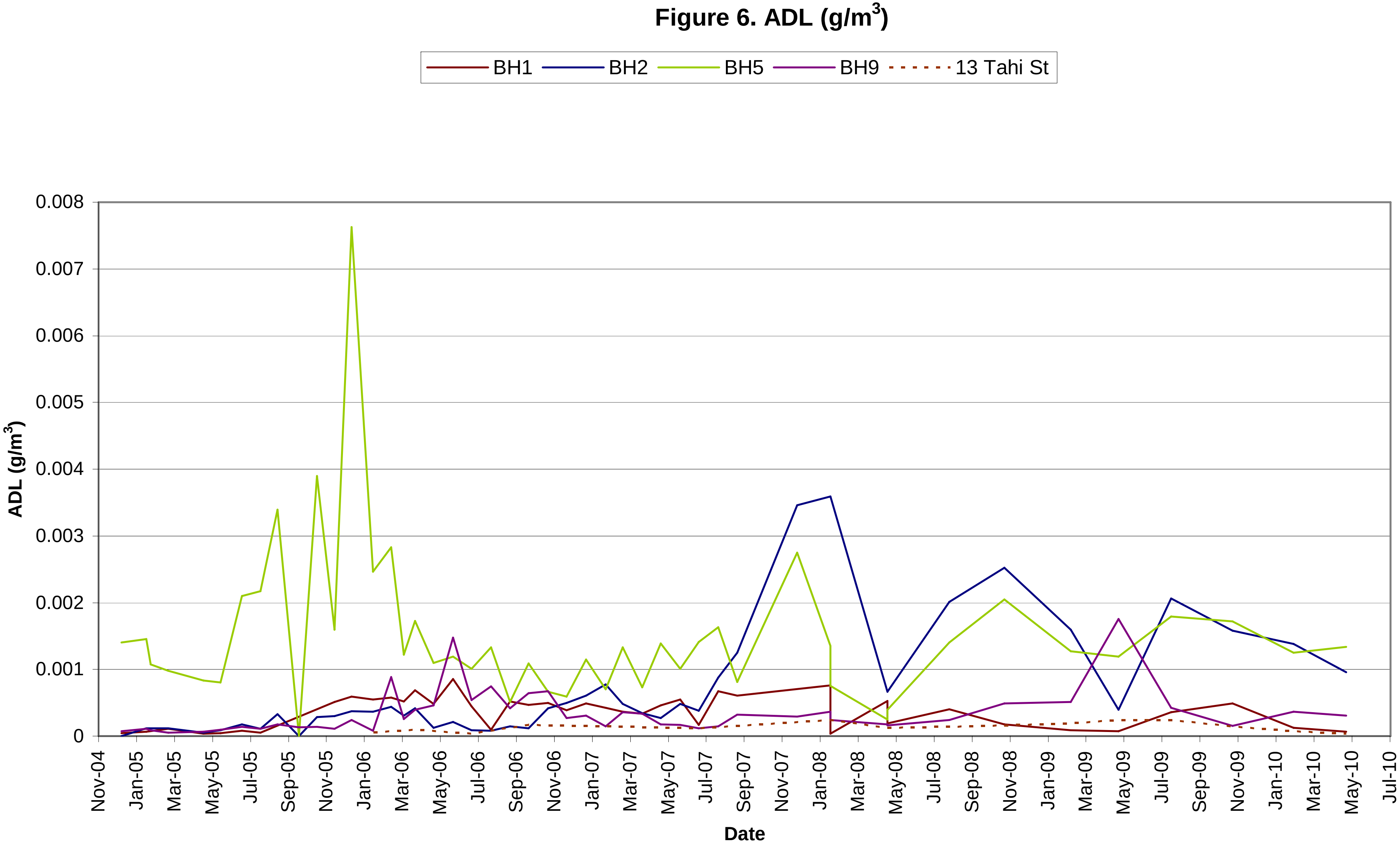
Figure 6. ADL (g/m3)
BH1
BH2
BH5
BH9
13 Tahi St
ADL (g/m3)
Date
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
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Mar-10
May-10
Jul-10

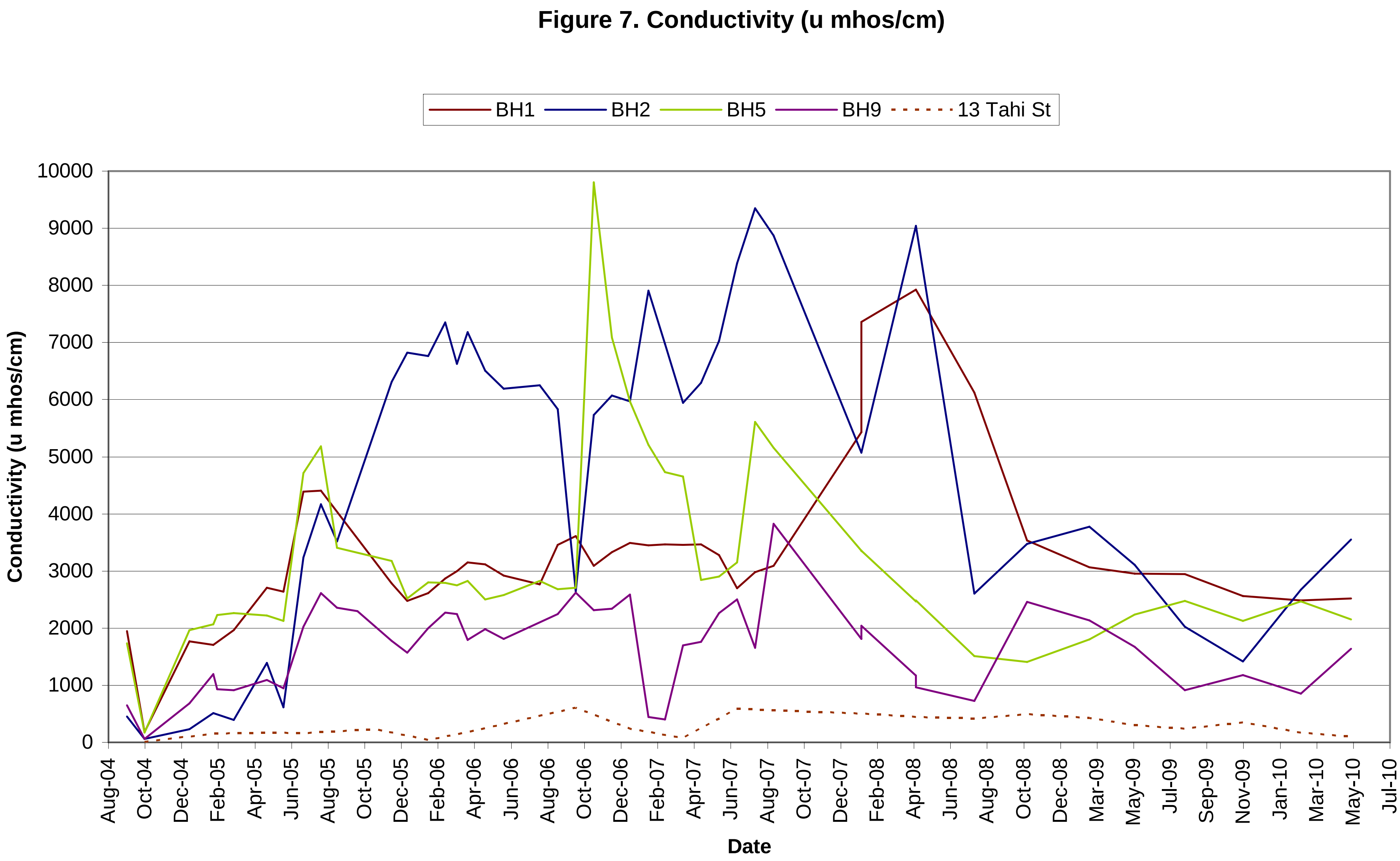
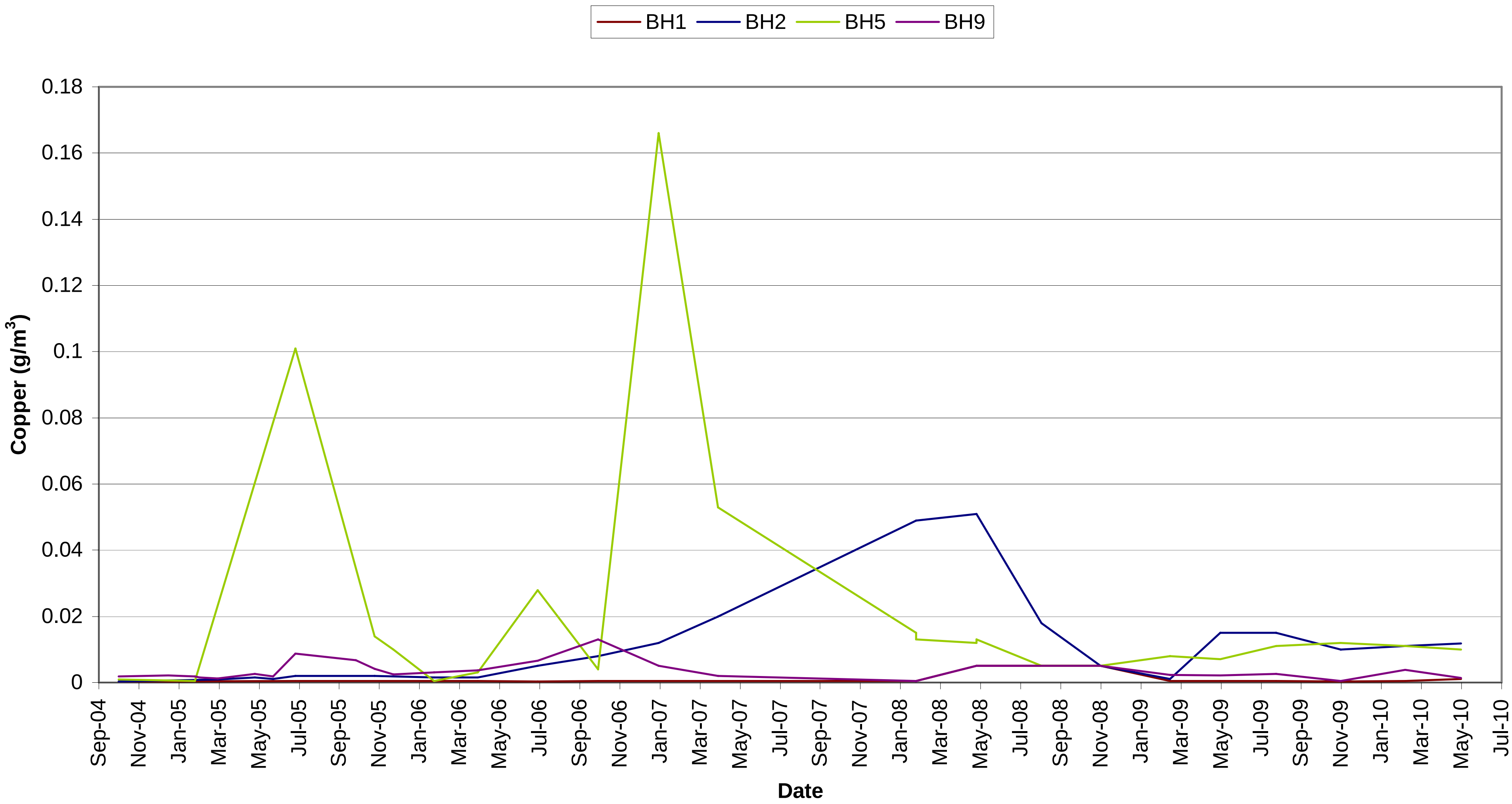
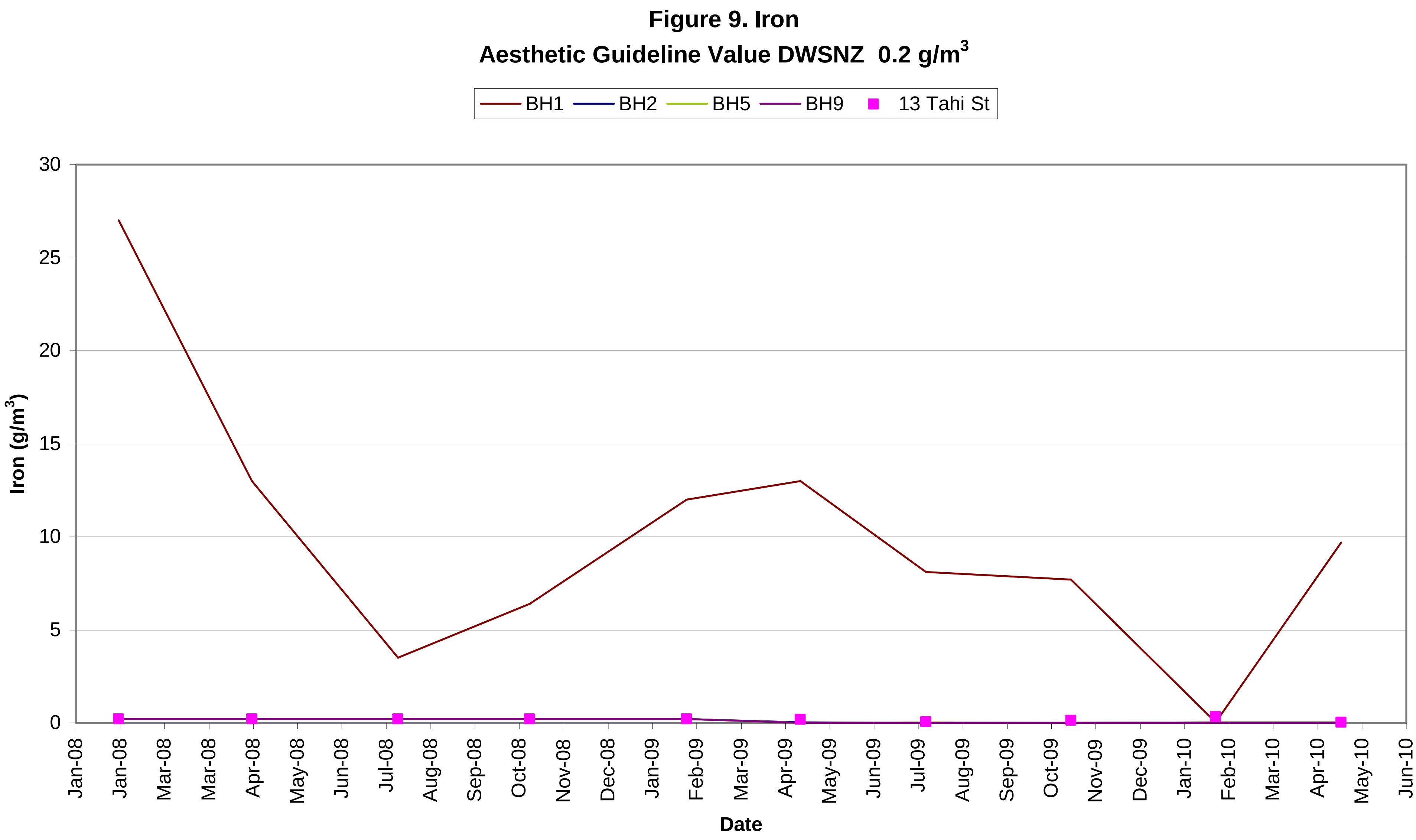


Figure 7. Conductivity (u mhos/cm)
BH1
BH2
BH5
BH9
13 Tahi St
Conductivity (u mhos/cm)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Dec-06
Feb-07
Apr-07
Jun-07
Aug-07
Oct-07
Dec-07
Feb-08
Apr-08
Jun-08
Aug-08
Oct-08
Dec-08
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Date

Figure 8. Copper

MAV DWSNZ 2 g/m^3, ANZECC Marine Guideline = 0.0013 g/m^3





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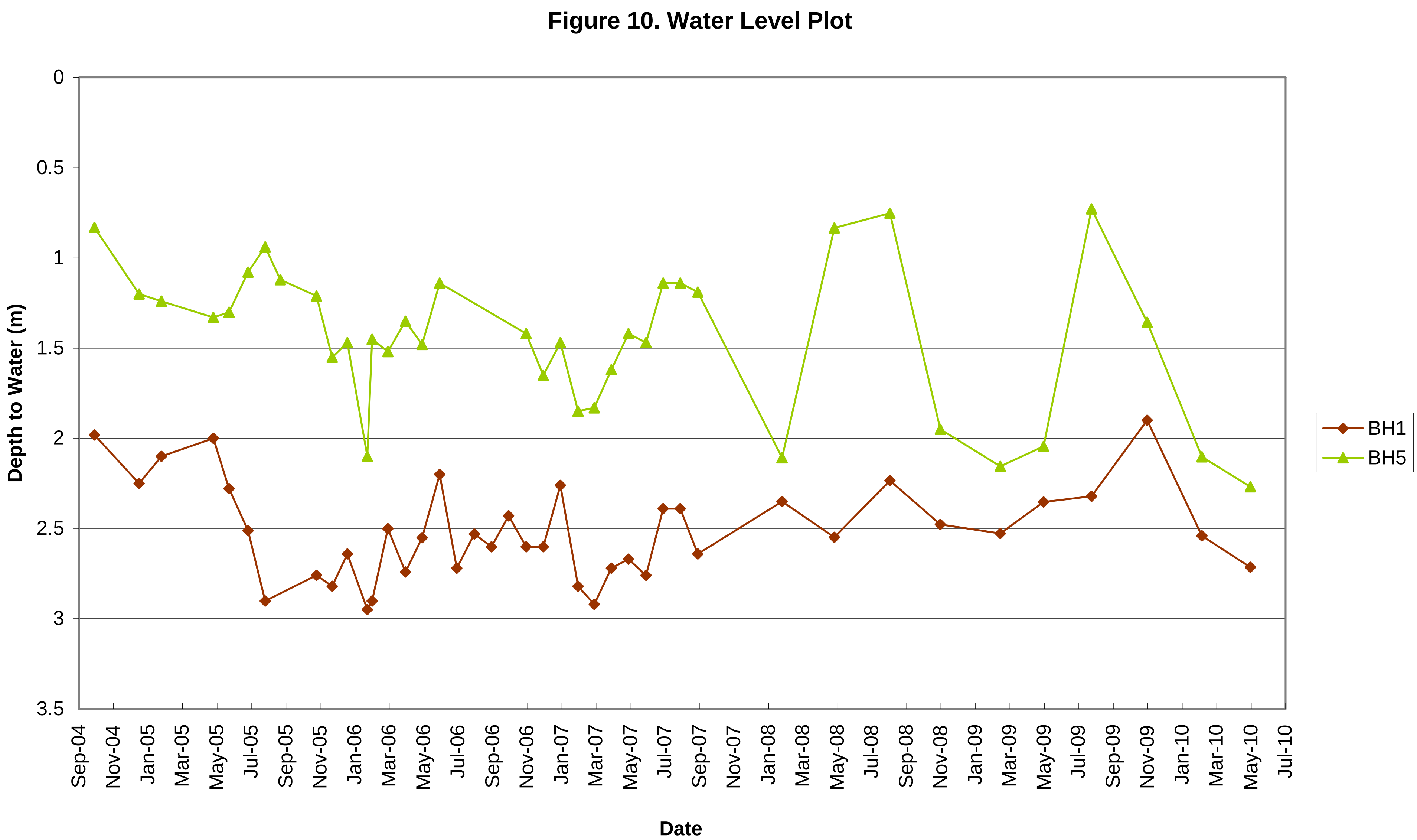
Figure 10. Water Level Plot
Depth to Water (m)
0
0.5
1
1.5
2
2.5
3
3.5
Sep-04
Nov-04
Jan-05
Mar-05
May-05
Jul-05
Sep-05
Nov-05
Jan-06
Mar-06
May-06
Jul-06
Sep-06
Nov-06
Jan-07
Mar-07
May-07
Jul-07
Sep-07
Nov-07
Jan-08
Mar-08
May-08
Jul-08
Sep-08
Nov-08
Jan-09
Mar-09
May-09
Jul-09
Sep-09
Nov-09
Jan-10
Mar-10
May-10
Jul-10
Date
BH1
BH5

Mapua

Figure 11 : Groundwater levels and contours on 3 May 2010

Mapua

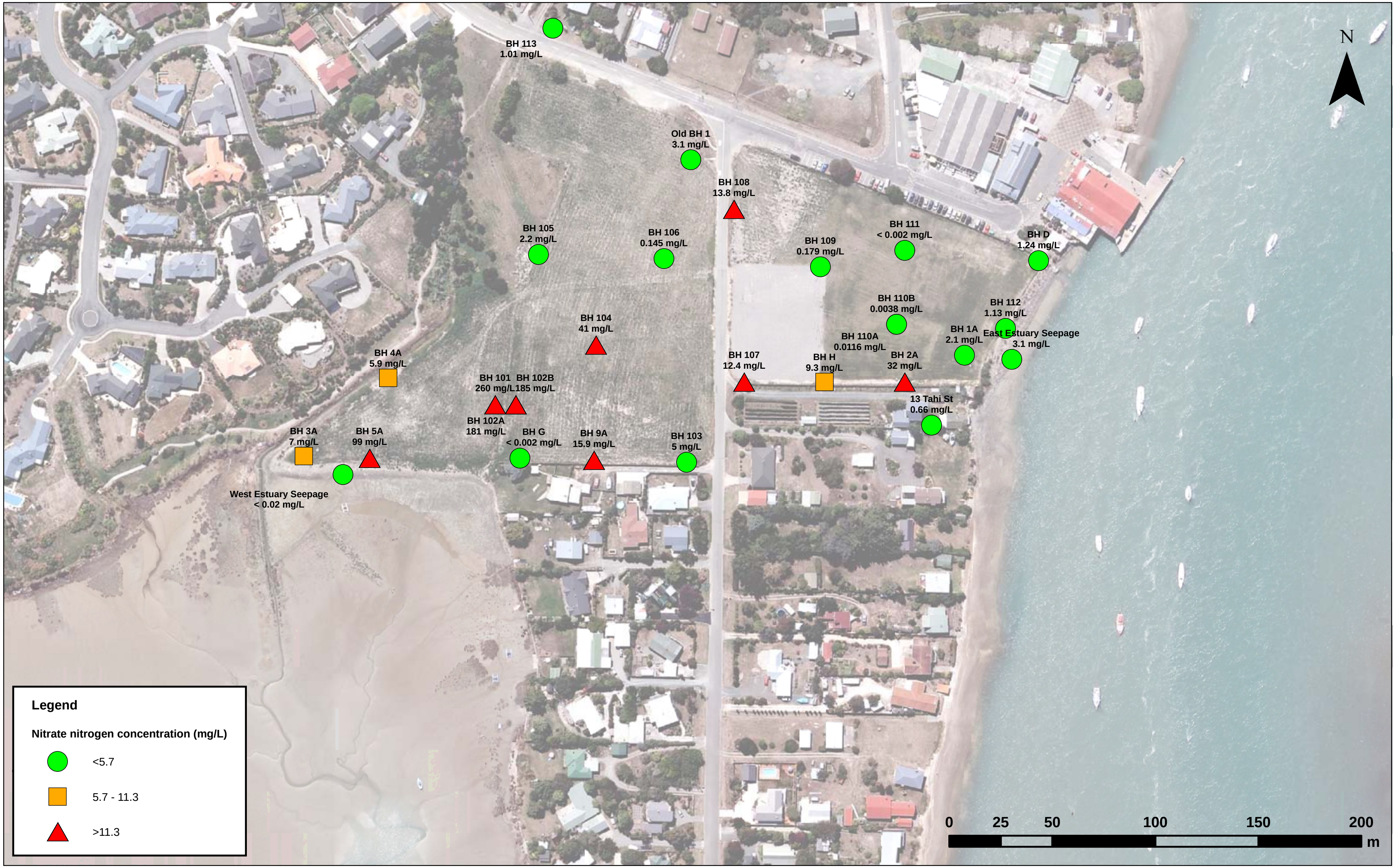

Figure 12 : Nitrate nitrogen concentrations in May 2010

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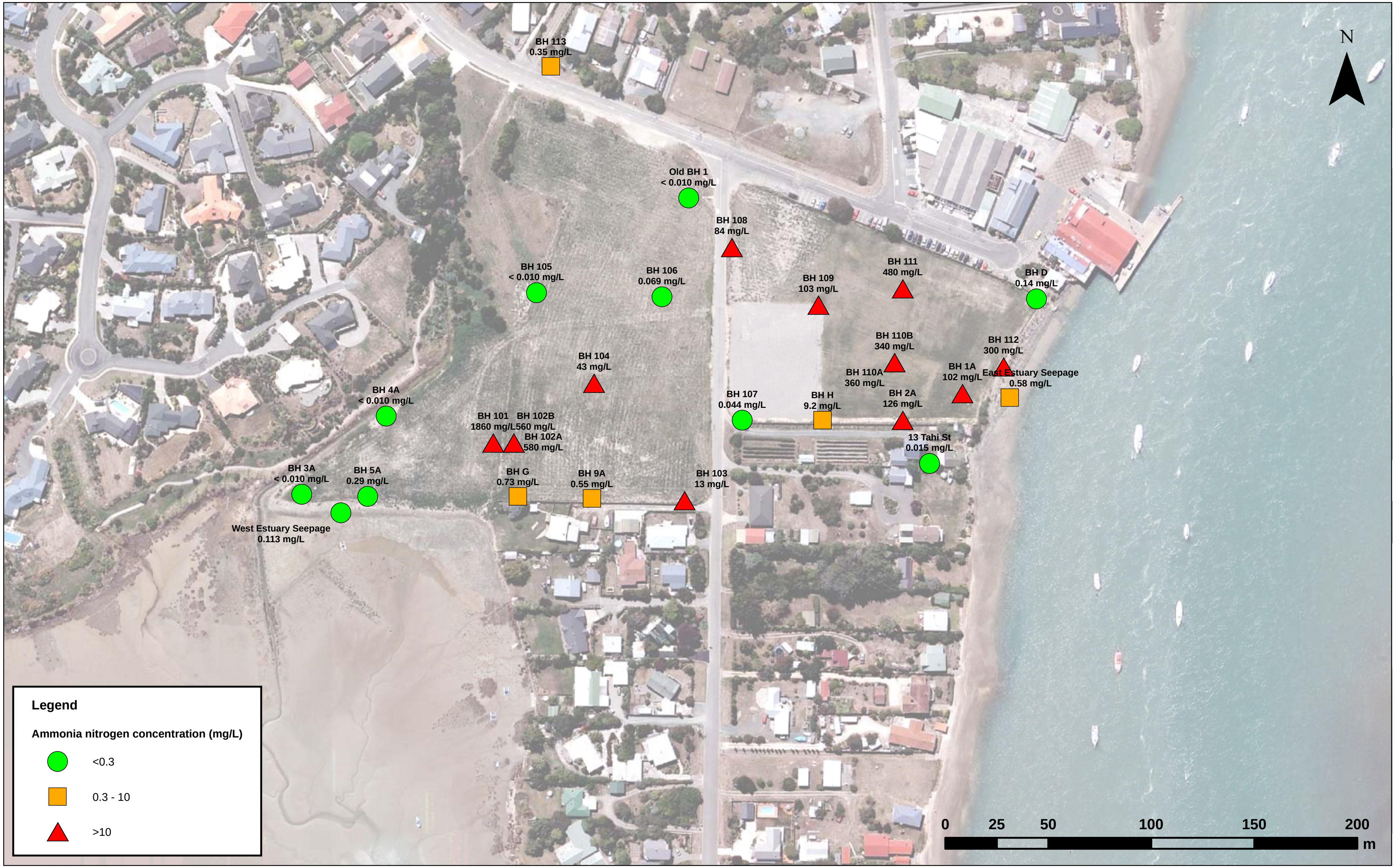

Figure 13 : Ammonia nitrogen concentrations in May 2010

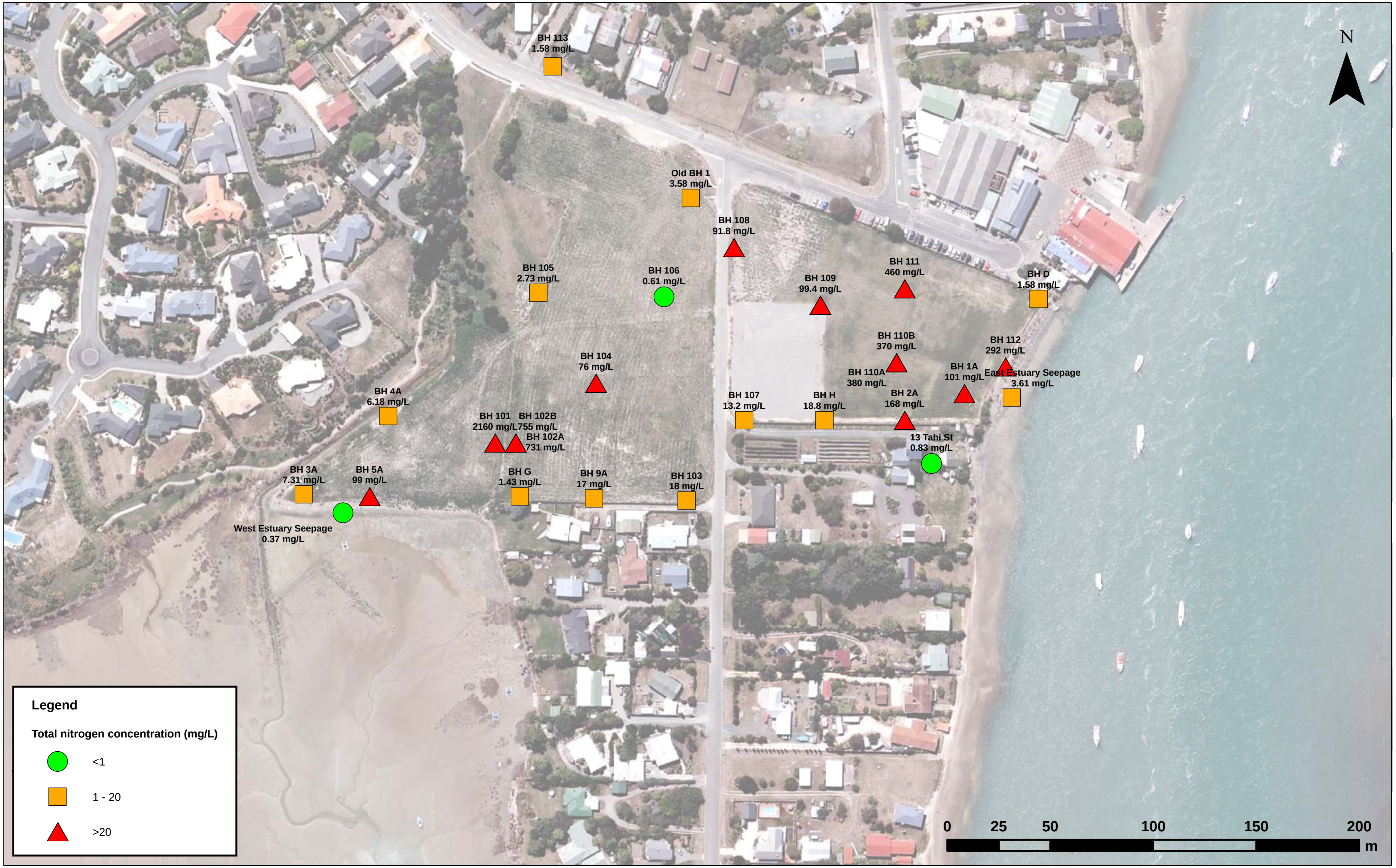

Figure 14 : Total nitrogen concentrations in May 2010

Mapua

Figure 15 : Dissolved reactive phosphorus concentrations in May 2010

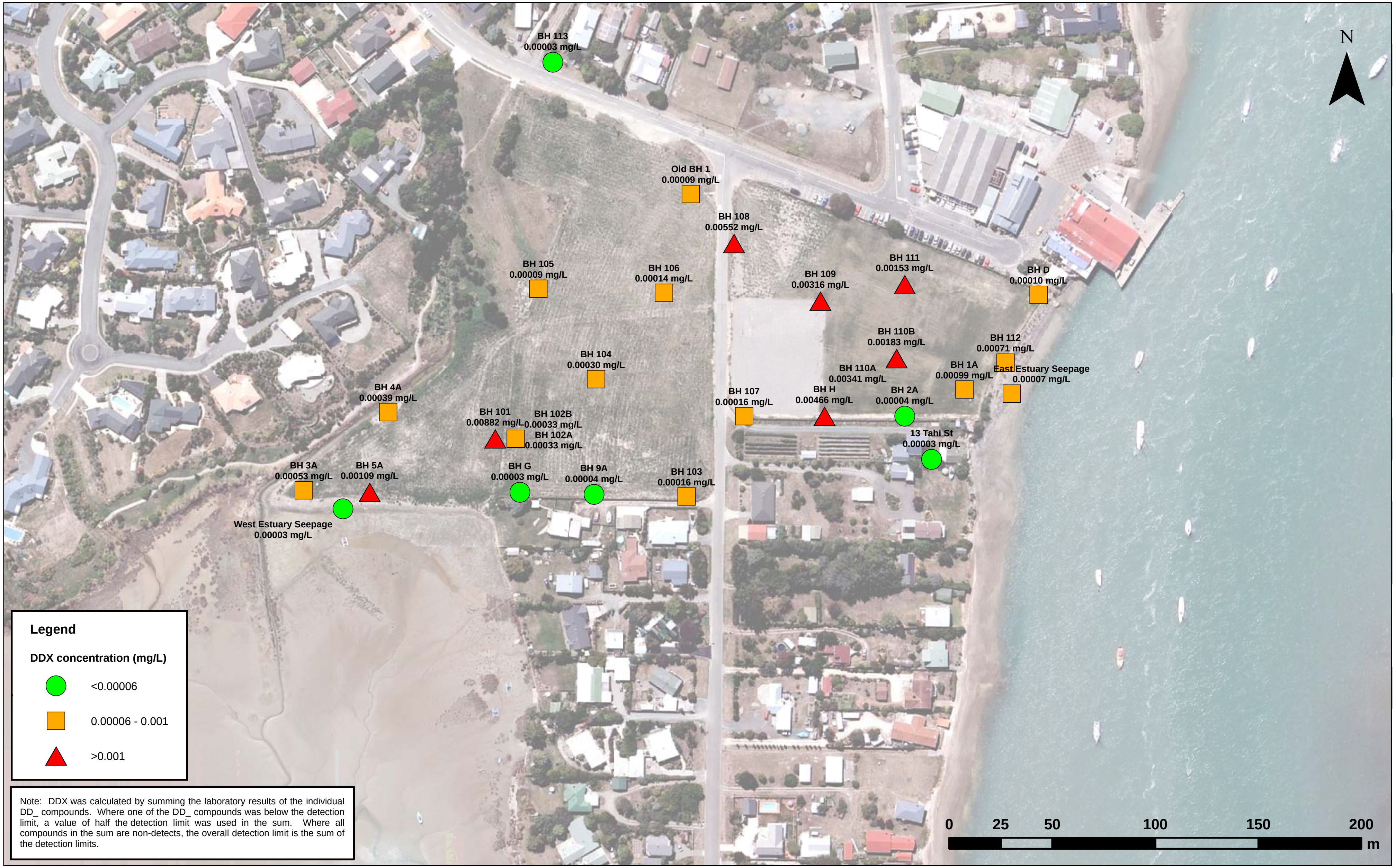

Figure 16 : DDX concentrations in May 2010

Mapua

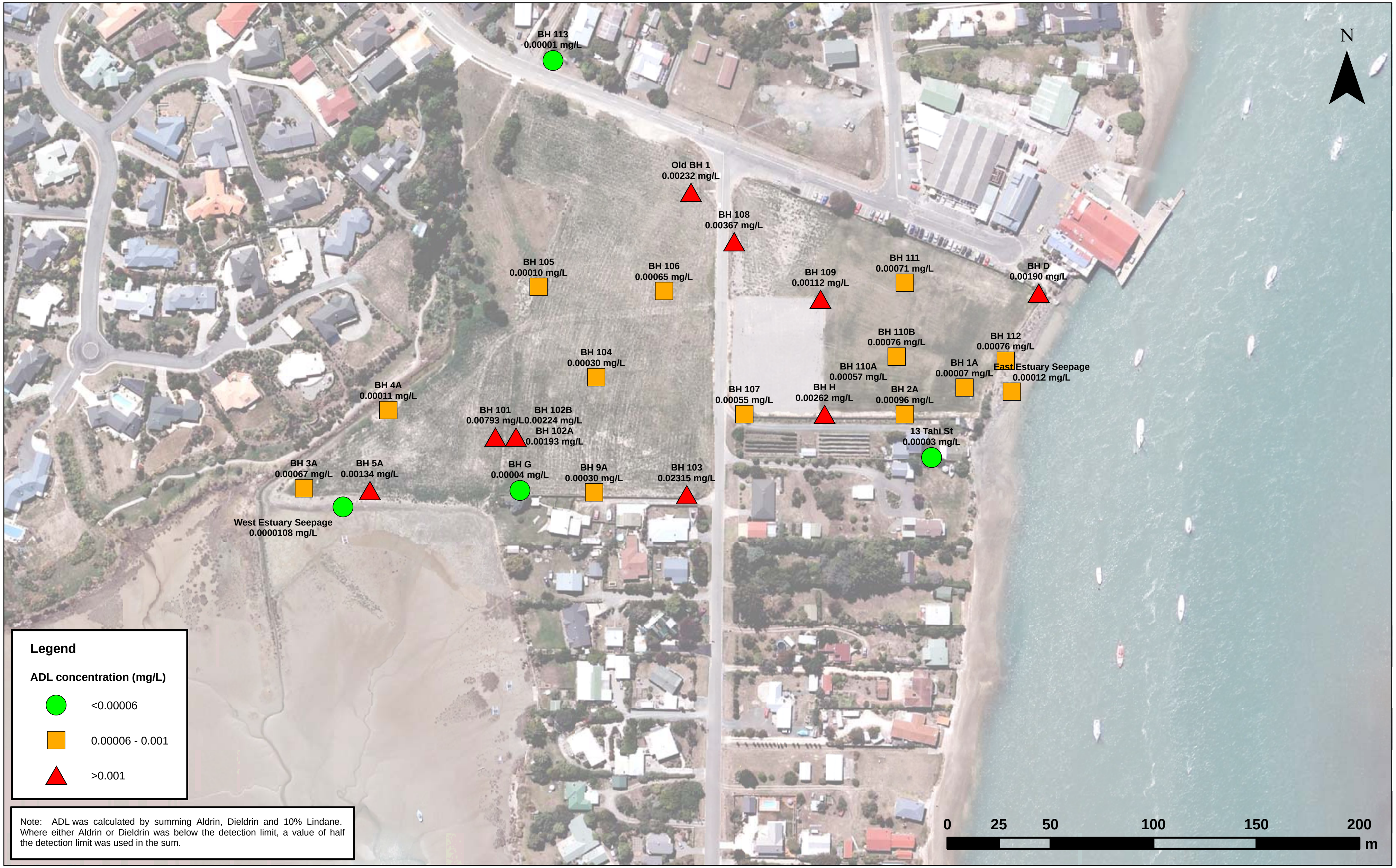

Figure 17 : ADL concentrations in May 2010

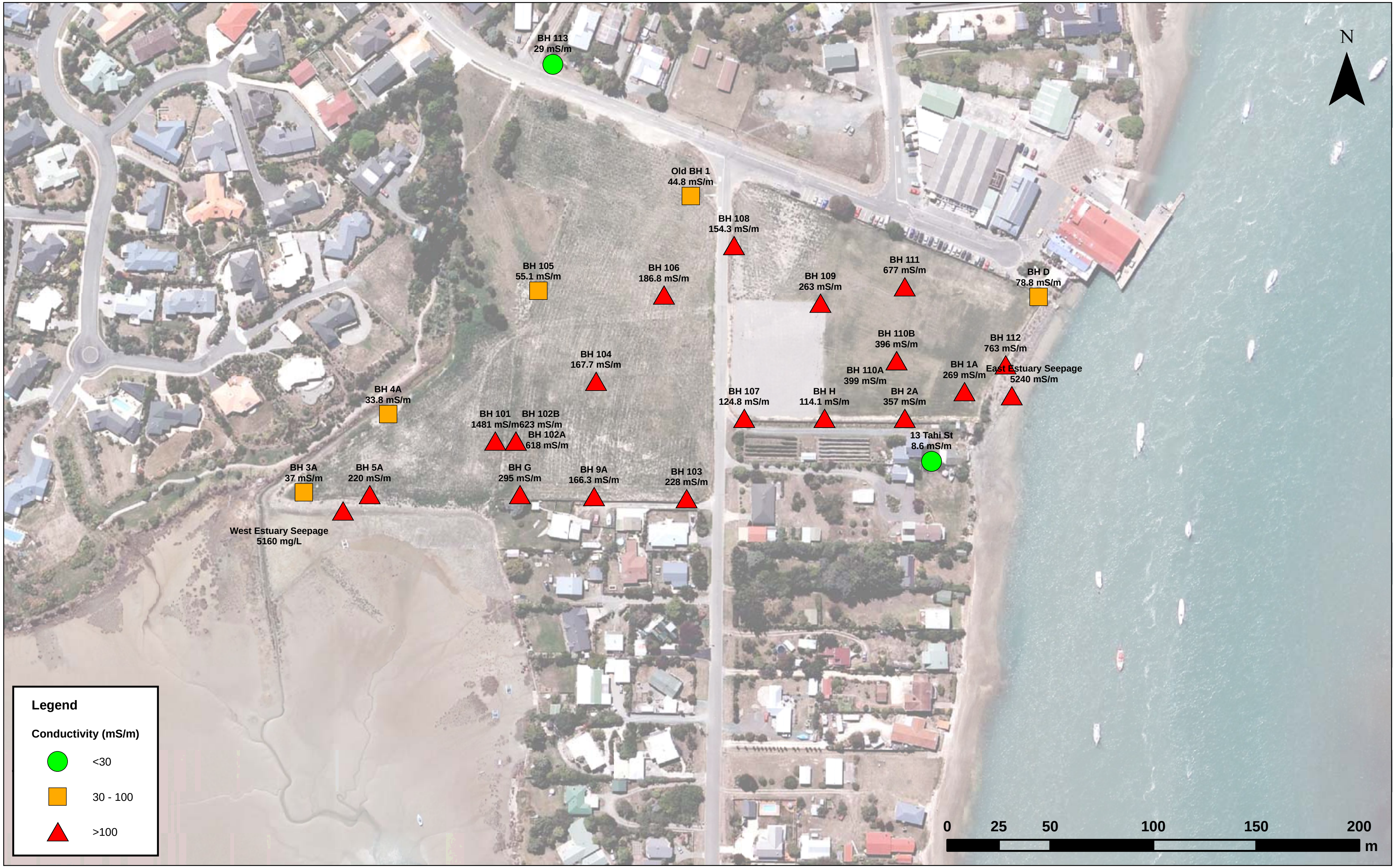

Figure 18 : Conductivity values in May 2010

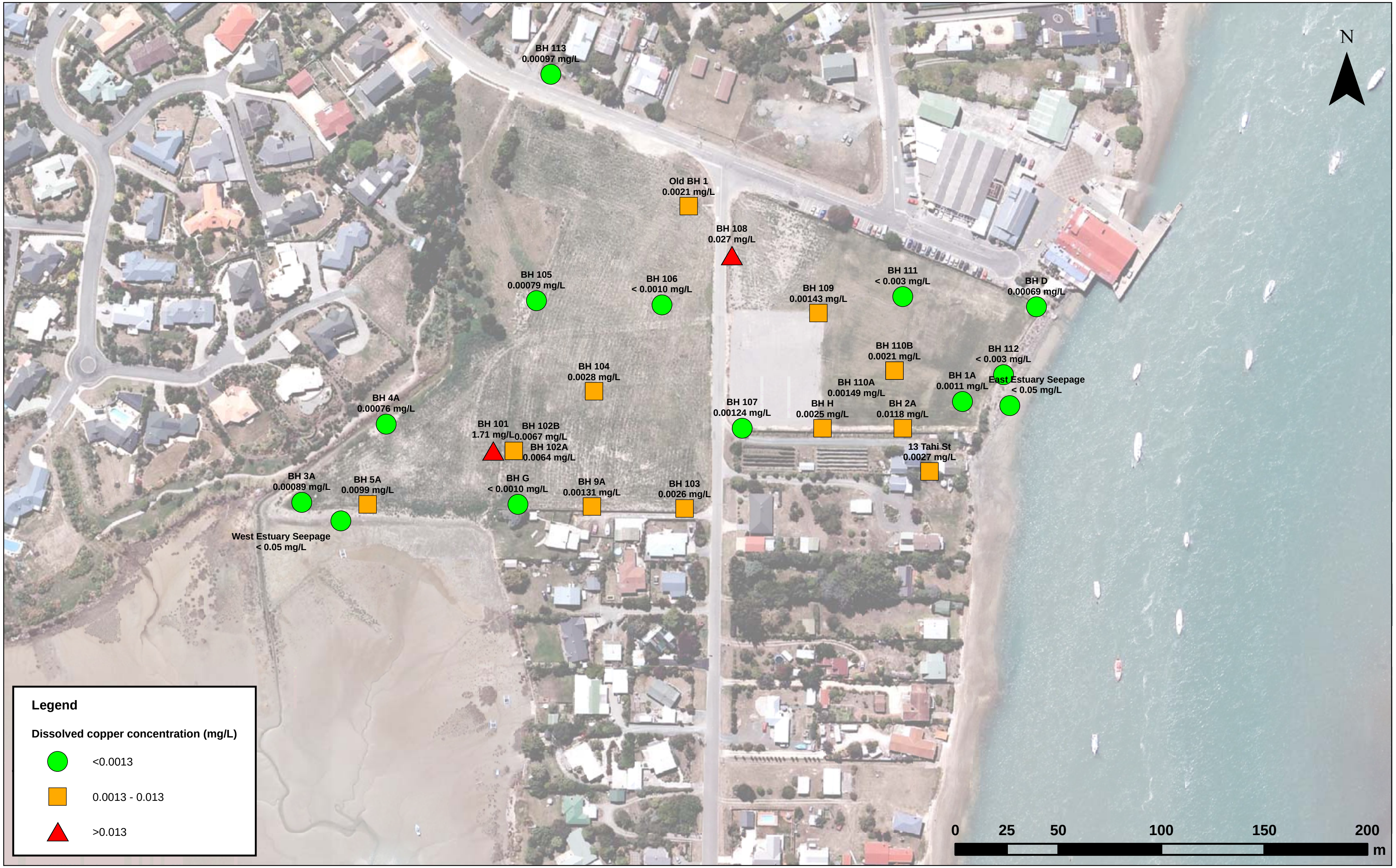

Figure 19 : Dissolved copper concentrations in May 2010

Mapua

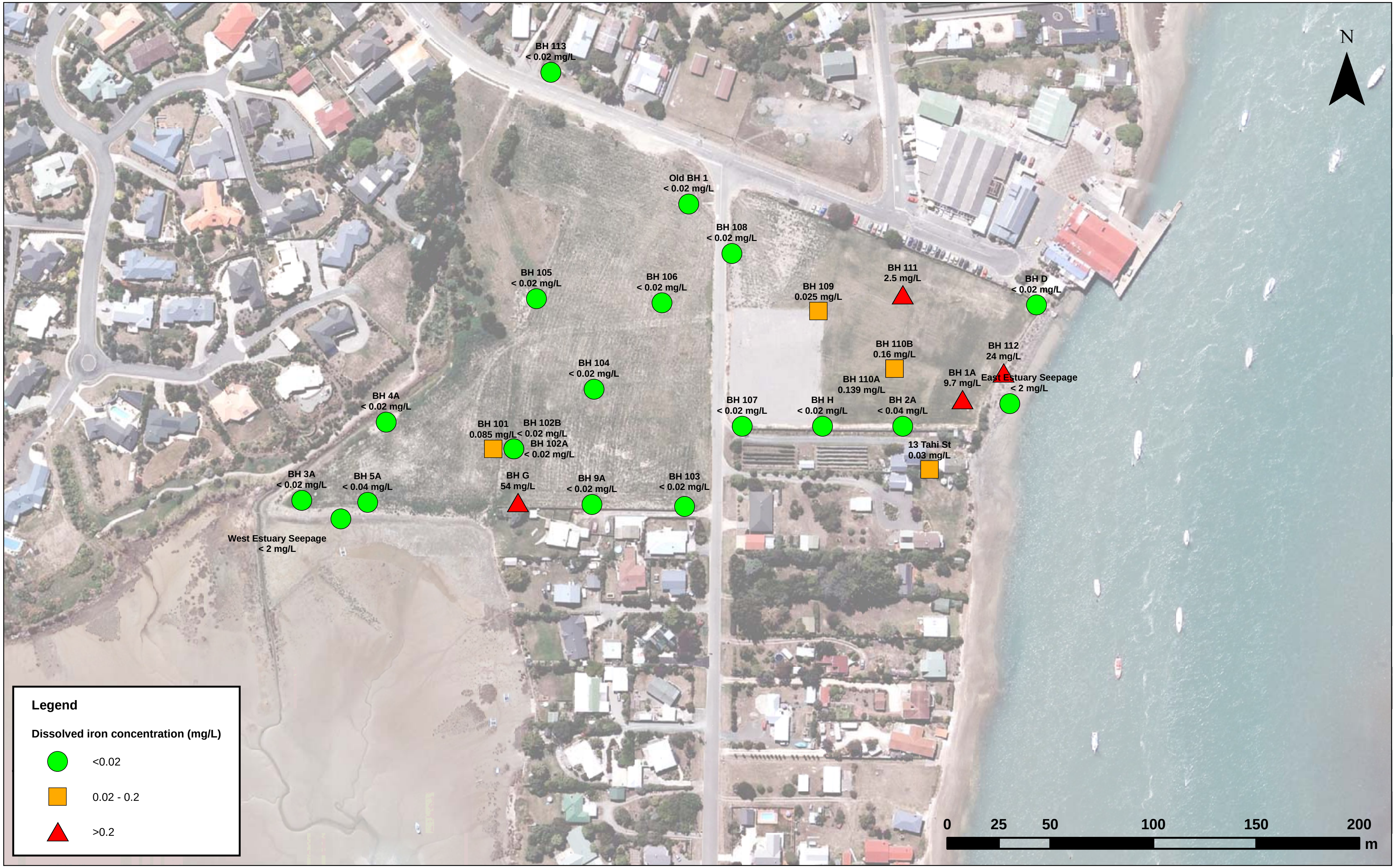

Figure 20 : Dissolved iron concentrations in May 2010