



19 March 2010

Ms Jenny Easton
Tasman District Council
Private Bag 4
RICHMOND 7050

Dear Jenny

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

The February 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 second 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 9-11 February 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/m³ in November 2009. BH5 continues to show elevated concentrations. In the latest sampling round, these three bores have shown an increase in nitrate-nitrogen, with

the increase being greatest in BH5, less in BH2 and smallest in BH9, although all three bores in February 2010 had 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 small increase in the latest sampling round, and are relatively stable at concentrations that are well below previously measured peak concentrations. Those bores with lower ammonia-N concentrations (Figure 3a) show decreasing or stable concentrations in BH5 and 13 Tahi Street, and a small increase in BH9.
- ∴ Figure 4 shows phosphorous concentrations, which continue to show stable concentrations compared to previous sampling. The most elevated concentrations occur in BH2 and BH5.
- ∴ Figure 5 shows DDX concentrations. The bores with elevated concentrations showed a decrease in BH1 and BH2, with stable concentrations in BH5, BH9 and 13 Tahi Street. Non-detectable DDX concentrations have continued at 13 Tahi Street.
- ∴ Figure 6 shows ADL concentrations. These concentrations have shown a relatively stable trend, with decreases in BH1, BH2, BH5 and 13 Tahi Street, and a slight increase in BH9.
- ∴ Figure 7 shows electrical conductivity values, which are a general indicator of all the chemicals dissolved in the water. These show a relatively stable or decreasing pattern with the exception of an increase in BH2.
- ∴ Figure 8 shows dissolved copper concentrations. Copper was one of the reagents used in the MCD process. The results show generally stable concentrations, with a small increase in BH9.
- ∴ Iron was utilised in the MCD process, but has only been sampled since January 2008. However, there are now sufficient measurements to present the data in a time series plot, which is shown in Figure 9. Detectable concentrations only occur in BH1A and have shown a significant decrease.

The most recent sampling round has occurred during a time of lower summertime water levels, as indicated by the plot in Figure 10. With the exception of nitrate-nitrogen (Figure 2), and to a lesser extent, ammonia-N (Figure 3), the general trend has been one of stable and slightly improving groundwater quality.

Piezometric Survey

The elevation of the groundwater table within the on-site monitoring bores was measured on 9 February 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 November 2009, but a similar pattern of groundwater flow occurs 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 12-21 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.

Whilst there is some significant variability in individual boreholes compared to the November 2009 sampling, 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 470 mg/L in BH101). 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 (8 mg/L in BH3A and 240 mg/L in BH5A), whereas seepage into the Waimea channel along the eastern side boundary has much lower concentrations.

∴ **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.

The results show elevated concentrations occur in both the east and west of the site, with the highest concentration of 2,100 mg/L occurring at BH101.

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.

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).

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 0.088 mg/L (above ANZECC guidelines), and the south-western boreholes adjacent to the Waimea Inlet have variable concentrations up to 1.5 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).

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 dieldrin and the MAV for lindane;
- red – elevated concentrations above 0.001 g/m³.

As with DDX, the results show variable concentrations within the site.

∴ **Rinsate Blank**

With regard to the DDX and ADL analyses, it is important to consider an issue that has arisen through one of the quality assurance checks that was undertaken during sampling. As part of the sampling procedure, a series of “blank” samples were collected to check that the water or equipment that is used in the sampling process is not causing a cross-contamination problem. In this sampling round, the “rinsate” blank indicated some carry over of 4, 4'-DDD, Lindane and Dieldrin between samples. Figure 18 has been prepared to show the concentrations of these chemicals that occurred on the day when the rinsate blank was collected in the order that sampling occurred.

The pattern shown by this plot indicates that the concentrations in the rinsate blank were very low (within 40% of the detection limit). Samples before and after the collection of the rinsate blank had significantly higher concentrations of DDX and ADL, so there was no significant effect from the detection of the rinsate blank. However, the detections in the rinsate blank indicate that it is possible that some of the very low detections of DDX or ADL could be affected by some carry over from previously sampled wells, although in terms of the patterns shown in Figures 16 and 17, these would still be classified as green dots (i.e. low concentrations).

To avoid any uncertainty regarding this issue, it is important to implement very thorough cleaning of equipment between wells, and it is recommended that the order of sample collection should generally be from wells with low concentrations of DDX and ADL being sampled first, through to wells with the highest concentrations of DDX and ADL being sampled last. It is also recommended that the collection and analysis of field blanks, rinsate water blanks and rinsate blanks should be continued to provide a check on this issue.

∴ **Conductivity**

Figure 19 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.

∴ **Copper**

Figure 20 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.

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.

The eastern seepage sample showed copper concentrations above the ANZECC guideline values.

∴ **Iron**

Figure 21 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 three significantly higher values occurred at BHG (60 mg/L), BH111 (7.9-12 mg/L) and BH112 (4.8 mg/L).

Overview

The patterns shown in Figures 12-21 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 November 2009, although there is some considerable variability shown at individual wells. The long-term regularly measured wells plotted in Figures 2-9 have shown a generally stable or decreasing trend, with the exception of the nitrogen species, which have shown some increases in both nitrate (BH2, BH5 and BH9) and ammonia (BH1 and BH2).

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

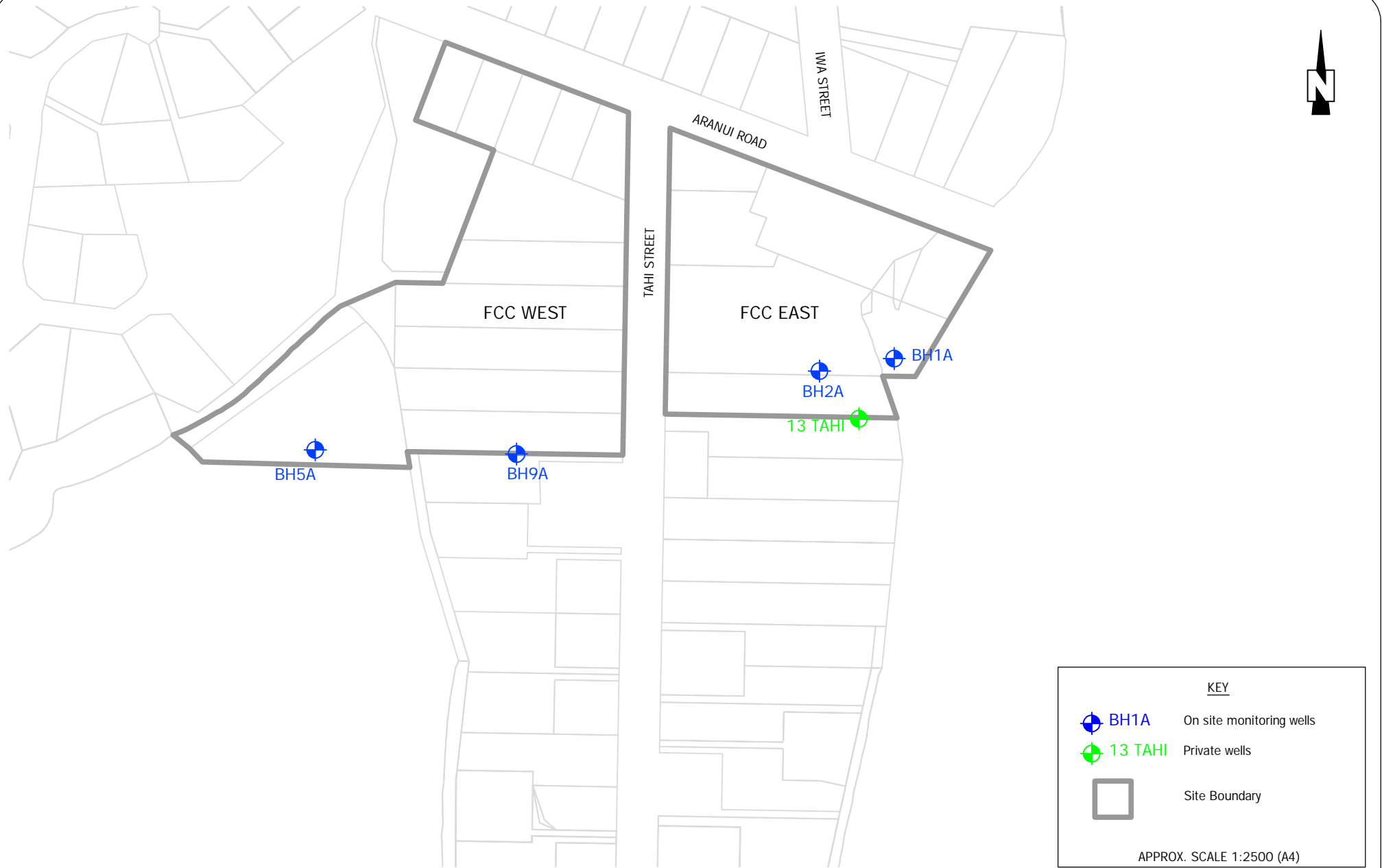
PATTLE DELAMORE PARTNERS LIMITED



Peter Callander

Encl.

GROUNDWATER MONITORING AT MAPUA



Source: Cadastral information derived from LINZ data.

Figure 1 : LOCATION OF REGULARLY MONITORED WELLS

Figure 2. Nitrate-N
MAV DWSNZ 11.3 NO₃-N g/m³

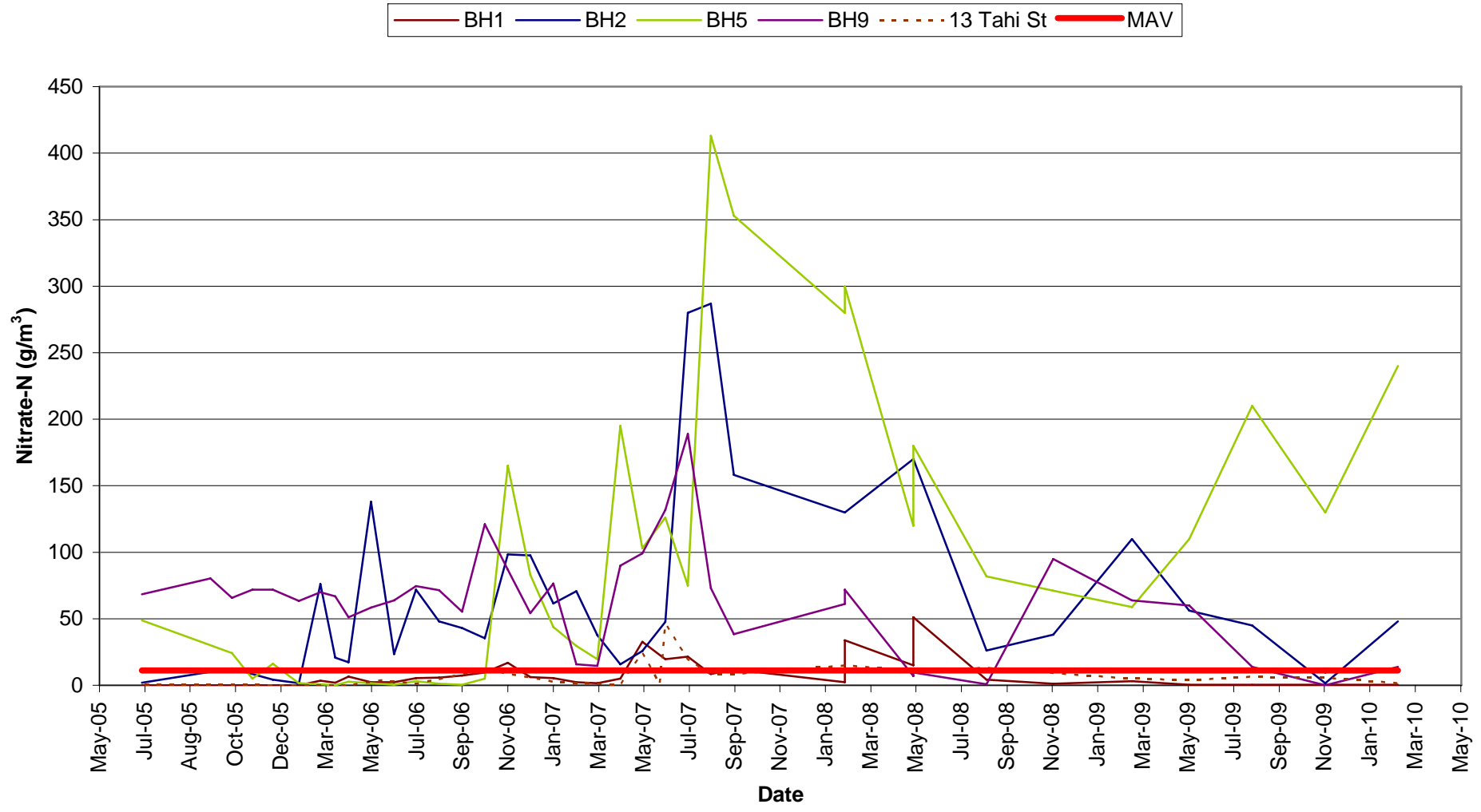


Figure 2a. Nitrate-N
MAV DWSNZ 11.3 NO₃-N g/m³

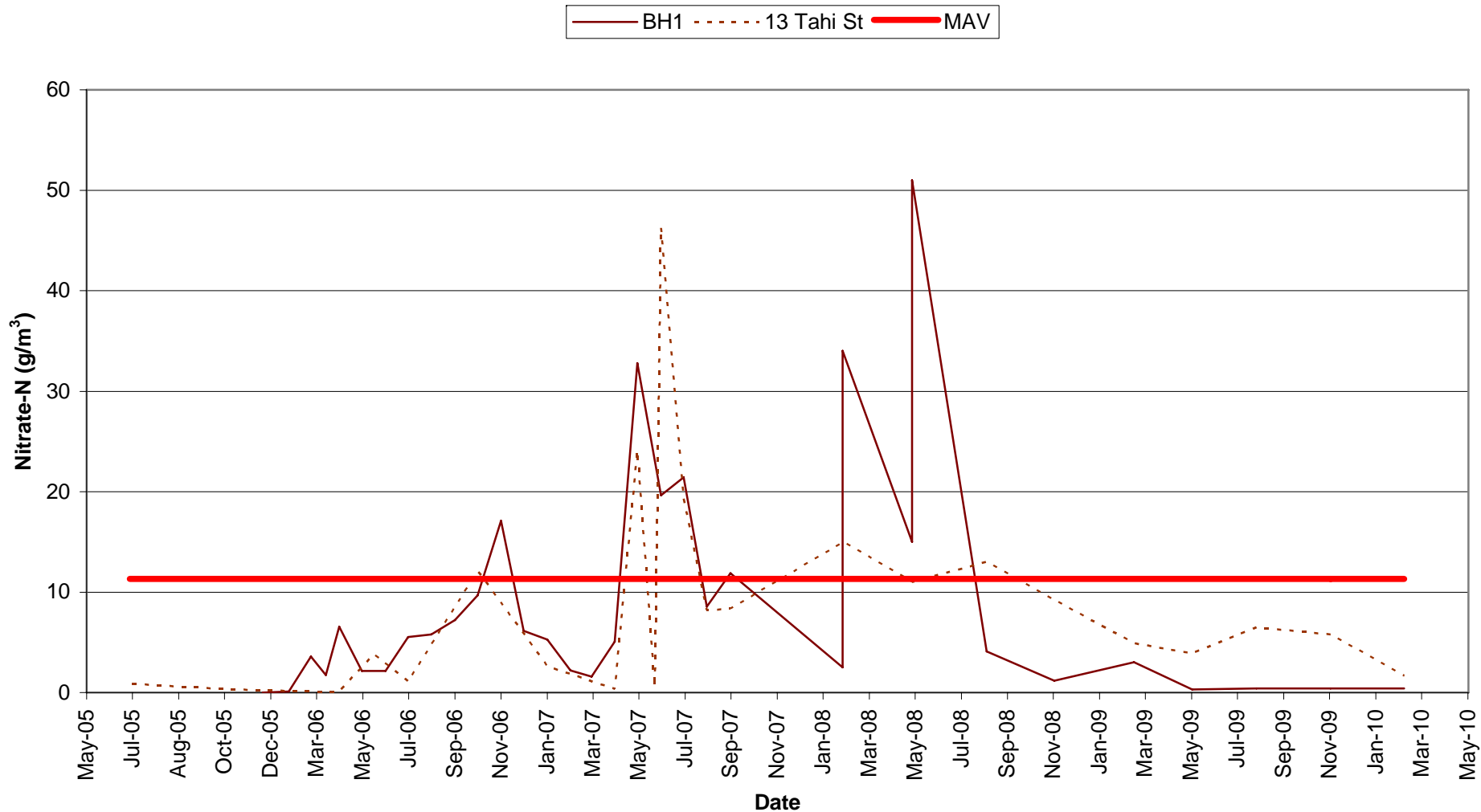


Figure 3. Ammonia-N
GV Aesthetic DWSNZ 0.30 NH₃-N g/m³; Aquatic Ecosystem Guideline 0.71g/m³

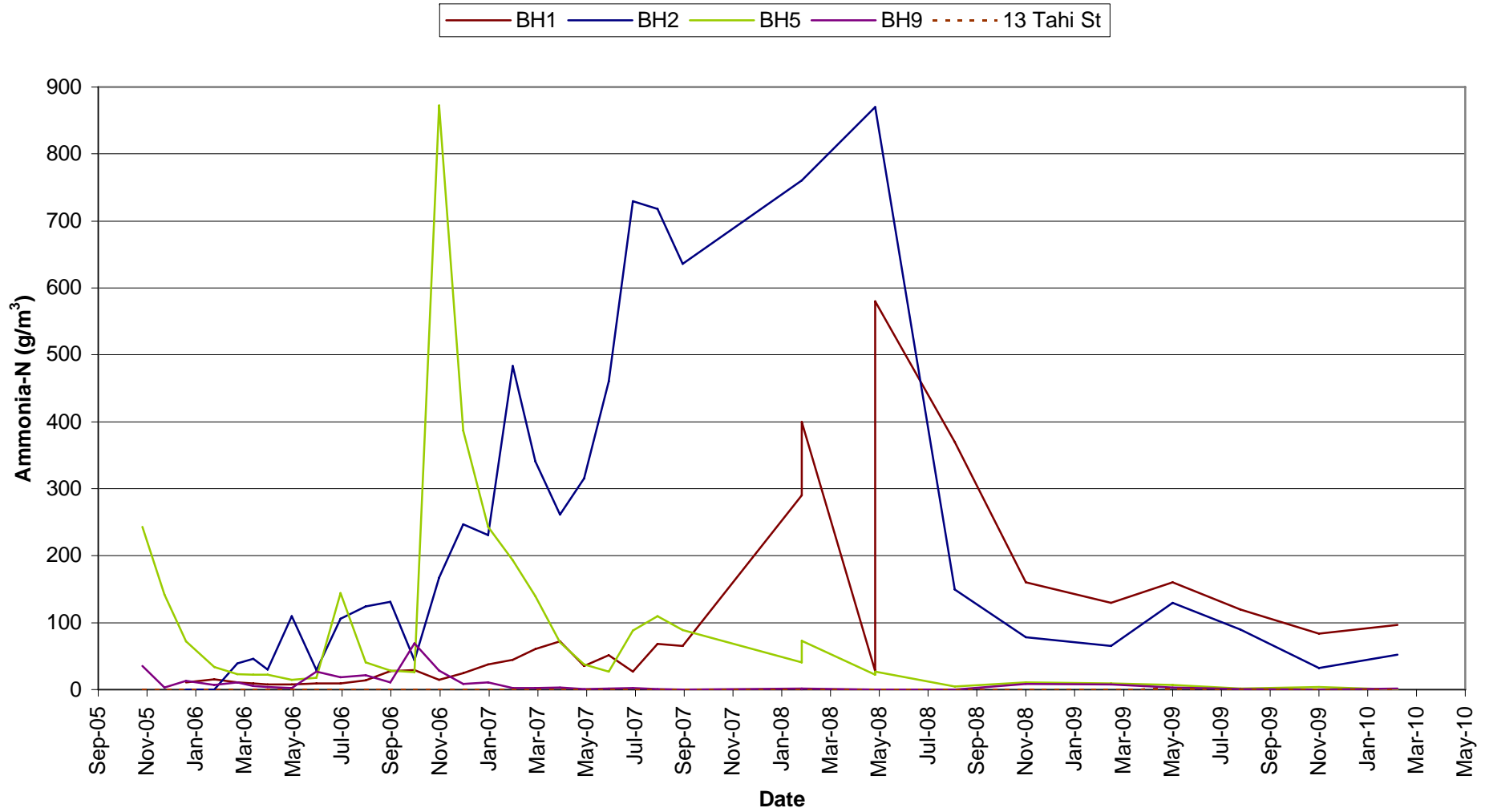
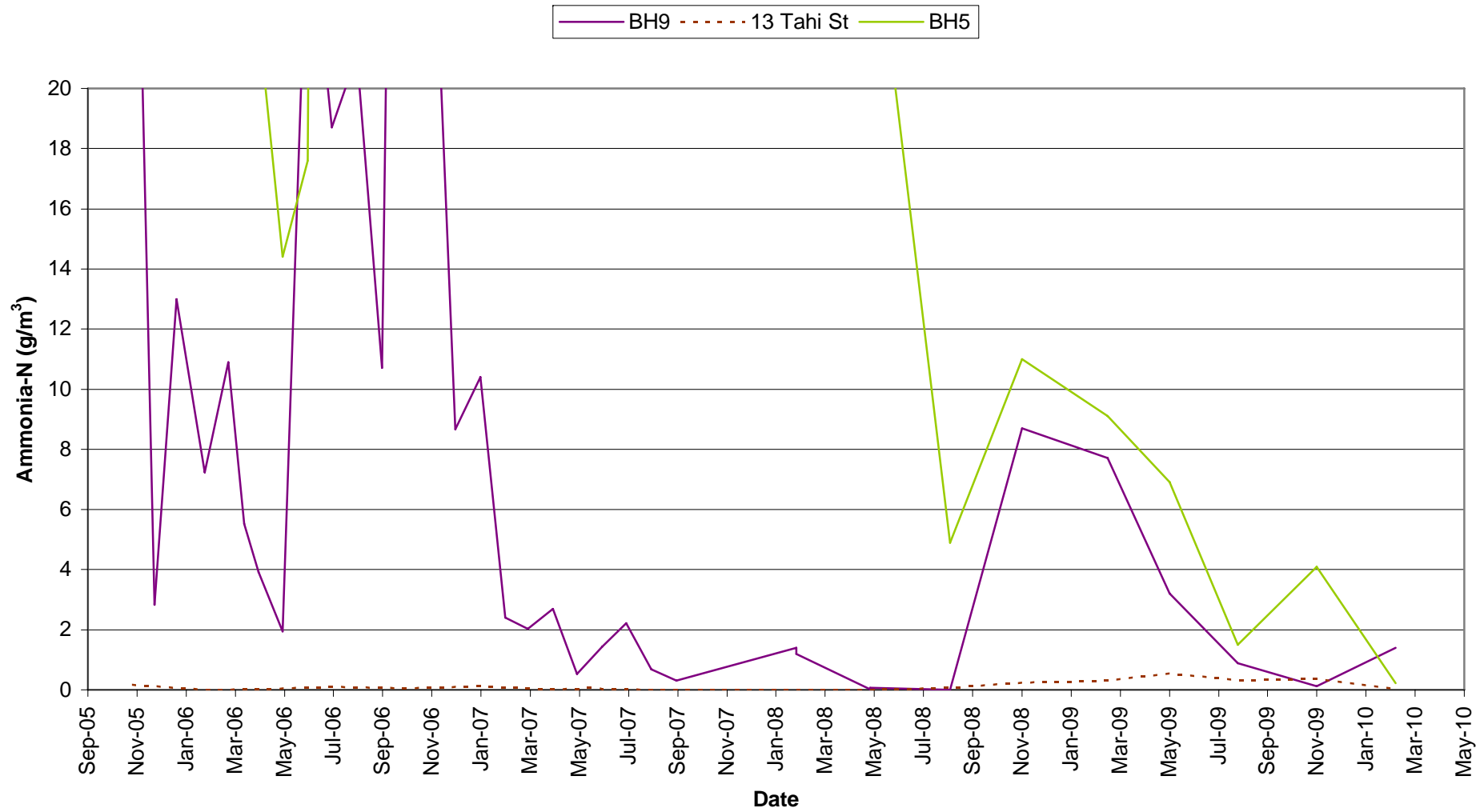


Figure 3a. Ammonia-N
GV Aesthetic DWSNZ 0.30 NH₃-N g/m³



**Figure 4. Phosphorous
Aquatic Ecosystem Guideline 0.01g/m³**

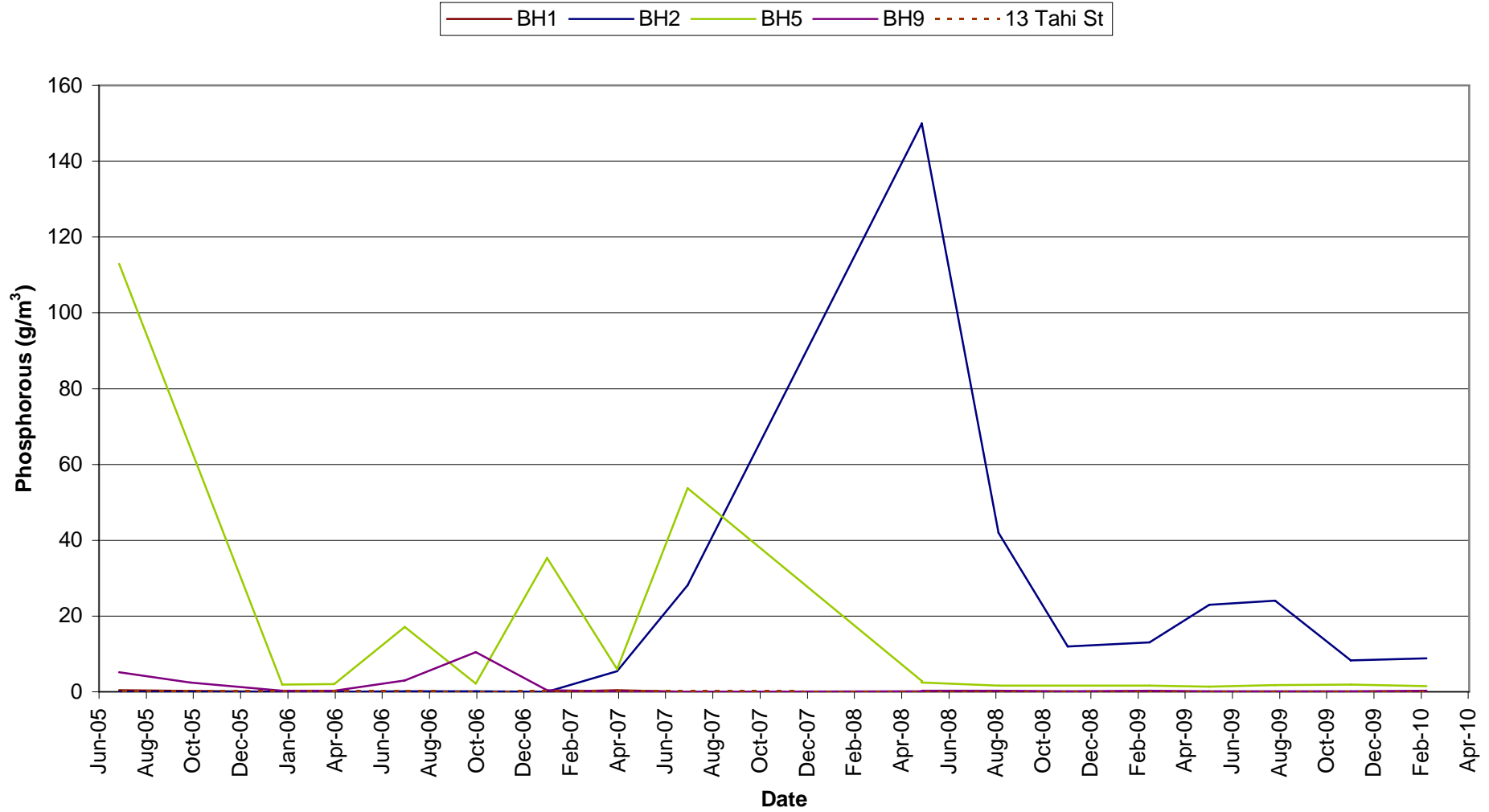


Figure 5. DDX (g/m³)

BH1 BH2 BH5 BH9 13 Tahi St

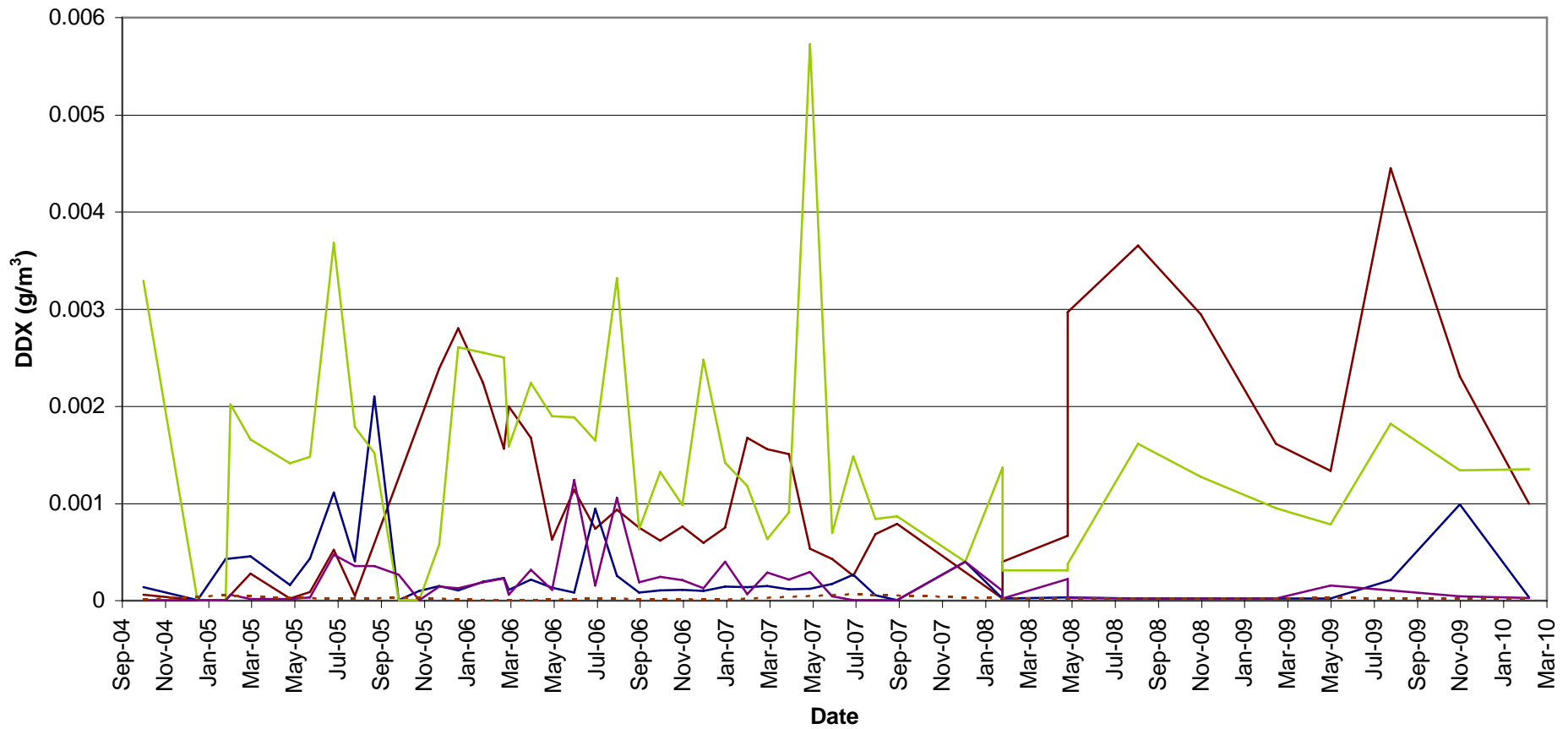


Figure 6. ADL (g/m³)

BH1 BH2 BH5 BH9 13 Tahi St

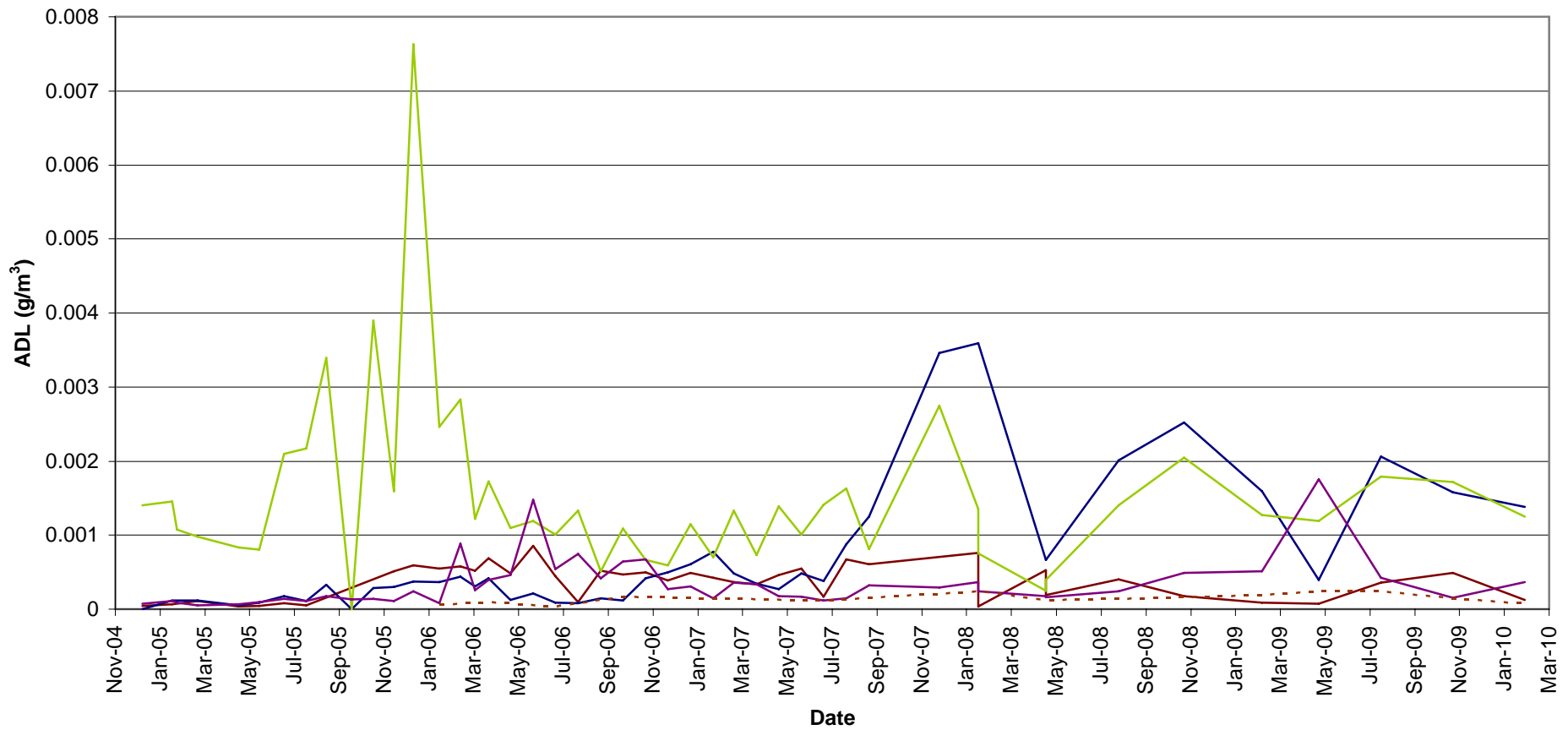


Figure 7. Conductivity (u mhos/cm)

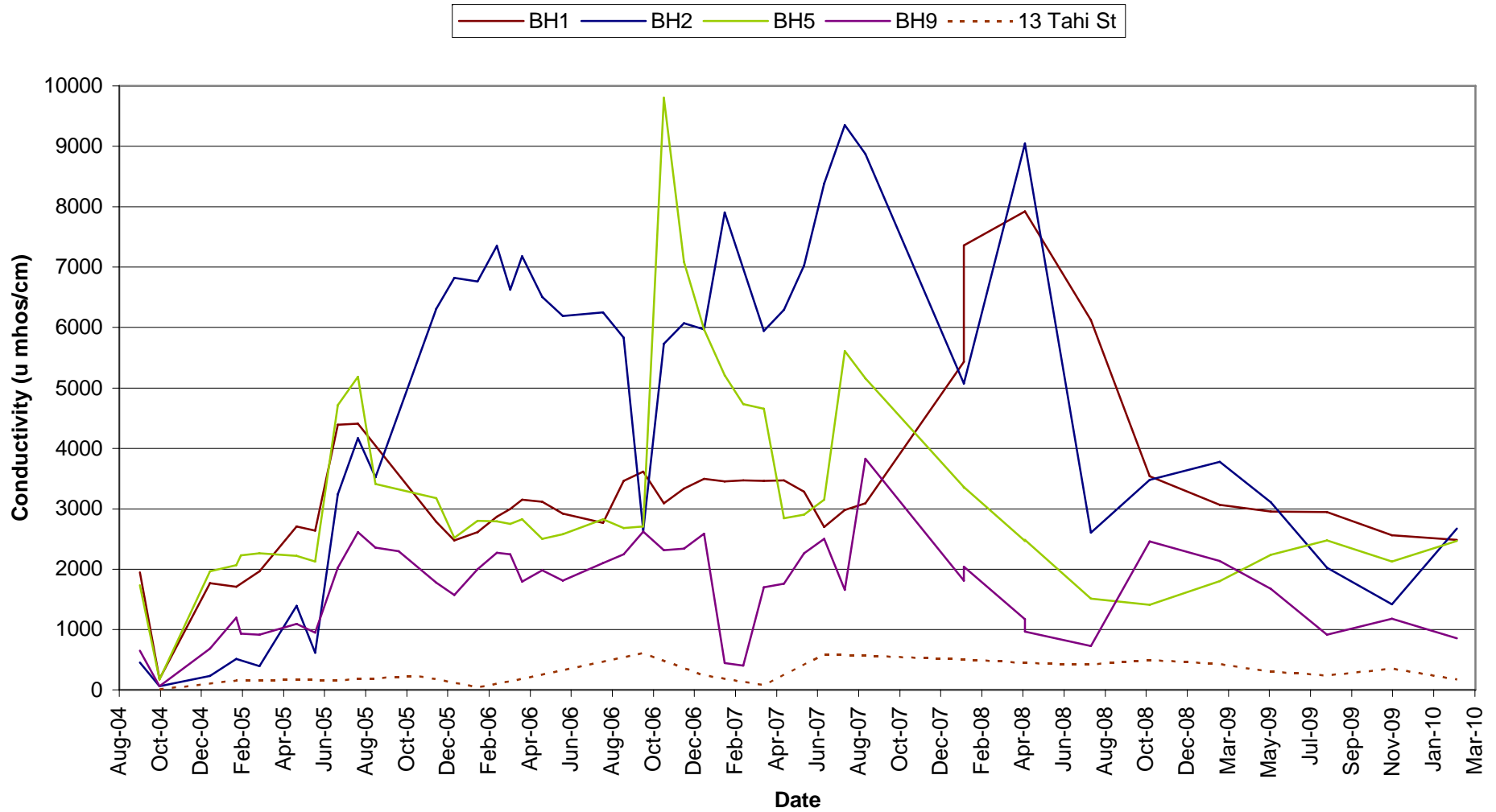


Figure 8. Copper
MAV DWSNZ 2 g/m³, ANZECC Marine Guideline = 0.0013 g/m³

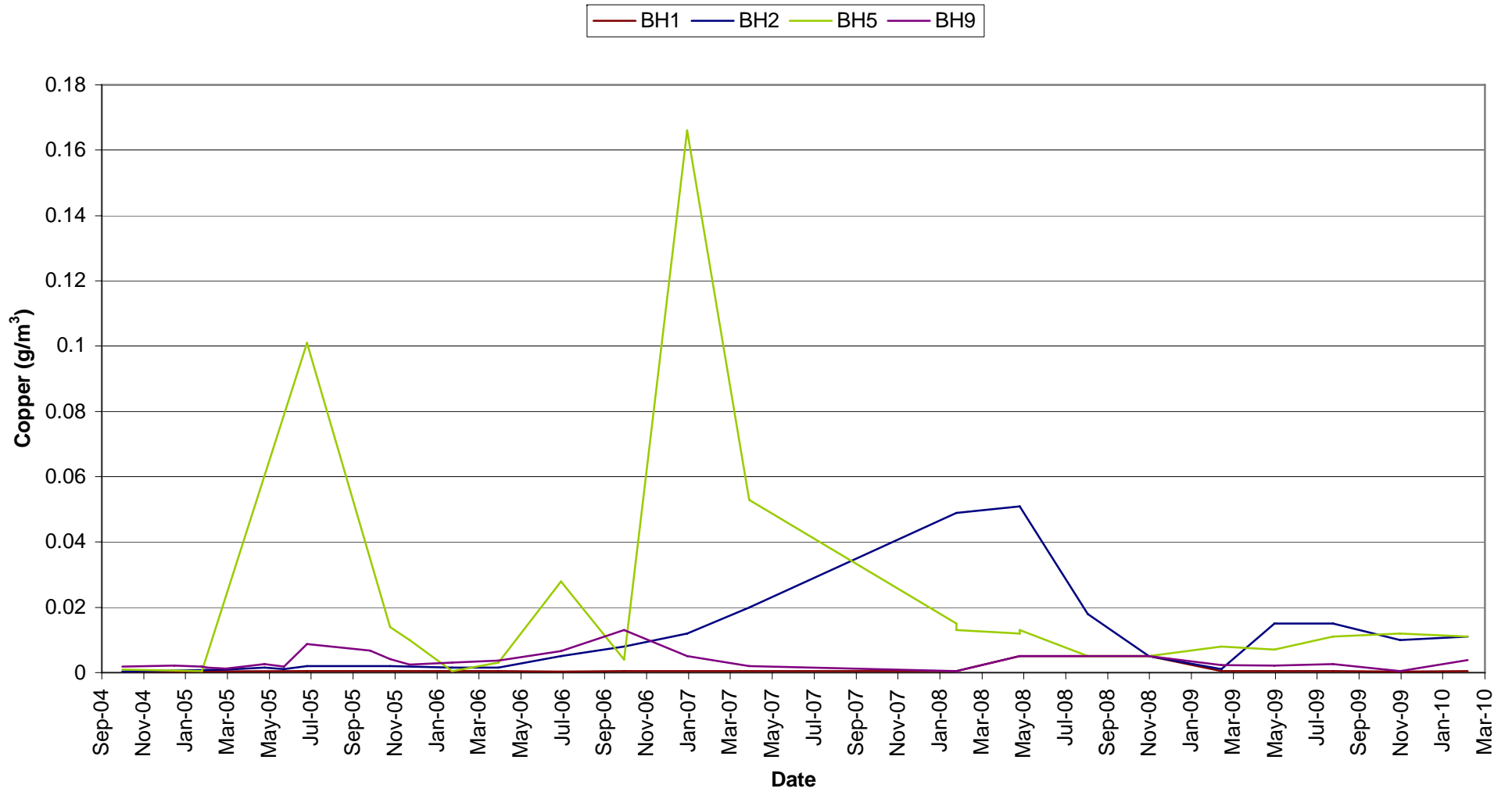


Figure 9. Iron
Aesthetic Guideline Value DWSNZ 0.2 g/m³

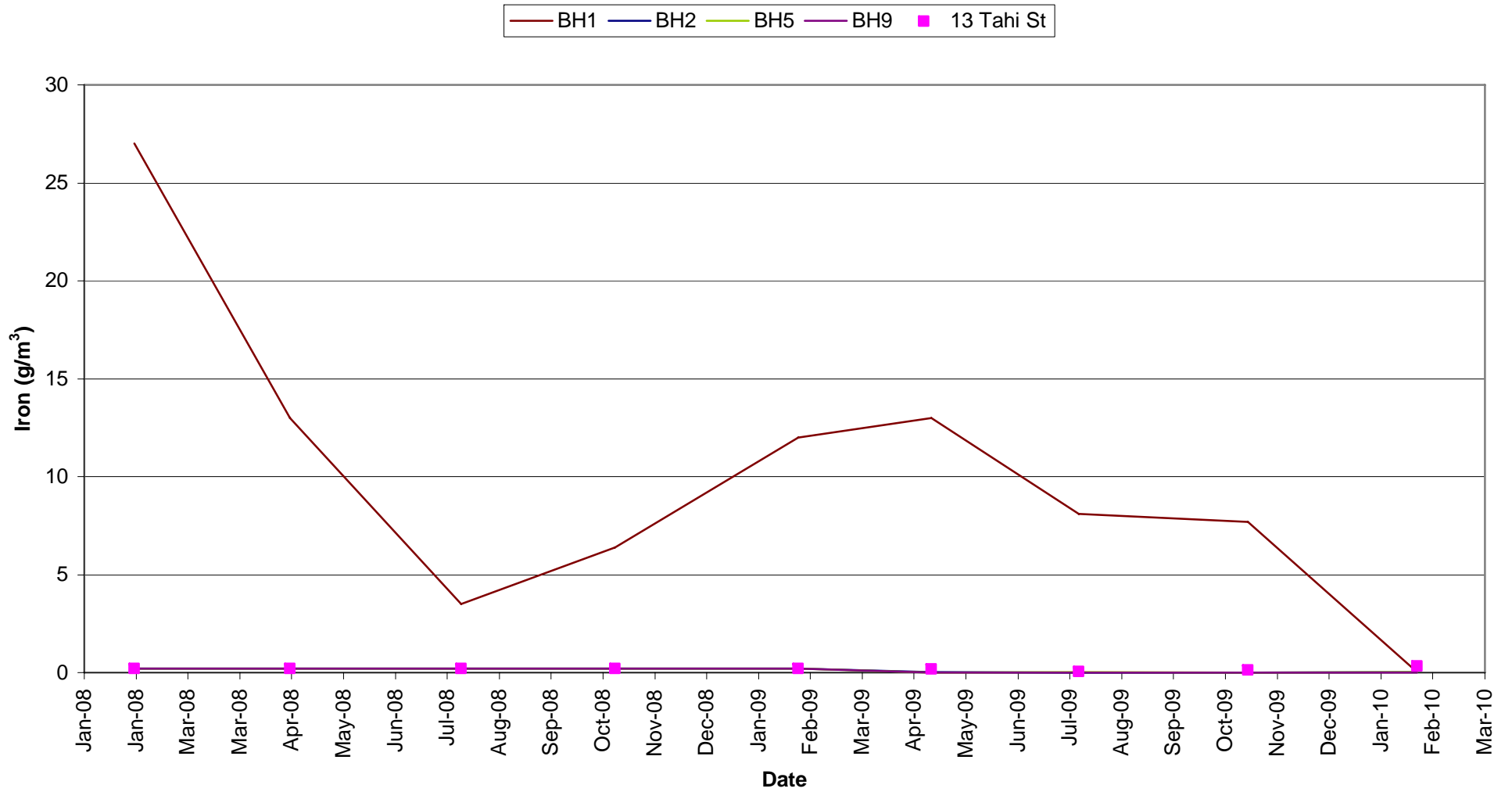


Figure 10. Water Level Plot

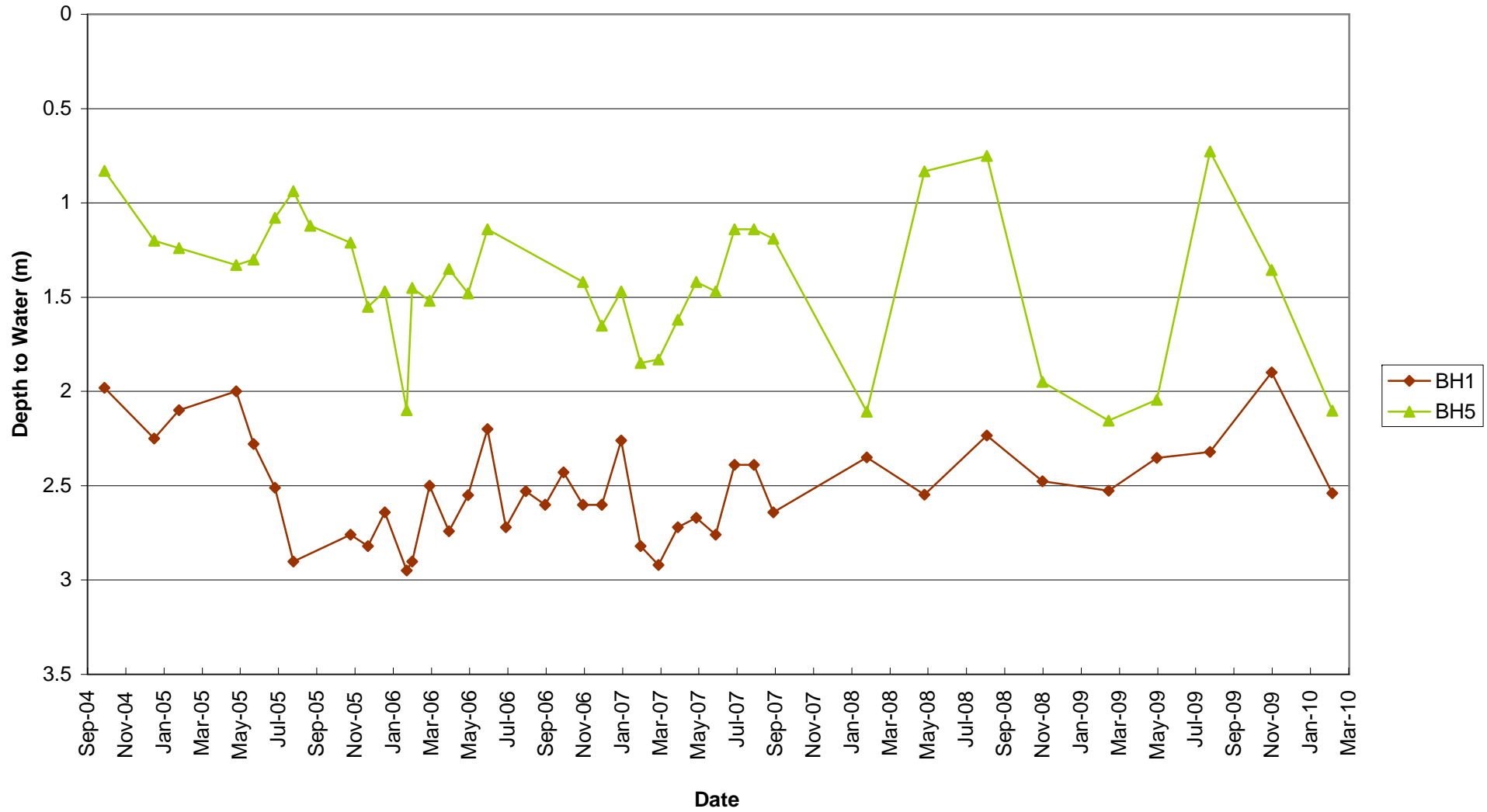




Figure 11 : Groundwater levels and contours on 9/02/10

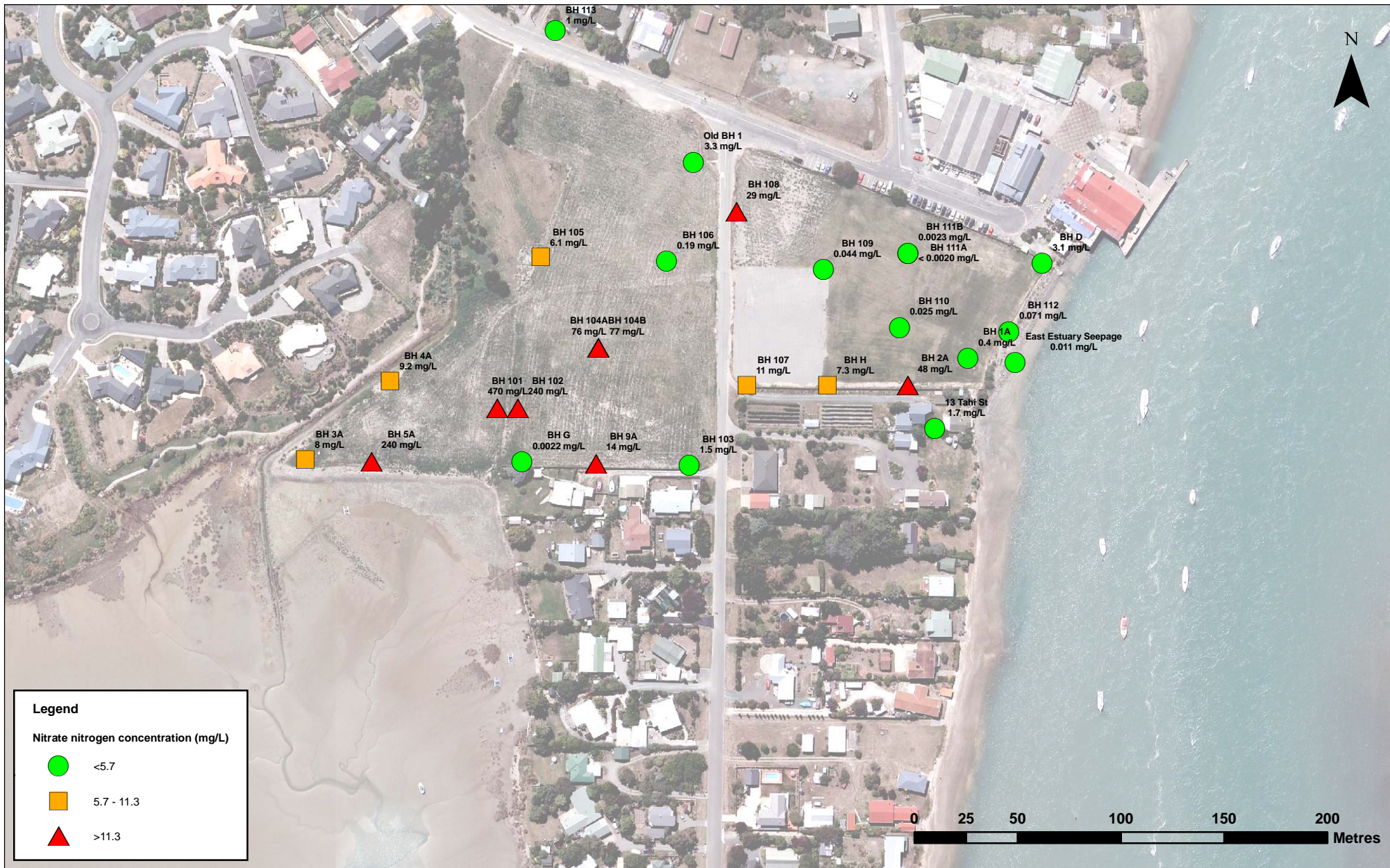


Figure 12 : Nitrate nitrogen concentrations in February 2010

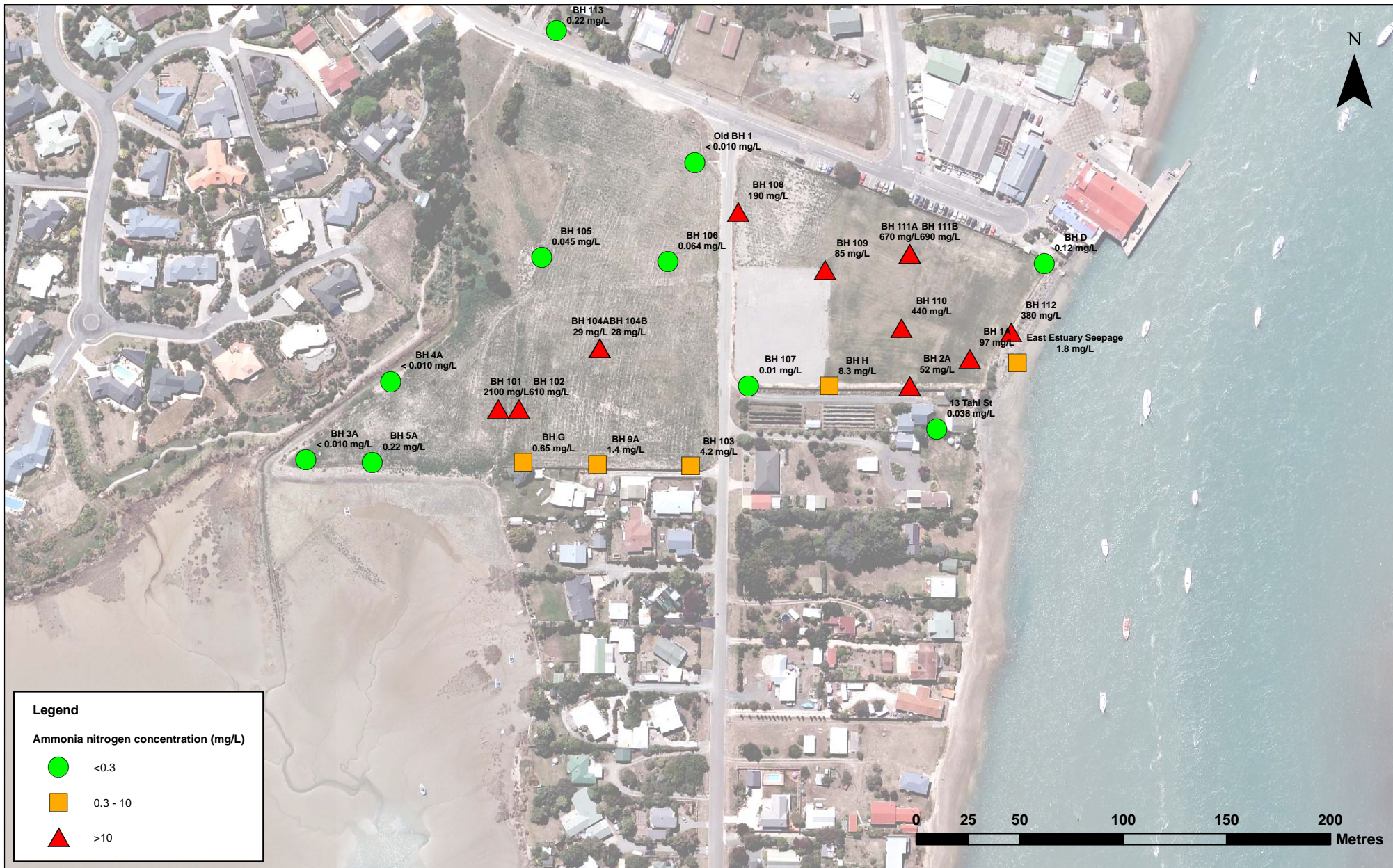


Figure 13 : Ammonia nitrogen concentrations in February 2010

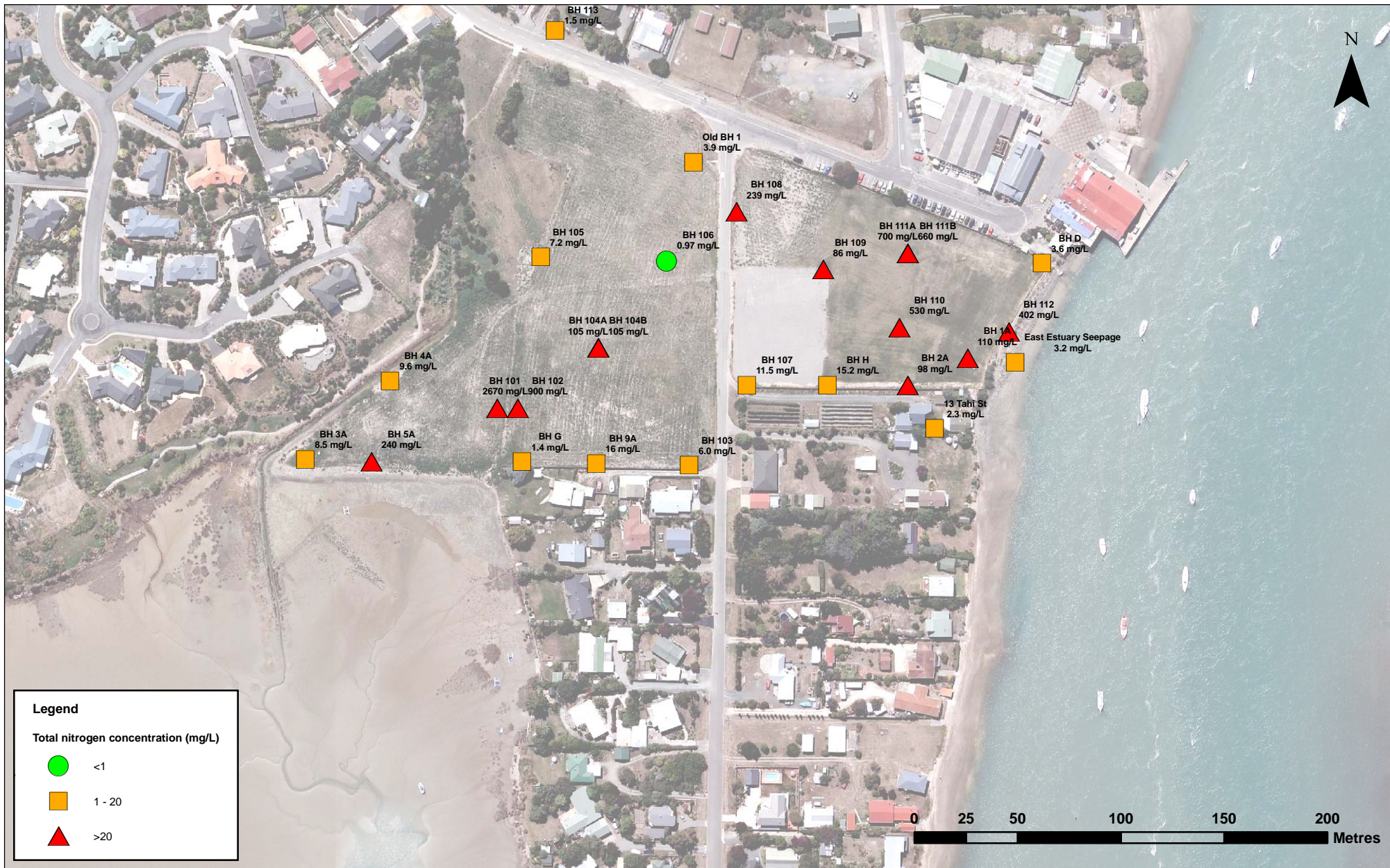


Figure 14 : Total nitrogen concentrations in February 2010

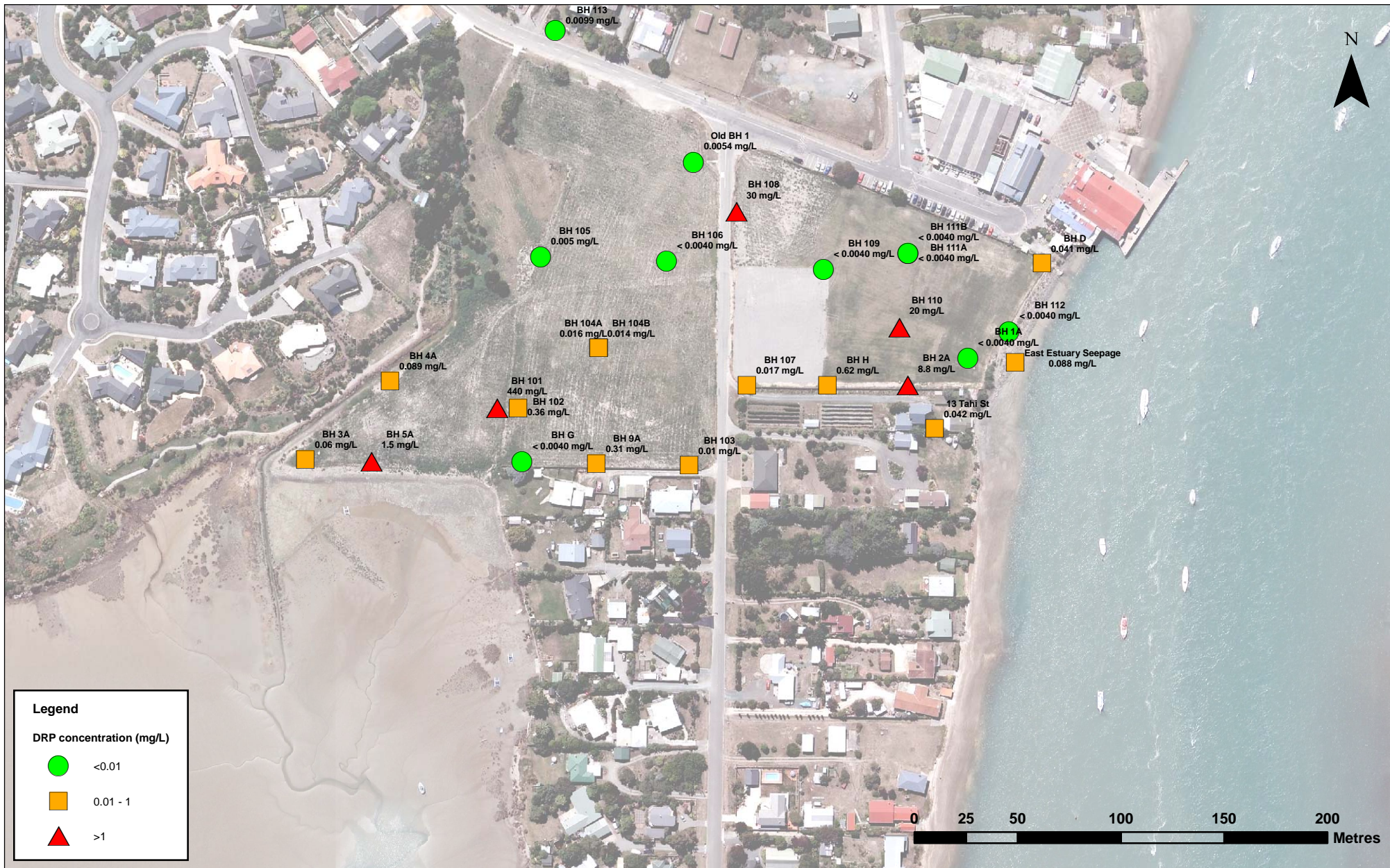


Figure 15 : Dissolved reactive phosphorus concentrations in February 2010

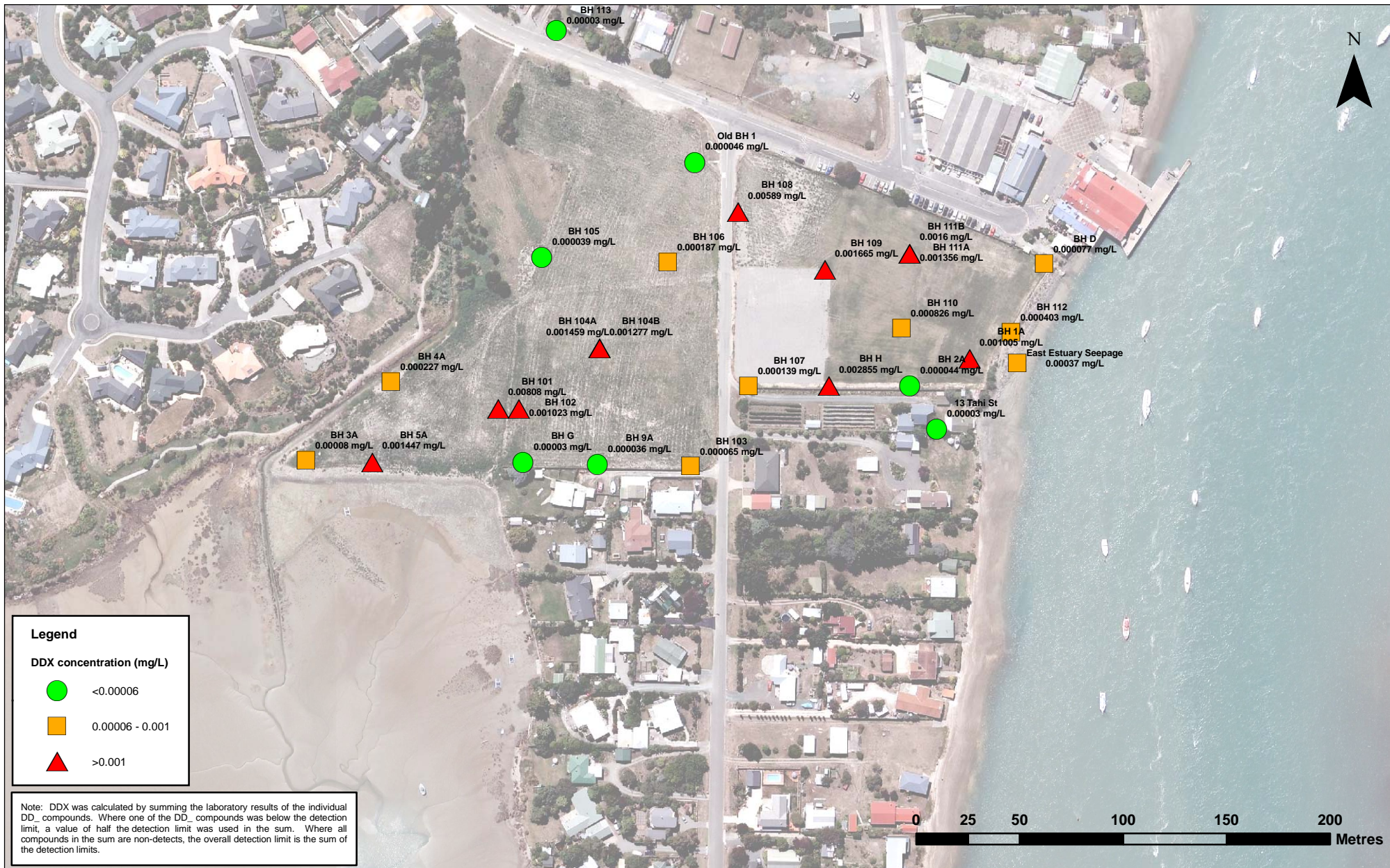


Figure 16 : DDX concentrations in February 2010

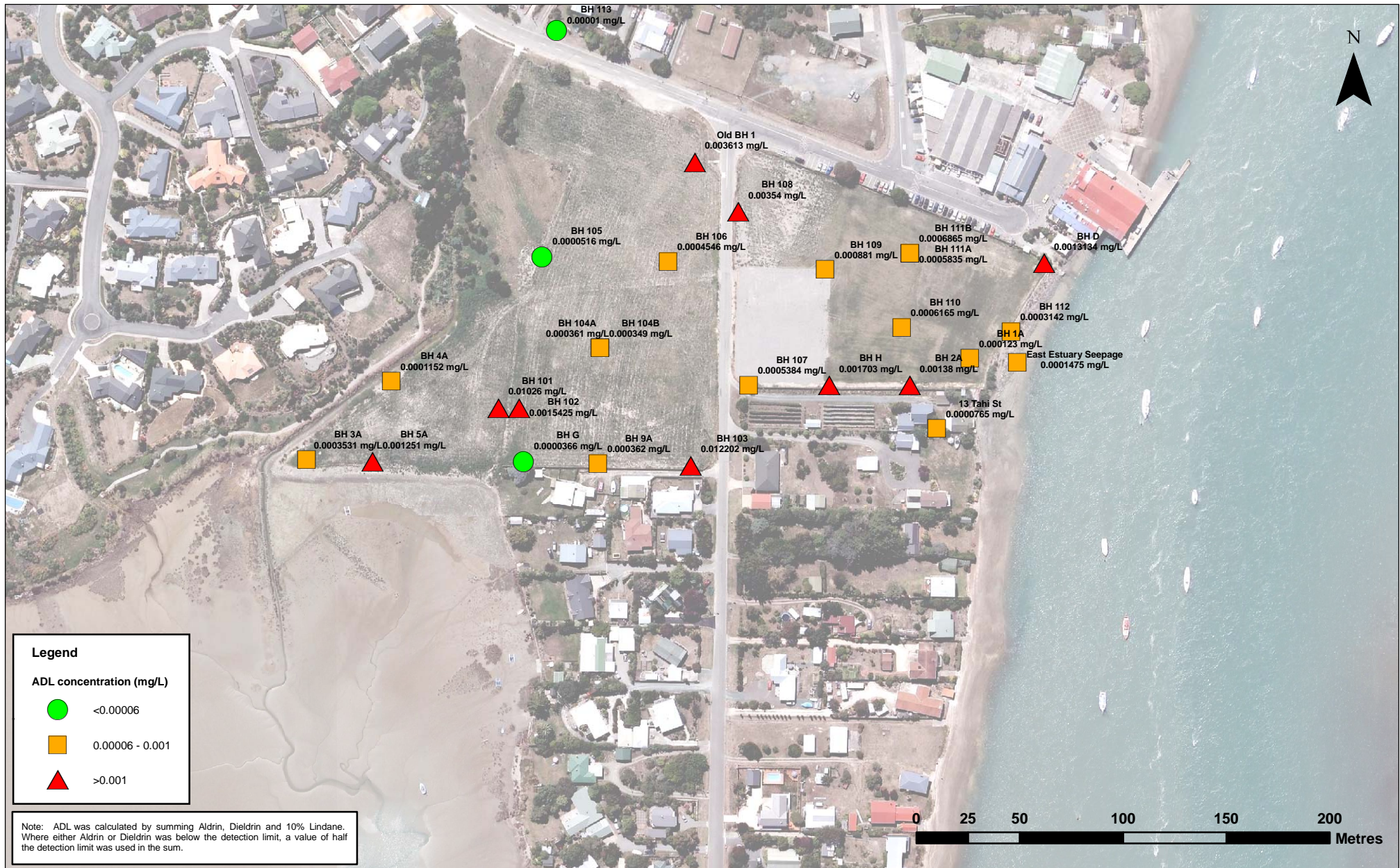


Figure 17 : ADL concentrations in February 2010

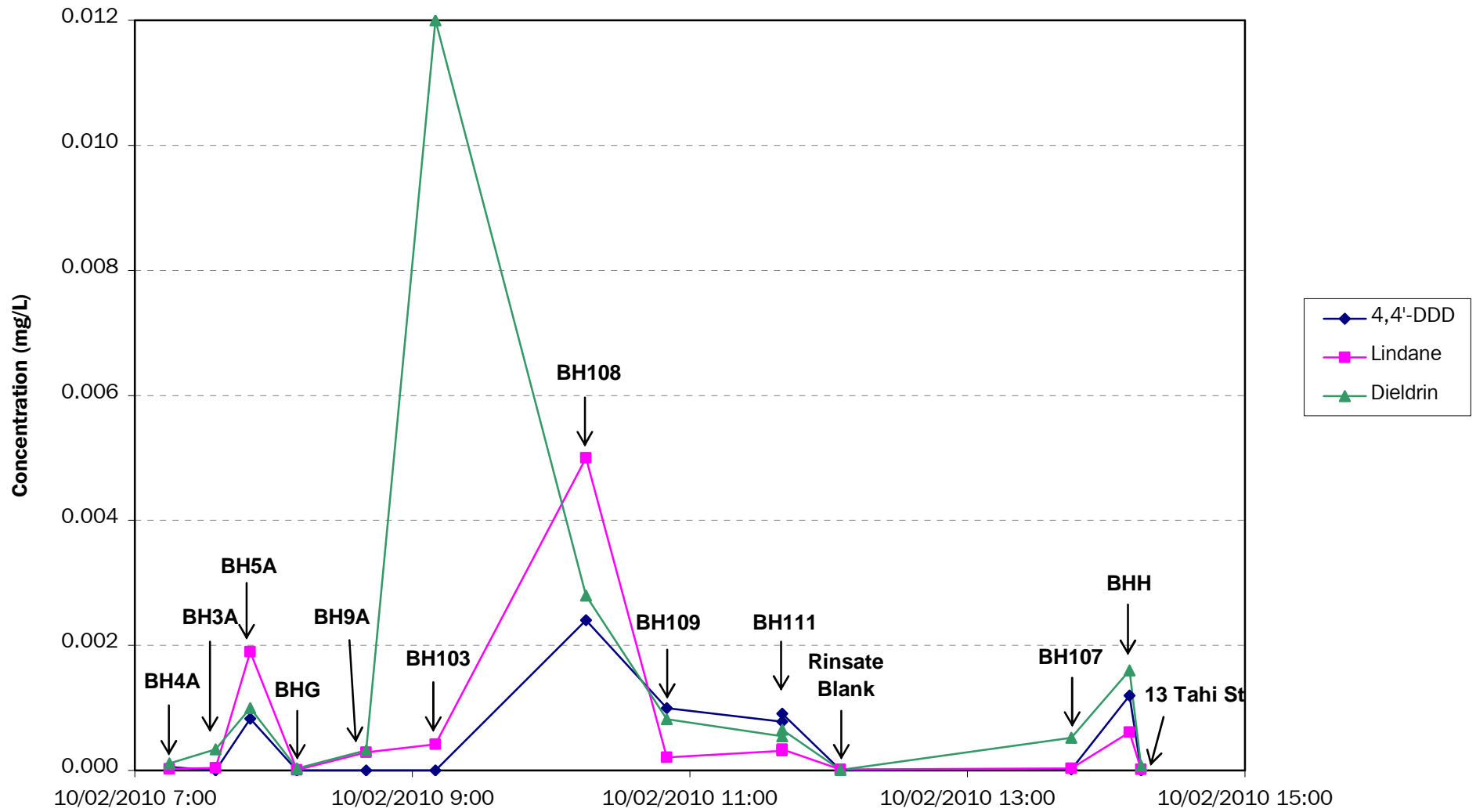


Figure 18 : Sample Analyses on 10 February 2010

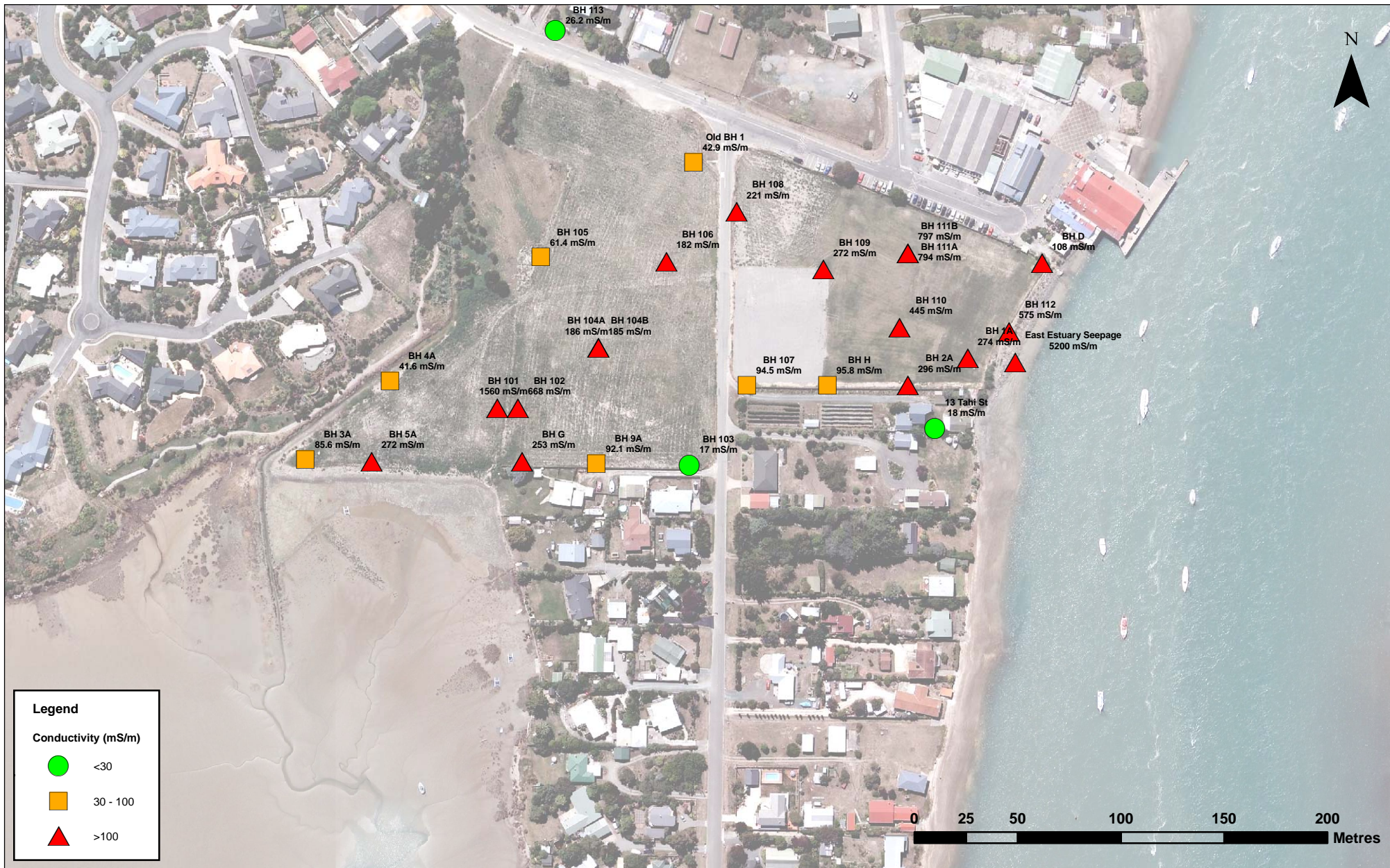


Figure 19 : Conductivity values in February 2010

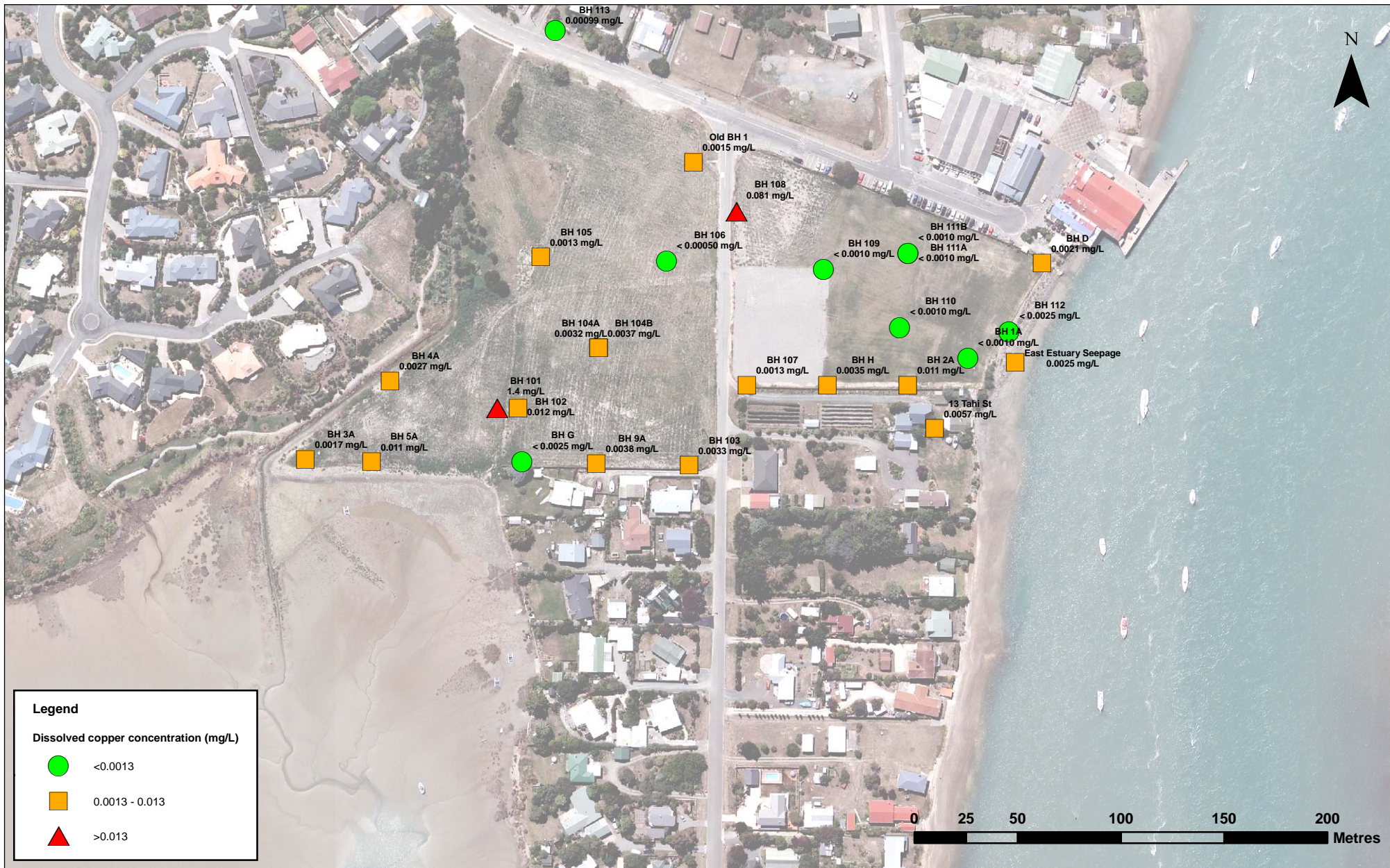


Figure 20 : Dissolved copper concentrations in February 2010

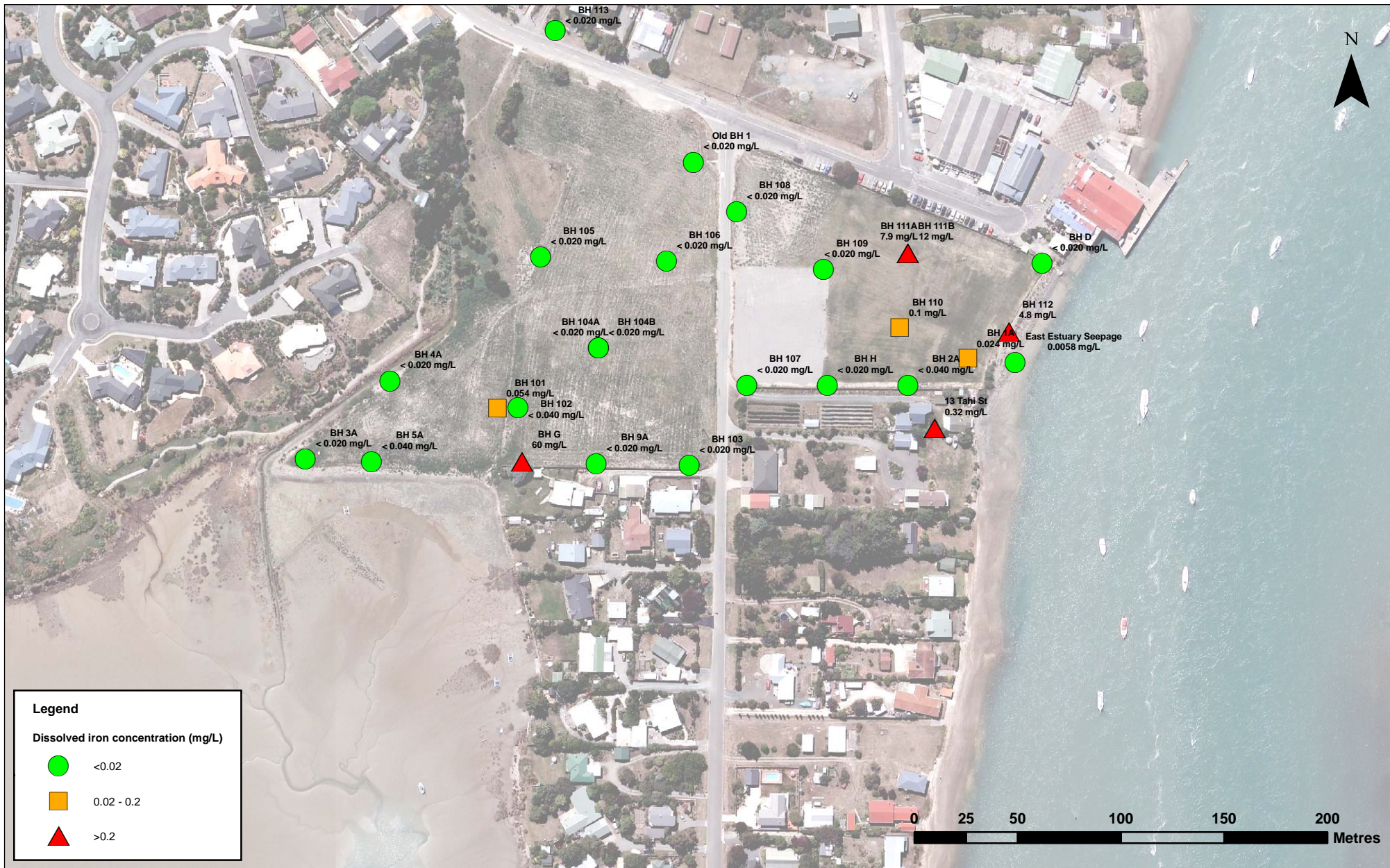


Figure 21 : Dissolved iron concentrations in February 2010