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[Sent by Email]
Bill.sloan@swdc.govt.nz

Job No.10071

2 June 2014

Asset Manager, Infrastructure Services
South Wairarapa District Council
PO Box 6,
Martinborough 5741

Attention: Bill Sloan

Dear Bill,

MWWTP – RESPONSE TO GWRC REQUEST FOR FURTHER INFORMATION

This letter has been prepared to address Greater Wellington Regional Councils (GWRC) request for further information for the Martinborough wastewater treatment plant discharge consent application (GWRC ref: WAR120258 [31707, 32044, 32045]) received 14 May 2014.

The request for information under section 92(1) of the Resource Management Act 1991 relates to the design and management of the land treatment system for land adjacent to the WWTP (MWWTP adjacent, Stage 1) and Pain Farm (Stage 2a and 2b). It is important to note that the information contained in this letter represents outcomes that are achievable under the proposed discharge to result in effects that are no more than those discussed in the consent application.

INFORMATION REQUESTED

Stage 1b – MWWTP Adjacent Site

1. Groundwater

The MWWTP adjacent site is located in the Lower Ruamahanga Water Management Zone[1] (formerly the Tawaha zone[2]). The underlying aquifer is unconfined to semi-confined in Q1 (Holocene) gravels and believed to have a high degree of connectivity to the Ruamahanga River. The hydraulic conductivity of the zone has been variously recorded as 100-300 m/day[3] and 300-400 m/day (Tawaha zone)[2]. The transmissivity of the zone has been reported from a geomean of 1,250 m^2/day[3] to 4,500 m^2/day (Tawaha zone)[2]. Storage is 0.016[1].

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[1] Hughes, B. and Gyopari, M. 2011. Wairarapa valley groundwater resource investigation – Proposed framework for conjunctive water management. *GW/EMI-T-11/53.*

[2] Gyopari, M. and McAlister, D. 2010. Wairarapa valley groundwater resource investigation – Lower Valley catchment hydrogeology and modelling. *GW/EMI-T-10/75.*

[3] Jones, A. and Gyopari, M. *Regional conceptual and numerical modelling of the Wairarapa groundwater basin.*

Concurrent gauging (GWRC Feb and March 2006) indicates that the river reach in the vicinity of the site (Waihenga Bridge to Walls monitoring sites) is a losing reach where river water passes to groundwater. This compares to the down river reach where the river gains through the section Walls to Pukio[2].

A series of seven standpipes were installed across the site as shown in Section 4.1.5.1 of the consent application. Water levels in the standpipes were monitored at least monthly during the period 22/10/2002 to 23/02/2004. The river level adjacent to the site was not concurrently monitored. However, we have compared the levels to stage heights at the Ruamahanga at Waihenga bridge monitoring site for that period.

Ground contours from lidar data supplied by GWRC (1 m contours) have been used to estimate the elevation of the standpipes. Annex A shows the mapped ground elevation over the site. Figure 1 below shows the monitored groundwater levels corrected to metres above mean sea level (m amsl) compared to the recorded stage heights for the Ruamhanga@ Waihenga site.

A visual inspection of the plot suggests that groundwater levels follow the River rising and falling.

The standpipes are laid out in two transects. Figure 2a shows the standpipe transect which is approximately parallel to the river. Hole 4 is the most upstream pipe (closest to the MWWTP). Figure 2b shows the standpipe transect which is approximately perpendicular to the river.

The groundwater plots do not show a clear gradient of groundwater movement towards or away from the river. It is expected that this reflects the high permeability of the groundwater strata and possibly the existence of old channels of the Ruamahanga underneath the site. The old river channel is likely to have a greater impact on the shallow groundwater flow direction than the potentiometric head which is likely to be relatively flat at the site.

Over the monitored period the groundwater level variation was around 2 m for the site. This is in line with variation observed in the river stage measurements. It is likely that the high value recorded for Hole 7 is due to an error in transcription, however this cannot be confirmed so the point has been retained in the dataset. Excluding that data point the shallowest measured depth to groundwater over the site is around 0.95 m.

It is considered that the groundwater under the application site rises and falls rapidly in line with the river. Given the rapid response, high hydraulic conductivity and high transmissivity of the underlying groundwater, and the design irrigation rate of 0.021 m (21 mm) per event for an equivalent of 47 passes on average per year, it was deemed that mounding of groundwater was likely to be minor and did not warrant detailed modelling.

However, to address GWRCs query groundwater mounding has been estimated using the method of Hantush (1967). Input values used are as given above and a land area of 320 m x 165 m (5.3 ha). The specific yield adopted is 0.001. Time of 10 years was used to approximate steady state conditions. A saturated thickness of 10 m was adopted. The parameters and method used are considered to be conservative in that mounding is likely to be overestimated[4].

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[4] Carleton, G.B., 2010, Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins: U.S. Geological Survey Scientific Investigations Report 2010-5102, 64 p.

Estimated groundwater mounding under the MWWTP adjacent site is in the order of 0.00044 m.

The application of wastewater to the site will be at a rate and schedule that avoids excessive drainage to groundwater. The drainage is a comparatively minor addition to a dynamic groundwater system and is not expected to result in breakouts affecting river bank stability.

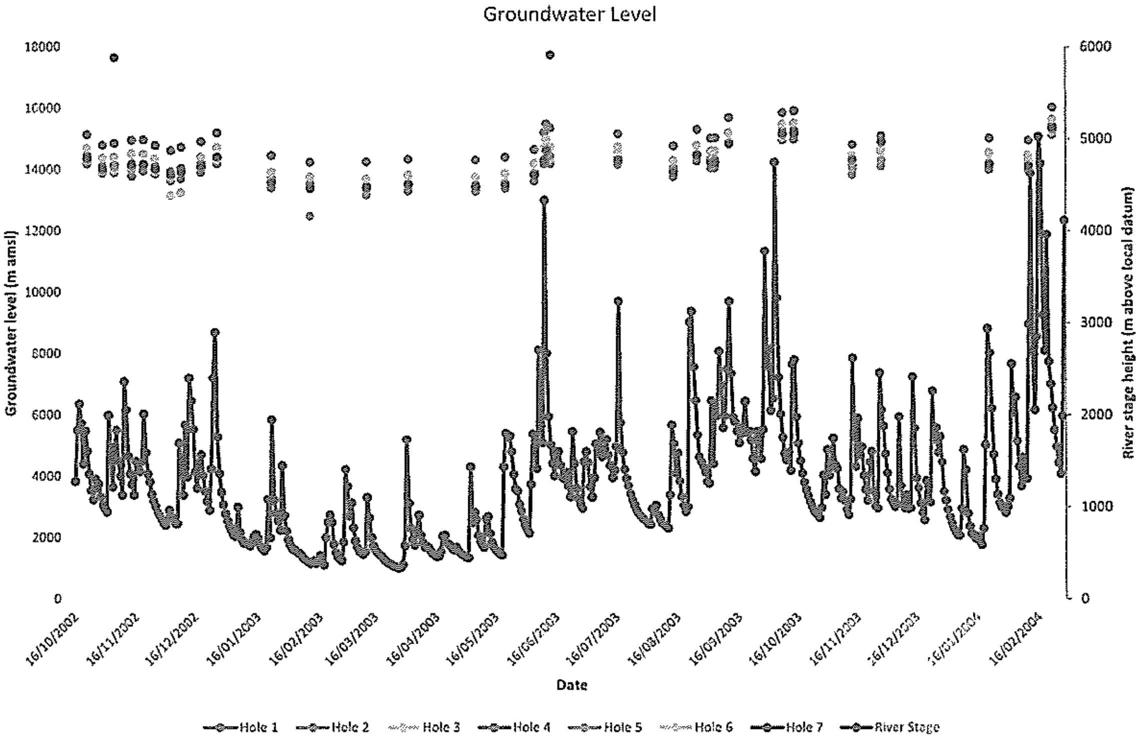

Figure 1: Groundwater and river stage height October 2002 – February 2004.

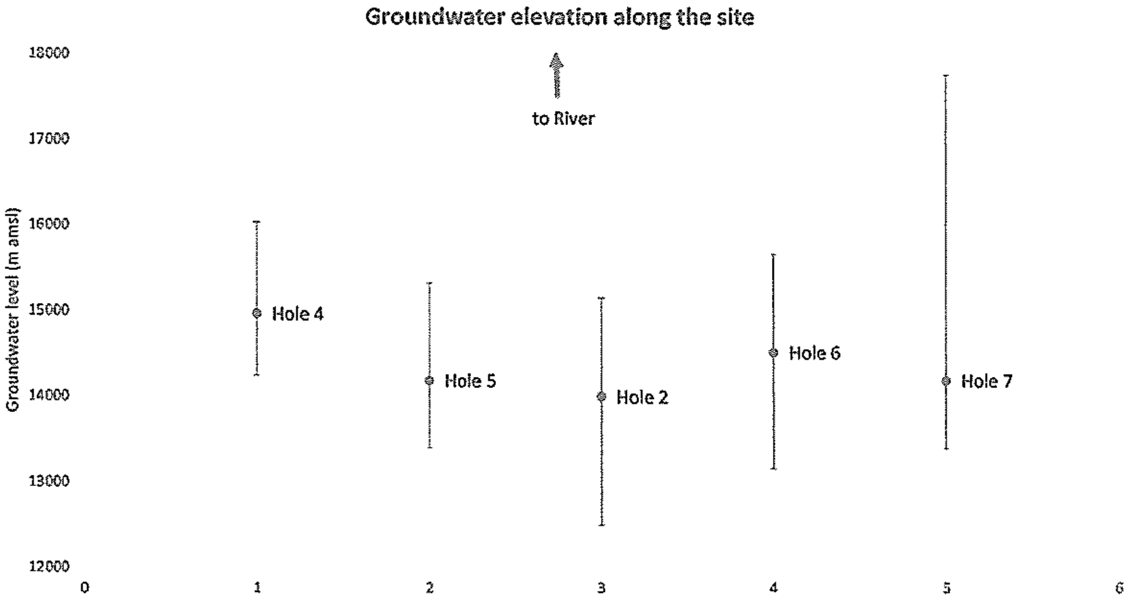

Figure 2a: Groundwater elevation parallel to river showing median, high and low.

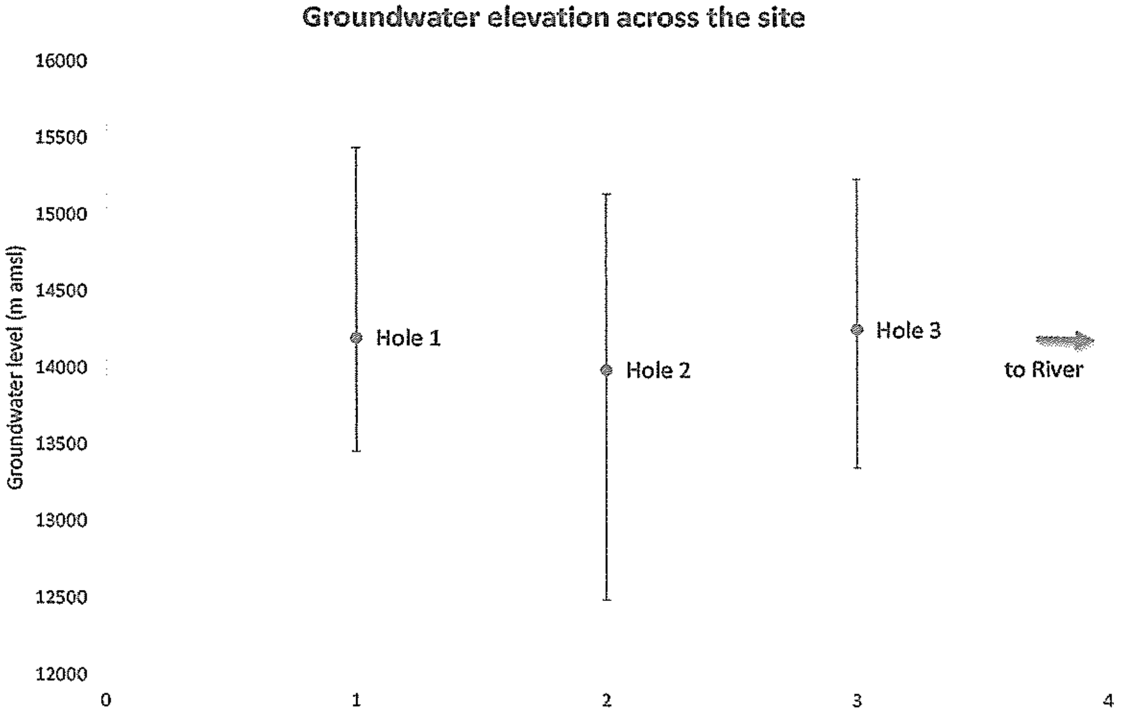

Figure 2b: Groundwater elevation perpendicular to river showing median, high and low.

2. Nitrate Flux during MALF

As discussed in the AEE, the exclusion of direct discharge to the river under MALF conditions is considered to result in substantial reduction of effects from the MWWTP on the Ruamahanga River. The corresponding discharge to land is in keeping with the existing farming land use.

The AEE contains an incorrect estimate of N loading to the land due to an incorrect wastewater total N concentration being used. The correct N loading to the site is 267 kg N/ha/y and not 177 kg N/ha/y as reported. This value is within the range that the effects were assessed on (300 kg N/ha/y). This value is in line with N application expected for the surrounding farming land use and so N losses from the site are expected to be no more than would occur normally under the permitted activity use of the site. Quantification of those losses has been requested and so the following gives a simple N flux during MALF conditions.

- The 7-day MALF at Waihenga bridge is 8.77 m^3/s;
- The maximum daily discharge to the site is 21 mm (1,113 m^3 over 5.3. ha);
- Average TN in the wastewater is 27.1 g/m^3 (it is lower in the summer when MALF is likely to occur however we have used the higher value for conservatism);
- TN loading per application is 30.2 kg for the 5.3 ha irrigation zone;
- Over the modelled period the number of discharges to land that occur during MALF or lower flows is 3 on average per year;
- A further 8 land discharge events per year occur within 3 days of MALF;
- Daily dry matter production and daily plant nitrogen uptake can be determined from the DairyNZ monitoring farm near Greytown; and
- Irrigated pasture production can be assessed from the Greytown values adjusted to follow trends in reported differences between irrigated and non-irrigated monthly pasture production values[5].

Discharge to land is likely to occur during MALF conditions. Following on from point 1 above, MALF conditions are expected to correspond to low groundwater levels under the site i.e. depth to groundwater is expected to be in the range of 2.7-4.3 m below the ground surface. Additionally, any N leached to groundwater is expected to move rapidly away from the site and be subject to rapid dilution.

The groundwater in the vicinity of the site is believed to be in a losing reach of the Ruamahanga River and as a result there is not expected to be a groundwater discharge indirectly to the

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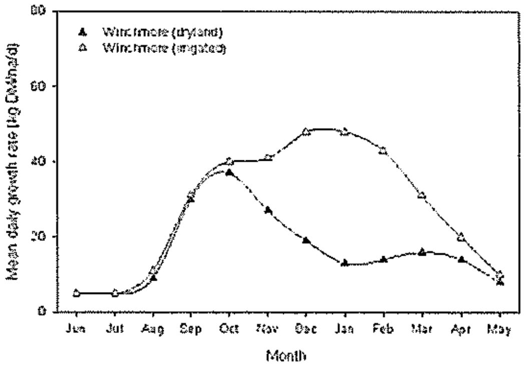

[5] E.g. Figure 42. Mean daily pasture growth rate (kg DM/ha/d) of irrigated and dryland pastures at Winchmore, Canterbury, New Zealand. NB. While pasture conditions at Winchmore are different to Martinborough, the addition of irrigation is expected to result in a similar trend of increased production through summer. It is the trend that has been compared here, not the values.

river adjacent to the site during MALF conditions. However, it is likely that the shallow groundwater is discharged further downstream as discussed in point 1 above.

The design discharge rate is intended to maximise the amount of time that wastewater is retained in the upper unsaturated zone of the soil, thereby maximising the uptake of nitrogen by plants and removal from wastewater by soil processes. However, to provide a worst case scenario we will assume that the applied N is only retained in the rooting zone of the soil for 24 hours, that no removal by soil occurs, that the remaining nitrogen is converted into nitrate, that the applied nitrate displaces its equivalent load from the soil into the groundwater and that the nitrate is diffused into the river over 24 hours. After plant uptake of 12.4 kg N over the site has been removed, this corresponds to a load of 17.8 kg entering the river via groundwater. Assuming no dilution in the groundwater this results in an increase in river NO_3-N of 0.023 g/m^3. This is well below the GWRC proposed limit of 1.7mg/l for chronic toxicity and ANZECC toxicant limit of 0.7 mg/L for 95% protection level (Forbes, 2013). In reality this scenario is a worst case and the actual discharge to the river is likely to be substantially lower and well below any form of detection.

Stage 2a and 2b – Pain Farm

3. Management Strategy

As described above the scenario prepared for the resource consent application details the segregation of WWTP flows between the components of the discharge system (storage, land discharge and river discharge). While the final design and management is yet to be confirmed, the effects of the actual system are expected to be less as the design assumptions used here are worst case.

The timing of the irrigation events is subject to the criteria described in Table 9, Appendix 7 of the consent application. If all criteria are met then irrigation can occur on ANY day of the year i.e. if soil moisture is low and there is evapotranspiration occurring in the middle of winter then irrigation can occur. In reality winter irrigation is unlikely due to elevated soil moisture and a management preference not to irrigate. Over the modelled period no irrigation occurred during June, July or August, and irrigation did occur the depth did not exceed 4.5 mm/application during May and September.

For the modelled time period the irrigation days were distributed as shown in Table 1.

Table 1: Irrigation passes for modelled period

	2007	2008	2009	2010	2012	2013
January	-	2	1	3	2	1
February	-	1	1	5	5	-
March	-	1	4	6	5	-
April	-	2	5	2	8	-
May	-	2	2	2	7	-
June	-	0	0	0	0	-
July	-	0	0	0	0	-

	2007	2008	2009	2010	2012	2013
August	-	0	0	0	0	-
September	-	7	7	7	7	-
October	-	15	11	15	15	-
November	-	11	2	4	5	-
December	2	2	4	1	3	-

The available irrigation days are more than the number of passes in Table 1, however the amount of wastewater available limits the discharged volume in late summer (i.e. the storage is drained faster than it is replenished). When detailed design is undertaken the distribution is likely to be tailored to ensure the stored wastewater is held over until later in the growing season. The actual number of days of irrigation is likely to be greater than the number of passes because one pass of the site is expected to take between two and three days by virtue of the rate of pumping likely to be adopted.

As part of the management plan to be produced, withholding periods before and after crop harvest will be included. As indicated from the number of passes in Table 1 there is plenty of scope to "close-up" portions of the site for harvest without limiting the ability of the system to discharge wastewater.

There are a number of methods for measuring the limiting parameters for determining when irrigation events will take place. Decisions regarding adoption of methods will be made based on the irrigation systems selected but may include any of:

- On-site weather station;
- NIWA VCS network data;
- Soil moisture meters (TDR, capacitance, Aquaflex style – not gypsum block or neutron probe).

SWDC staff will be responsible for day-to-day decisions on irrigation. However, the management plan will outline in detail the roles and responsibilities for operation and maintenance. Details of agricultural contractor relationships are subject to detailed design and contract procedures.

4. Winter Irrigation

As indicated in the resource consent application (Appendices 7 and 16) the discharge regime has been designed around managing the limitations of the receiving site's soil, specifically the underlying pan. As a result a deficit regime has been proposed which results in the wastewater being applied at a rate to supply plant requirements, with no drainage following an irrigation event. While the onset of rainfall following irrigation will result in excess water in the soil profile, there is sufficient time between irrigation events and there is sufficient land available to ensure that no area is in an "induced wet" state going into the winter period. As identified there is seasonal perching of water on the soil pan. This occurs now and will not be exacerbated by the irrigation regime.

5. Winter Nitrate Loading

Nitrogen applied via wastewater is less than that required by the pasture or other crop over the course of a year. Even if wastewater were to be applied during winter a review of dryland (not irrigated) pasture production (Greytown) shows in this area plant uptake in the order of:

- April = 16 kg/ha/d DM (0.72 kg N/ha/d)
- May = 11 kg/ha/d DM (0.50 kg N/ha/d)
- June = 15 kg/ha/d DM (0.68 kg N/ha/d)
- July = 12 kg/ha/d DM (0.54 kg N/ha/d)
- August = 17 kg/ha/d DM (0.77 kg N/ha/d)
- September = 24 kg/ha/d DM (1.08 kg N/ha/d)

The values above should be compared to an application (at 9 mm) of 2.4 kg N/ha/pass. Were an application to occur at this time of the year, there is likely to be sufficient time for plant removal and soil renovation between irrigation events. This would be assisted by slower N transformation in cold weather, and by the natural slow drainage of the site. Further, for an application to occur during the winter period dry soil conditions are necessary resulting in no irrigation around rainfall periods.

A conservative design with hydraulic loading as the limiting parameter results in a low rate of N application. It also results in N being applied during active crop growth (and therefore rapid uptake). Additional N applied as (for instance) fertiliser is likely to be needed to supply plant requirements, however this can be planned to minimise risk of loss from the site (i.e. Fertiliser Code of Practice).

Storage Volume

6. Determination of Storage Volume

Storage volume has been determined based on a daily water balance. The water balance used has been used by LEI for some time and was independently reviewed by Dave Horne (Massey University) in 2010. For reassurance storage volumes have also been calculated by AWT (Appendix 2, consent application) and have been run through the Massey Storage Pond Calculator. The storage volume as modelled is shown in Figure 3.

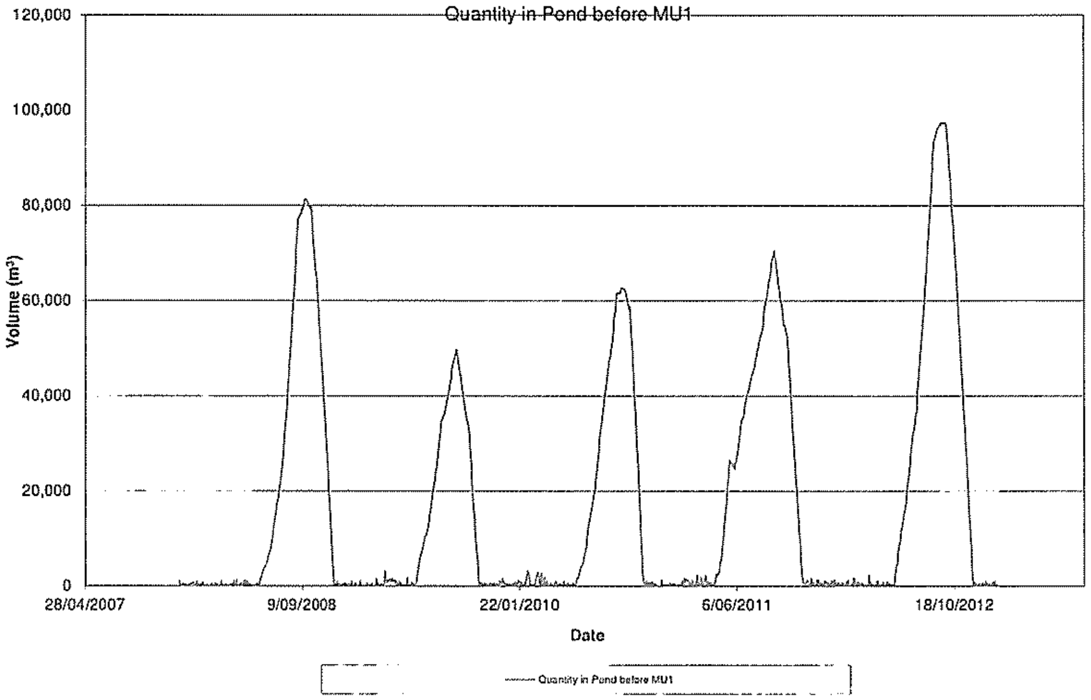

Figure 3: Volume in Storage Pond

The pond volume is indicative and subject to development of long term data sets.

We trust the information contain herein meets the requirements for GWRCs section 92 request. Please contact LEI if you have any queries.

Yours sincerely

Lowe Environmental Impact

Katie Beecroft/Hamish Lowe

Enclosure
» Annex A: MWWTP Adjacent Site Elevation

ANNEX A: CONTOUR MAP FOR MWWTP ADJACENT SITE – STAGE 1