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Dear Rebecca,

Review of the Wairarapa Airborne Electromagnetic Survey Acquisition and Deliverables

1.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

SkyTEM Australia (SkyTEM) completed the airborne electromagnetic (AEM) survey of the Ruamāhanga River valley for Greater Wellington Regional Council (GWRC) using the SkyTEM 312 system. The SkyTEM survey was flown as part of a contract, awarded to Greater Wellington Regional Council (GWRC) by the Provincial Growth Fund (PGF), to undertake an AEM survey to deliver data that will contribute to an improved knowledge, understanding and 3D aquifer mapping of the Wairarapa's critical groundwater systems. The flying commenced on 28 January 2023 and was completed on 2 March 2023. A total of 5653 line-km was flown, and the draft data and report were delivered to GNS Science (GNS) on 27 April 2023. After an initial review by GNS, a revised dataset was delivered by SkyTEM on 10 May 2023. The following aspects of the survey and the data have been reviewed by GNS relative to the contract specifications between SkyTEM and GWRC:

1. The completed flight lines compared to planned flight lines.
2. Elevation of the AEM loop, flown groundspeed and AEM station spacing.
3. The delivered raw AEM and magnetic data (Geosoft and ASCII XYZ format).
4. The delivered AEM inversions (sections and depth slices).
5. The repeated sections of line for system consistency.
6. The acquisition and processing report.

The survey area is divided into two blocks, described as the 'Main block' and 'Masterton block'. The Main block was flown on lines oriented 130/310° (True North), with areas around Martinborough and Featherston not flown as expected. The Masterton block was flown on

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lines oriented 030/210° (True North). Parts of this block were not flown around suburbs, hobby farms and stables adjacent to Masterton, Carterton and Greytown that were larger than anticipated. However, despite the loss of flight lines over these areas, the density of data is still adequate to meet the project's objectives.

GNS has made some edits and recommendations in the SkyTEM acquisition report that have been adopted by SkyTEM. In this report, GNS does not address any aspect of the cost of the survey or details of the contract between SkyTEM and GWRC. GNS is satisfied that the data are correct and suitable for undertaking the next proposed phases of the 3D aquifer mapping project.

2.0 SURVEY TIMELINE

SkyTEM commenced data collection on 28 January 2023. GNS provided on-the-ground support during the initial phase of the surveying. Production was initially slow due to poor weather. The collaboration between SkyTEM, the helicopter sub-contractor, GNS and GWRC was essential in addressing the division between production and weather days. The survey was completed on 2 March 2023. There was one incident, where the AEM loop was damaged after clipping a tree. All reporting processes were followed and production resumed after one day of repairs and re-calibration.

3.0 QUALITY CONTROL

Table 3.1 gives the breakdown of line coverage planned versus delivered for tie-lines, for the Main block and for the Masterton block. Repeat lines were conducted on a mixture of tie-lines and flight-lines. The length of tie-lines flown increased with the addition of two extra lines in the Masterton block along some key ground locations. The length of flight-lines flown in the Main block was 58 km less than planned due to Martinborough and Featherston areas not flown. The length of flight-lines flown in the Masterton block was 223 km less than planned due to hobby farms, Carterton, Greytown and Masterton areas not flown.

Table 3.1 Line kilometres.

Area	Planned	Completed
Tie-lines	264	282
Main Block	3078	3030
Masterton Block	2545	2322
Repeat	0	19
Total	5887	5653

All survey lines complied with the specifications in terms of minimal deviation from the planned line, elevation of the AEM loop above the terrain within 40–60 m and operation of the AEM system. The data from the first set of tie-lines were reviewed extensively immediately after acquisition. The final delivered data have been checked for signal strength, noise levels and lateral continuity along and between flight-lines. The AEM data are within the expected range of amplitudes and have acceptable noise levels. The flight speeds are within the tolerances required to deliver an AEM sounding point approximately every 11 m along the flight-lines.

High-altitude calibration flights were undertaken at the start of the survey, mid-way through the survey and after the loop was repaired. These calibrations are complete and allow the data to be corrected for the primary field. The primary field compensation is important for imaging the shallow geology.

Three short sections of line were repeated to evaluate the stability of the AEM system. The processed data yield models that are repeatable, confirming that the AEM system gave consistent results throughout the duration of the survey.

4.0 ACQUISITION REPORT

SkyTEM produced an acquisition report that described the survey and provided the information needed to interpret the data and derived products (SkyTEM 2023). The report is a factual account of the survey and contains all of the relevant information.

5.0 PROCESSED DATA

SkyTEM delivered the following data that has been checked for completeness:

- AEM data (Raw binary format, ASCII format and Oasis Montaj Database).
- Digital terrain model derived from the GPS and Laser Altimeter (Grids and GeoTiff images).
- Conductivity models as data points, cross-sections and depth maps (ASCII format, Oasis Montaj Database, PDF files and images).
- GIS layers of the flight paths.
- Magnetic data (ASCII format, Oasis Montaj Database, Grids, PDF and GeoTiff images).

GNS has loaded the raw AEM data into a computer software package designed to process SkyTEM data and confirmed that the data supplied is complete and suitable for more advanced processing. The appendices of plots and sections have been reviewed to ensure that they contain all of the data mentioned in the report.

GNS has reviewed a subset of the conductivity models derived from the delivered processing of the SkyTEM data. The review included plotting the sections in a workstation and comparing them to resistivity sections from ground-based data (Ingham 2014; Kellett et al. 2020, 2022). The cross-sections contain sufficient information to undertake a simple interpretation. The maps of the electrical conductivity in depth slices show patterns across the Wairarapa that are consistent with the existing ground-based data and the regional geological map (Heron 2020).

6.0 CONCLUSIONS

Based on the review of the material described above, GNS recommends that GWRC accept the report and data as a final deliverable from SkyTEM.

Yours sincerely,

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7.0 REFERENCES

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