Case Analysis

Waste Water Treatment Plant Queenstown NZ

Market Sector

INFRASTRUCTURE

Application

DEEP IMPACT COMPACTION

Project Phase

POTENTIAL FOR LIQUEFACTION

LANDPAC

INTELLIGENT GROUND ENGINEERING SOLUTIONS

Project

The proposed upgrade of the new Waste Water Treatment Plant (WWTP) in Queenstown, Otago, New Zealand, located west of the Shotover River, required an increase in ground bearing capacity to support the planned construction works, including a new clarifier, an MLE reactor tank, and associated structures.

Soil Conditions

The in-situ geotechnical investigations conducted prior to the HEIC works indicate that the subsurface profile consists primarily of loose to dense gravel fill overlying native alluvial sand, silty sand, and gravel deposits. Two loose to medium-dense silty sand layers were identified between approximately 2 m and 5.5 m below ground level. These layers are considered potentially liquefiable and are likely to undergo reconsolidation when subjected to cyclic loading. A relatively high water table was present during the HEIC works which had no adverse effects on the superior compaction results achieved.

Client: Queenstown Lakes District Council

Engineering Consultant: Jacobs

Main Contractor: Downer

Ground Engineering Contractor: Landpac

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Geotechnical Solution

Landpac was engaged as the ground improvement contractor for the WWTP to carry out High Energy Impact Compaction (HEIC), also referred to as Impact Compaction (IC). The objective of the works was to increase the ground's bearing capacity by densifying the upper in-situ sand strata to 5m depth, thereby reducing both total and differential settlements and ultimately mitigating the site's liquefaction potential.

Landpac successfully achieved a rapid reduction in both total and differential settlements across the site, increasing the soil's resistance to liquefaction and thereby reducing the risk of damage to infrastructure from excessive ground deformation. Following the HEIC works, the recompacted in-situ sand and gravel materials were assessed to provide suitable foundation conditions for a design bearing pressure of 260 kPa.

Monitoring & Verification/QA

Landpac's integrated Intelligent Compaction Measurement (ICM) systems was used to monitor total average and differential settlements as well as relative stiffness values across site. Verification of design parameters was done by doing post HEIC CPT's.

Average compaction settlements of approximately 217 mm were recorded across the MLE and clarifier areas. An increase in soil response—reflected by higher stiffness and density—was observed within the zones treated by Impact Compaction. The table below summarises the average G-values measured during the IC works at various pass intervals, showing a consistent increase in subgrade stiffness with additional passes. The measured average G'Value (average stiffness) recorded indicated that an average increase of 3.6g's was obtained after 70 surface passes with cyan (very high response) being the predominant colour showing that the site was relatively uniform post IC works.

Soil Response

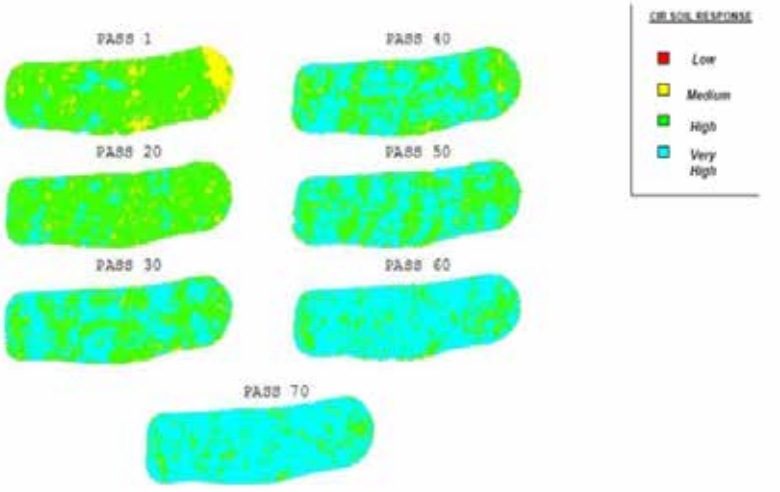

Table 1. Recorded Soil Response Average Relative Stiffness

Number Passes	Average Recorded G'Value
1	6.7
20	7.6
30	8.9
40	9.1
50	9.18
60	10.28
70	10.29

Recorded significant ground volume reduction

Alternative Design Analysis

Mitigated liquefaction and differential settlement

Summary

- **Target**: 260 kPa bearing capacity.
- HEIC densification to 5m depth.
- **Settlement**: 217mm average total reduction.
- **Stiffness**: Average G-Value increased by 3.6.

Construction

The upgrades included, MLE tank with dewatering and blower building, a clarifier, administration operations and control building, septage, an MLE distribution chamberand grit works at the inlet works, inlet works drainage, and new paving.

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