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The Albany Regional Centre Development

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SUMMARY

The Albany Regional Development is located in Albany, about ten minutes north of Auckland City on Auckland's North Shore. Some 200 hectares are being developed for a combination of residential, commercial and industrial uses. Development has been underway since 1994 with completion of the project expected to take another four to five years. Three stages have been completed to date, with Stage 4 to begin in the 1997/98 earthworks season. The site straddles quite different geological terrain with variable earthworks characteristics requiring detailed monitoring during fill placement. One area of the development was found to contain old timber treatment chemical contaminated filling which had to be removed and dealt with under strict health and safety guidelines. Several gullies have, or are to be filled to depths of up to 18 metres requiring detailed subsoil drainage specification, stability and settlement analysis. The site illustrates several problems encountered in undertaking earthworks on what is essentially "soft rock" terrain.

1.0 Geology

The Albany Regional Centre site comprises two distinct geological formations.

The east of the site is characterised by rolling hills and incised gully features being deeply weathered Miocene Age Waitemata Group deposits. The Waitemata Group is a flysch or flysch-like deposit dominated by interbedded mudstones and poorly graded sandstones. Weathering of these deposits tends to produce sandy silts and silty clays.

Much of this material on site consists of pink silts which tend to be volcanogenic in nature, have high water contents and are moderately sensitive to disturbance. This has implications for earthworks control, the soils being quite difficult to earthwork unless within a few % of optimum water content.

To the west of the site, the geology is characterised by relatively gentle gradients and shallow gullies. This area consists of Pleistocene Alluvium unconformably overlying Waitemata Group deposits. In Pliocene times the area was below sea level, resulting in deep embayment of the Waitemata Group. A depositional basin was then created with the infilling of Pleistocene sediments. As the alluvium in this area of the site is basically eroded Waitemata Group material the upper weathered profile is relatively similar to that in the east. This profile typically comprises mixtures of orange/ brown/ light grey clays, silts and sands, with some organic inclusions and pumiceous silts.

Development earthworks generally consist of cutting down the hills in the east and filling over the alluvium in the west. Apart from the pink silts mentioned above, other earthworks challenges include obtaining suitable fills from variable and variably mixed residual and alluvial soils as well as settlement considerations given the depths of filling anticipated.

2.0 Site Investigation

Site investigations are an extremely important part of any major development. Knowledge of the prevailing ground conditions is necessary to enable cut/fill designs to be evaluated and changed if necessary. Several different methods of site investigation have been employed on this development.

For the most part site investigations for the Albany Regional Centre have involved hand auger boreholes and machine boreholes. A total of 132 hand auger boreholes and thirty machine boreholes have been drilled to date to depths of up to 5.2 metres and 25 metres respectively.

Hand auger boreholes are very useful when investigating the upper 5 to 6 metres of any given profile. They provide a rapid economical investigation technique for either smaller jobs or where coverage is required over a large area. Information such as the insitu shear strength, remoulded strength, detailed descriptions and depths of strata can all be obtained. During drilling shear vane readings are taken in the undisturbed soil at the base of the hole using a Pilcon hand shear vane. If ground water is encountered the standing groundwater level is recorded following drilling completion.

Disturbed samples can be taken to ascertain water content, liquid limit, plastic limit, allophane contents, Casagrande classification and associated parameters.

Machine boreholes allow the gathering of detailed information about the soil profile to greater depths than is possible with hand augers and trial pits. The changing strata, from weathered residual soils, through transition materials, and the underlying bedrock can all be examined in detail. Samples from the core, as well as undisturbed samples from the upper soil profile, can be taken for laboratory testing at a later date. Samples of the underlying bedrock can be used for triaxial testing. Consolidation tests are often performed on samples of the residual materials likely to be used as fill so as to provide estimates of likely settlements within the fill.

Within the underlying natural ground in areas to be filled, consolidation tests can be performed to estimate settlements due to fill placement. Joints and defects within the underlying strata can often be identified through inspection of the core recovered from machine boreholes. Closer examination can be carried out on samples brought back to the laboratory.

When slope stability is likely to be of importance, laboratory tests on samples taken from machine borehole core can give parameters, such as cohesion and friction angles, for design of final contours and any retaining structures to be constructed.

Another method of investigation used on this site was the excavation of trial pits. This method of investigation was used only in the area of the Western Entry as old filling containing timber treatment chemical contaminated waste and other assorted waste including bricks, glass, car parts and timber mixed with clayfill, topsoil and hardfill was found.

Trial pits are usually excavated with a 12 to 20 tonne tracked excavator and enable an accurate description of strata encountered, generally in the top 5 to 7 metres. Provided strict health and safety guidelines are followed, it is possible to descend into the pit for detailed inspection of the material encountered. It is often possible to examine slip faces and joint defects insitu, thus enabling accurate descriptions of dips and strikes. A potential disadvantage is the disturbance caused by the excavation. The trial pits excavated in the Western Entry allowed estimates of volumes of the various old fill types.

3.0 Laboratory Testing

Laboratory testing has been an integral part of our investigations on this site. Given the differing geology across the site, it was essential that testing was undertaken to evaluate the differences in the materials encountered. Water contents, plastic and liquid limits, Casagrande classifications, shrinkage potential, allophane contents, cohesion, friction angles and settlement parameters were all evaluated from borehole samples taken during the site investigation phase.

Water contents across the site ranged from 20% up to 67%. Within the clayey alluvial materials, water contents tended to be lower, while water contents within the more silty, weathered Waitemata Group were a lot higher. These high water contents have caused minor difficulties when this silty material was used for filling, as laboratory testing has shown optimum water contents to be in the vicinity of 25% to 35%, and within the weathered Waitemata Group the average water content was 42%.

Figure 1 shows results from several compaction tests in and around the Albany area in similar geological terrain to the residual weathered Waitemata Group deposits on this site, which gave an optimum water content and dry density for fill material.

As can be seen in Figure 1., the weathered Waitemata Group deposits have an optimum water content between 25% and 35%.

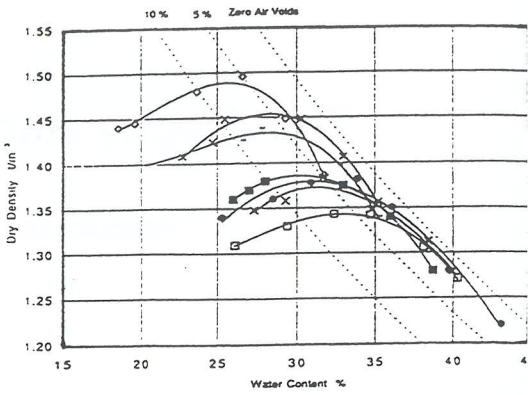


Figure 1. Optimum Water Content Within Waitemata G Deposits

On this site, within the weathered Waitemata Group, showed the material to be generally an inorganic silt, within the Pleistocene alluvium, testing showed this m to be generally an inorganic clay. Figure 2 Casagrande Classifications for samples taken fro different geological terrain present on the Albany Re Centre site.

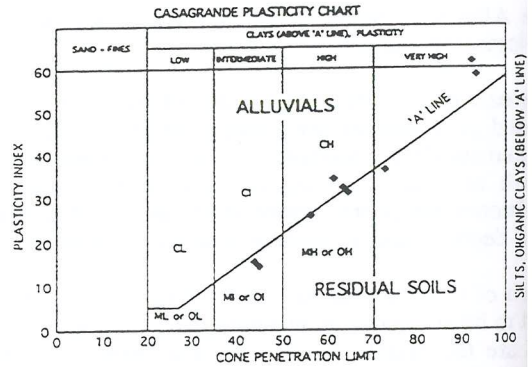
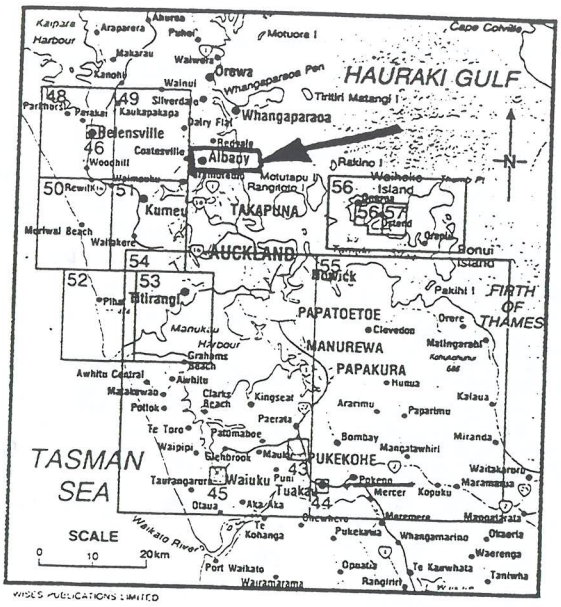


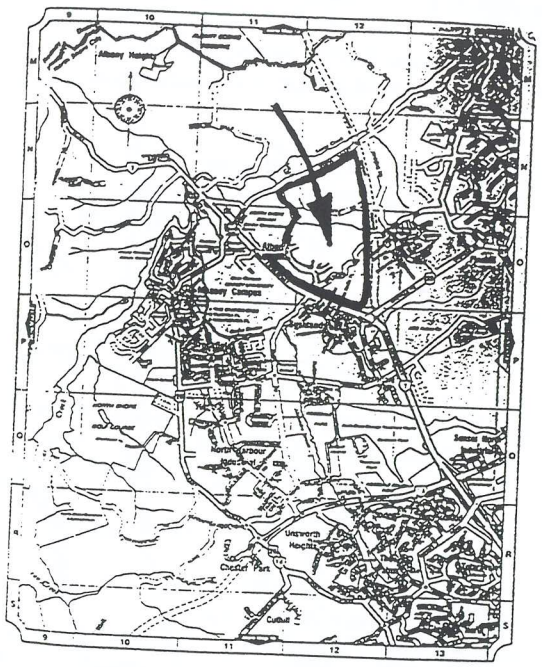
Figure 2. Casagrande Classification Results

The liquidity index is a measure of the proximity natural water content to the liquid and plastic limit. the weathered Waitemata Group soils, the samples test values around 1, indicating high compressibilit sensitivity. Within the alluvials, values obtained testing were around zero, indicating highly over-consol soils.

The results from our tests showed the subsoils moderately to highly expansive. This is a phenor common to both Pleistocene alluvial and Waitemata subsoils throughout many parts of the Auckland Area. implications of moderately to highly expansive soils brittle building construction on shallow founda However, provided adequate drainage is installed pr developments occurring, problems can be avoided quite

The allophane content is an indication of the amou allophanic clay minerals in the soil. Allophanic soils marked irreversible changes in their physical properties dried below the natural water content.





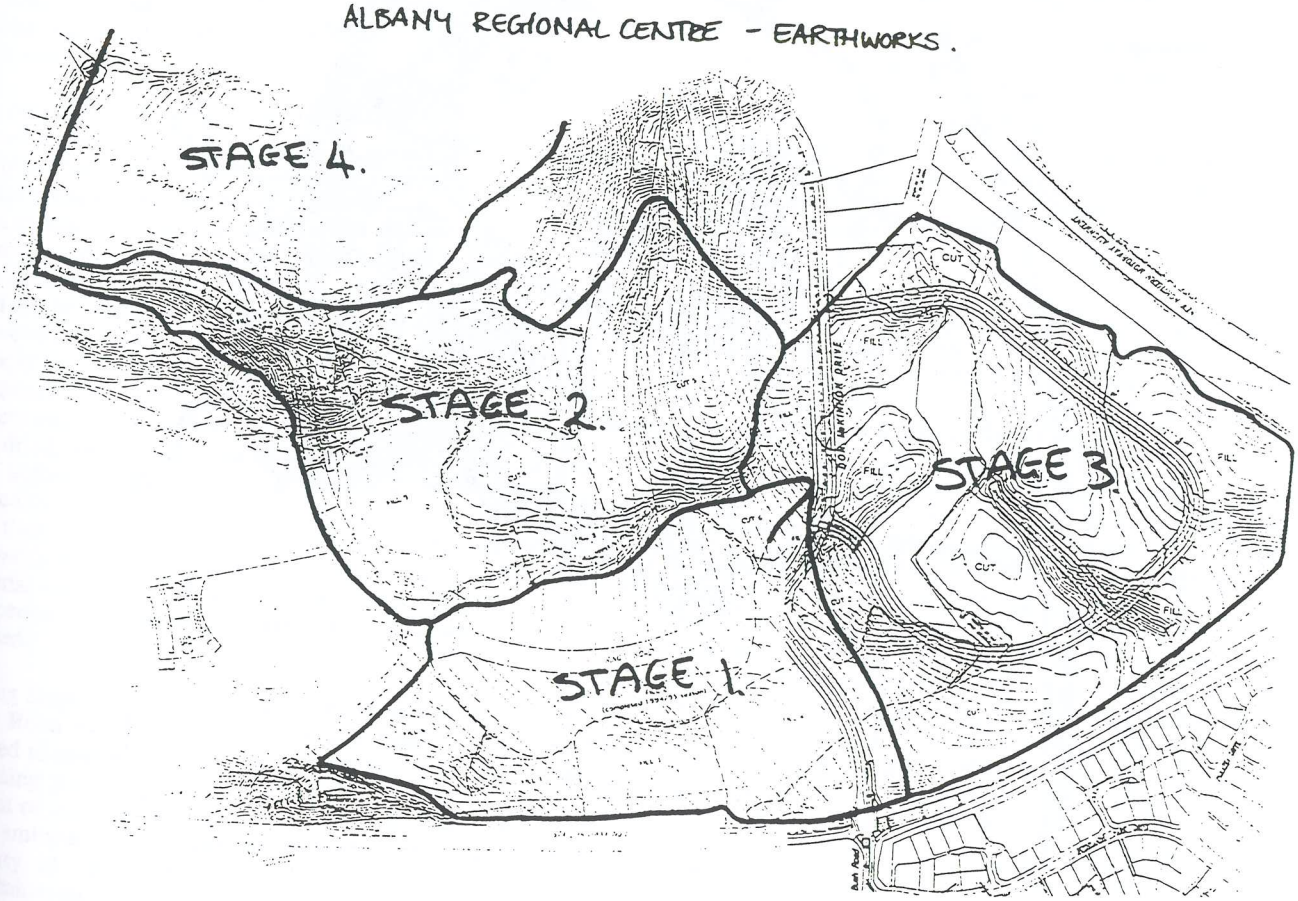


Figure 3. Site Location and Earthworks Stages

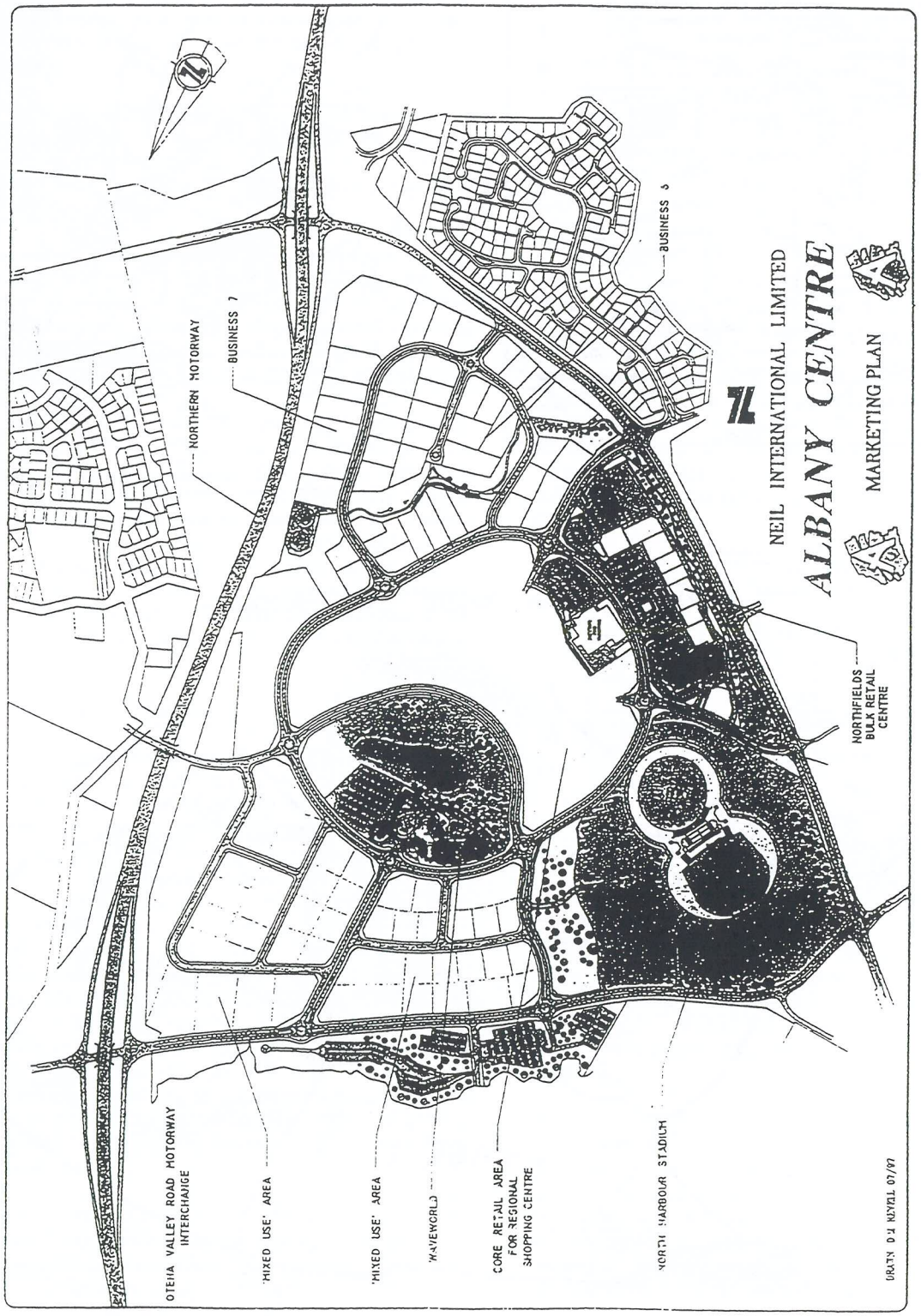


Figure 4. Marketing Plan for the Albany Regional Centre

Our testing within the Waitemata Group soils showed allophane contents of less than 5% and within the alluvial soils allophane contents were between 5% and 7%. Provided care is taken when working with higher allophane content soils, any difficulties should be minor.

Coefficients of compressibility and consolidation have also been established. The compressibility of the soils across the site lie in the low to medium range. The coefficients of consolidation calculated over appropriate loading ranges showed that any settlements that do occur as a result of the fill loading are likely to be at a moderate rate, 90% being likely to have occurred within the first year.

As development of any single site is likely to occur outside of this time frame, and with associated post-construction swelling of the fill likely to negate any settlement effects, no problems are envisaged.

4.0 Earthworks

4.1 Stages 1 to 3

Stage 1 of the Albany Regional Centre development commenced in the 1994/95 earthworks season. (See Figure 3 for site location and earthworks stages). This stage essentially involved the filling of a gully adjacent to State Highway 1. Following mucking out of the gully, suitable drainage was placed and filling began. Figure 4 shows the marketing plan for the site when all works have been completed.

In subsequent earthworks seasons, Stages 2 and 3 commenced. These areas are adjacent to Stage 1 and involved the filling of gullies and levelling off of hillsides. These areas were chosen to be worked initially to give a large area available for early development of the commercial area. During the early stages of each earthworks season there were few difficulties as the upper profile of the Waitemata Group tends to be slightly more clayey than the material at depth. However, once this has been used up, siltier, wetter material is exposed. This material requires drying before it can be adequately compacted. This resulted in contractors discing the cut areas prior to cutting, laying the cut out to be disced and dried, and then discing the material once it was in the fill, before compaction could occur. To add to the difficulties experienced with this material, if it became too dry then air voids within the fill would be above the allowable limits. To get around this problem, as silty, wet material was uncovered in a cut area, another cut area would be opened up so a mixture of clayey and silty materials could be used.

During Stage 3 operations we were informed that part of the Ring Road extension through the site needed to be fast tracked to enable access to the North Shore Stadium, on an adjoining property. This involved mucking out up to 4 metres of mullock and unsuitables and then filling for the road embankment. The final depth of fill was in the vicinity of 18 metres. At the time that work was undertaken on the Ring Road Extension, there was very little clayey material left in the open cut areas. This meant that as filling was progressing rapidly in this small area almost constant supervision of the filling operations was necessary to ensure water contents, air voids and shear strengths were at acceptable levels.

Late in the season part of Stages 1 and 2 was sold for commercial development. To facilitate the completion of these areas in what was becoming very inclement weather the cut area was limed to assist drying prior to placement in the fill.

To check the assumptions made during laboratory testing as to any likely settlements, settlement markers were placed following the completion of filling in Stage 2.

Results showed virtually zero settlement occurred over several months, which appeared to validate our initial assumptions.

4.2 Stage 4.

At present the geotechnical investigation has been undertaken in the Stage 4 area. Earthworks are expected to commence during the 1997/98 earthworks season.

4.3 Western Entry

The site for the Western Entry had in the past had several different owners. Initially the site was used as a timber mill between 1950 and 1978. The owner of the site claimed that no treatment had occurred on the site during his occupation, and from the remaining facilities on site it was assumed that there would be no contaminated material found.

Following its use as a timber mill the site had been used for boat building, pole storage and as a car wreckers. However, following site investigations in this area, large amounts of old, contaminated filling were found. Environmental and Earth Sciences were contracted to undertake a detailed environmental investigation of this area. Several trial pits were excavated under Environmental and Earth Sciences' supervision to ascertain just what exactly had been dumped in this area.

In the top two to four metres, unsuitable filling comprised varying amounts of refuse, steel offcuts, timber, brick rubble, tyres, old batteries, car parts and glass, mixed in with topsoil, clay fill and hardfill. Below this material, large volumes of woodwaste from the timber mill were found.

This waste was tested for a wide range of contaminants and it was found that there were large amounts of chromium, copper and arsenic present. The levels of these contaminants were well above both the New Zealand Environmental Protection Agency and Dutch Guideline cleanup levels.

Obviously this material could not be left where it was, so the waste was excavated and removed to approved disposal sites. This operation had to be conducted under stringent Health and Safety controls. This resulted in all those likely to be involved with the operation being taken through an induction course on the removal and handling of contaminated materials. Any person venturing on site during the works had to first be screened by the clerk of works to ensure they knew of, and abided by the health and safety measures. Each truckload of material taken offsite was logged as the woodwaste was being sent to a contaminated material disposal site, whereas the steel, brick and carparts were being sent to a regular landfill site. Each truckload also had to be covered by a tarpaulin to ensure no material was lost in transit.

Following the removal of all contaminated unsuitable fill material, work began on the actual earthworks for the Western Entry. The development proposals for this area included an 8 metre embankment with a road to be constructed across the top of this. To the east of this embankment a stormwater retention pond was to be constructed. Normal earthworks specifications for filling were not acceptable for this area and contractors were informed that specifications had been changed.

The specifications were changed to allow the fill to be placed slightly wet of optimum so as to prohibit the occurrence of high air voids, which could compromise the integrity of the embankment.

As there was a limited amount of clayey fill material available on site it was decided that the siltier fill was to be placed slightly wet of optimum to allow the material to bind adequately.

Discharging into this stormwater retention pond were several subsoil drains. This discharge, combined with the overflow from the pond was directed into a manhole and then into a pipe running through the dam. To prohibit seepage occurring along the line, the pipe was placed in a trench backfilled with vibrated concrete.

Below the downstream face of the dam, a subsoil drain comprising scoria, novacoils and wrapped in a geotextile cloth was constructed to relieve any uplift pressures likely to occur.

5.0 Parallel Developments

The North Shore of Auckland is a rapidly expanding area with more than 90 subdivisions of various sizes on the North Shore City Council's books last season. Adjacent to the Albany Regional Centre development work is almost complete on the North Shore Stadium. This complex contains a state of the art stadium overlooking a full sized cricket pitch/rugby field surrounded by an athletics track. There is also another cricket pitch behind the main stand.

Across State Highway 1 from the Albany development, work is continuing on construction for the Albany campus of Massey University.

To the east of the site, work will soon be commencing on the extension of the northern motorway. This development is included in the development proposals for the Albany Regional Centre.

6.0 Summary

In conclusion, the Albany Regional Centre is a la development incorporating residential, commercial a industrial uses, and is part of a general increase development of the North Shore. The site is situated differing geological terrain, which led to complexity earthworks supervision and has been a very interesting site be involved with.

Acknowledgements

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