Local Project – Maraenui Hill
SH35 Re-alignment

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Project Manager / Asset Manager
The New Zealand Transport Agency
“Creating Transport Solutions for a thriving New Zealand”
Location of the Project

1. Emergency works
2. Earthworks
3. Soil disposal
4. Last Planner
5. Pavement
6. Route Security

The East Cape
Maraenui Hill
Site History 2004 to 2010

- Two lane highway
- Cut and fill on steeply sloping ocean facing hillside
- Sections of gabion wall, built in 2004, supporting the road on the seaward side
- Highly weathered greywacke bedrock
- Bedrock folded and sheared, closely fractured
Steep terrain
Site History 2004 to 2010

- Movement was initiated by a storm in July 2004 which deposited 590mm of rain in a 24-hour period.

- Situation was worsened by a series of small but significant earthquakes beginning on 18th July 2004 (3.2M almost beneath the site, and 4.9M about 20km from the site).

- Cracking and subsidence seen in 3 distinct areas – highway closed for several weeks.
Site History 2004 to 2010

• Pavement repairs show evidence of movement and settlement long before 2004

• **Remedial works:**
  - Two zones of pavement ripped up and reconstructed
  - Tied back gabion wall 2 to 5m high constructed
Site History 2004 to 2010 continued

October 2006

• Reactivation of movement

• Settlement noted during 2005

• Survey pegs installed and monitored over 30 months

• Borehole drilling undertaken, and inclinometer installed
Collapse of the seaward facing slope
Population Statistics - Te Kaha

Te Kaha area unit

- Number of people: 306
- Median age: 38
- Median personal income: $14,700
- Number of households: 114

View QuickStats
Source: 2006 Census

2010 estimated population: 290
2031 projected population: 280

More on estimates and projections
Population - Cape Runaway block

Cape Runaway area unit
Number of people: 1,374
Median age: 37
Median personal income: $13,800
Number of households: 504

View QuickStats
Source: 2006 Census

2010 estimated population: 1,340
2031 projected population: 1,200

More on estimates and projections

Maraenui
Log track as we found it August
Early cracking closes the road
Cracking worsens!
The slip on the seaward side

Approximate limits of movement 27/8/10

Area with wedge/graben formation movement predominantly down slope

Area with possible translational movement across slope towards gully to east.

Fresh exposed material
Log truck stacking
Re alignment takes shape
Temporary sacrificial seal
Maraenui Hill
SH35 Re-alignment

PERMANENT WORKS PHASE
A contract was awarded January 2011. But work on site didn’t start until March.

<table>
<thead>
<tr>
<th>Description</th>
<th>Key Contract Data</th>
<th>Document Reference</th>
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<tbody>
<tr>
<td>The Contract Works</td>
<td>Upgrading of detour route to highway standard</td>
<td>IFT Section 1.1</td>
</tr>
<tr>
<td>Type of contract</td>
<td>Measure and Value</td>
<td>IFT Section 1.2</td>
</tr>
<tr>
<td>Closing date for tender</td>
<td>3 days prior to tender close</td>
<td>IFT Section 1.6</td>
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<tr>
<td>Site Visit</td>
<td>No appointment needed to visit the site.</td>
<td>IFT Section 1.9</td>
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<tr>
<td>Tenders close</td>
<td>4pm, Tuesday, 16th November, 2010</td>
<td>IFT Section 3</td>
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<tr>
<td>Supplier selection method</td>
<td>Prequalification PQM Simple</td>
<td>IFT Section 6.1</td>
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<tr>
<td>Conditions of Contract</td>
<td>NZS 3910:2003</td>
<td>CC General Conditions</td>
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<tr>
<td>Contract Period</td>
<td>Eighteen (18) Weeks</td>
<td>CC 1st schedule 10.2.1</td>
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<tr>
<td>Liquidated Damages</td>
<td>$500 per calendar day</td>
<td>CC 1st Schedule 10.5.1</td>
</tr>
<tr>
<td>Defect Liability Period</td>
<td>52 Weeks</td>
<td>CC 1st Schedule 11.1.1</td>
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<tr>
<td>Cost fluctuations</td>
<td>Apply after 1 year</td>
<td>CC 1st Schedule 12.8.2</td>
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</table>

18 weeks; I was too optimistic, the project is now in MONTH 18!
Agreed earthworks solution

With GIS surveying undertaken by FH was being fed to the designer who had to always be one step ahead of the excavators:

Initial design concept –

• 50km/hour alignment and geometry
• 7m batters, 2m benches wherever track widening was deemed necessary
• Batters all 60° angled faces.
In April progress came to a halt!

Wet Weather Summary

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Description</th>
<th>MM</th>
<th>Rain affected</th>
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<tbody>
<tr>
<td>Monday</td>
<td>21-Mar-11</td>
<td>Rain</td>
<td>57mm</td>
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<tr>
<td>Tuesday</td>
<td>22-Mar-11</td>
<td>Rain</td>
<td>14mm</td>
<td>1</td>
</tr>
<tr>
<td>Monday</td>
<td>28-Mar-11</td>
<td>Rain</td>
<td>60mm</td>
<td>1</td>
</tr>
<tr>
<td>Monday</td>
<td>4-Apr-11</td>
<td>Rain</td>
<td>91mm</td>
<td>1</td>
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<tr>
<td>Tuesday</td>
<td>5-Apr-11</td>
<td>Showers</td>
<td>27mm</td>
<td>1</td>
</tr>
<tr>
<td>Wednesday</td>
<td>6-Apr-11</td>
<td>Cloudy</td>
<td>5mm</td>
<td>1</td>
</tr>
<tr>
<td>Saturday</td>
<td>16-Apr-11</td>
<td>Showers</td>
<td>15mm</td>
<td>1</td>
</tr>
<tr>
<td>Monday</td>
<td>18-Apr-11</td>
<td>Rain</td>
<td>9mm</td>
<td>1</td>
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<td>Tuesday</td>
<td>26-Apr-11</td>
<td>Rain</td>
<td>80mm</td>
<td>1</td>
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<td>Wednesday</td>
<td>27-Apr-11</td>
<td>Rain</td>
<td>170mm</td>
<td>1</td>
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<tr>
<td>Thursday</td>
<td>28-Apr-11</td>
<td>Rain</td>
<td>1mm</td>
<td>1</td>
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</table>

Cumulative Rain Affected Total: 529 mm

Rain affected: 11
Slip on the new alignment
Hold point – Risks assessed

**Option 1** - No change from current plan

**Option 2** - Change cut slope profile and use *wider* working platforms

**Option 3** - Move new alignment minimum for zero new cutting, minor 50kph non standard design issues

**Option 4** - Move new alignment for zero cutting maintaining 50kph design standards
Option 2 & revised cut batter profiles

5m wide minimum

Wide lower benches
Cuts 1 and 2 completed before July
MSE wall location

Top of the major slip

Large slip failure May 2011

The old alignment

MSE Wall
MSE wall construction

June 2011
The MSE wall in construction

July 2011
The Completed MSE Wall

August 2011
SH35 Maraenui Hill Re-alignment

Top of the major slip is just visible
Cut 6 – The Hairpin

Now redundant
Creating the benches
Track for Cuts 3, 4 and 5

Track begins

Track for excavators
The access track in use
Completed benches
Disposal sites

Two Beach Area Dumpsites – combined capacity = 100,000cu.m

Maraenui 153 Block capacity = 40,000cu.m

Whituare dumpsite, Abandoned

Re-alignment work

Hawai Dumpsite - capacity of 80,000cu.m
The Area 2 cleanfill site.
Beach disposal sites

The two disposal sites

AREA 1

AREA 2
Protective bunds
Environmental Management

The decanting structure and settlement pond
Silt capture and removal
Silt Traps
A culvert with sock flume
# Last Planner Meetings

## Combination Production Plan (1 Week + 3 Week Lookahead)

### Requirements From Others

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Action</th>
<th>Required by</th>
<th>When will the work be done?</th>
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<tbody>
<tr>
<td>Milestone Date 2 July</td>
<td></td>
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<tr>
<td>Cut Out</td>
<td>Paul</td>
<td></td>
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<tr>
<td>Cut to Waste (4500mH)</td>
<td>Let</td>
<td></td>
<td></td>
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<tr>
<td>Entrance of cut batters</td>
<td>Steve</td>
<td></td>
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<tr>
<td>Site inspection of cut batters</td>
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<td></td>
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<tr>
<td>NTC for Batter approval to F4</td>
<td>Paul</td>
<td></td>
<td></td>
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<tr>
<td>Update Program</td>
<td>Mark</td>
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### Hawaii Fill sites

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Action</th>
<th>Responsible</th>
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</thead>
<tbody>
<tr>
<td>Cut to site</td>
<td>Let</td>
<td></td>
</tr>
<tr>
<td>NTC re-arranging road and drainage controls</td>
<td>Paul</td>
<td></td>
</tr>
</tbody>
</table>

### Revised cost forecast

<table>
<thead>
<tr>
<th>Action</th>
<th>Responsible</th>
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<tbody>
<tr>
<td>Paul</td>
<td></td>
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</table>

### Key Milestones

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Task Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Cut 34 Earthworks</td>
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</tbody>
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### Milestone Dates

- Completion Date Full Project: 31-Aug-12
- Completion Date Excluding Cut 5: 22-Aug-12
- Stakeholder Comments Date: 12-Oct-12

**Note:**
- Late or defective materials
- 1. Necessary items not in place
- Interface with other packages
- Job-related activity not recognised by shop party
- Change in priority requested by client or GM
- Lack of human resources
- Plant

**Legend:**

**PPC:** 67% PPC exceeds deliverables

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Last Planner Meetings
Lean Construction is currently used in:-

- Germany,
- UK
- Denmark (the longest running)
- Sweden
- Brazil
- Chile
- Peru
- Taiwan
- Malaysia
- India
- Egypt, Israel, and Nigeria
The abandoned alignment May 2011
The abandoned alignment Jan 2012
The hairpin bend - Jan 2012
Recent aerial photos from July 2012
Cuts 1, 2, 3 and 4 July 2012
Cuts 9 and 8
Two kilometers to the east
State Highway just east of Maraenui Hill

Numerous small drop outs along the coastal section.

Chris Stones farm drop out.
SH2 Waioeka Gorge - Initial slip 3rd March 2012
SH2 Waioeka Gorge slip 2012
Any [reasonable] questions [related to this slide show]?