Kaituna Cut Surf Break Investigation

Preliminary Assessment
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# CONTENTS

1 Executive Summary ........................................................................................................ 1

2 Introduction ....................................................................................................................... 1
   2.1 Overview of Kaituna Cut and nearby Surf Breaks ...................................................... 1
   2.2 Background and Objective of Study ........................................................................... 4
   2.3 Overview of Assessment Methodology ....................................................................... 4

3 Overview of Key Surf Principles and Important Parameters for Surf Quality Assessment......................................................................................................................... 6
   3.1Wave Height ................................................................................................................. 6
   3.2Wave Breaking Intensity and Pealing Velocity ............................................................. 6
   3.3Length of Wave Ride ................................................................................................. 8
   3.4Wind Speed and Direction ....................................................................................... 9
   3.5Reoccurrence Frequency ......................................................................................... 9
   3.6Surfer Skill Level ..................................................................................................... 9

4 Coastal Processes in Vicinity of Kaituna Cut.................................................................10
   4.1Near-shore Wave Climate .........................................................................................10
   4.2River Mouth Dynamics ....................................................................................... 15
   4.3Wind and Tide Conditions .................................................................................. 16
   4.4River Flows ......................................................................................................... 17

5 Quantitative Analysis of Kaituna Cut and Two Comparison Surf Breaks ....................19
   5.1Predicted Swell Frequency and Occurrence of Surfable Waves ............................... 19
   5.2Predicted Type of Breaking Wave ............................................................................ 26
   5.3Inferred Ride Length and Pealing Angle .................................................................. 29
   5.4Summary of Quantitative Analysis of Surf Breaks .................................................. 29

6 Discussion of Anecdotal Observations of Quality of Surf Break .................................31
   6.1Description of Surf Break from Surfing Community ................................................. 31
   6.2Typical Skill Level Required for Break .................................................................... 32
   6.3Size of Surfing Community for Break ...................................................................... 32

7 Conclusion ....................................................................................................................... 34

8 Recommendations for Future Work ............................................................................. 35

9 References ....................................................................................................................... 36
1 Executive Summary

The Kaituna Cut surf break has been identified by BoPRC as a surf break of regional significance in its proposed Regional Coastal Environment Plan. The inclusion of the Kaituna Cut as a break of regional significance is currently being challenged by Te Tumu Land Owners Group as they feel its significance has been unsubstantiated.

DHI have undertaken a preliminary quantitative assessment of the Kaituna Cut surf break, which indicates the potential for a barrelling powerful wave attractive to expert level surfers. The study suggests that the break does not work as often compared to other nearby breaks, due to in particular less frequent suitable wave conditions. However based on the preliminary study presented in this report, it is at this stage found to be plausible that the significance of the surf spot is comparable to that of nearby surf spots and shows the potential to, on occasion, provide high quality surf waves potentially superior to other nearby breaks.

As a result, but subject to further confirmation in subsequent detailed studies, DHI concludes that Kaituna Cut has the potential to be considered a regional significant surf spot as suggested in Perryman (2011).
2 Introduction

The section provides an overview of the location and characteristics of the Kaituna Cut surf break; presents the background and objectives of the study; and the methodology for the preliminary assessment undertaken.

2.1 Overview of Kaituna Cut and nearby Surf Breaks

The Kaituna Cut surf break in the Western Bay of Plenty is located close to the town of Maketū approximately 40 km from Tauranga (see Figure 2-1). The surf break is a sandy river mouth break situated at the mouth of the Kaituna River, named Te Tumu Cut (Figure 2-2). Historically the Kaituna River used to enter Maketū Estuary, and entered the sea via the estuary entrance. There would periodically be breakouts of the river along the stretch of coastline between Te Tumu Cut and Maketū, which would in time close up, illustrating the dynamic nature of this coastline. In 1956, the Te Tumu Cut was permanently established with the aim of reducing flood risk within the Kaituna River drainage catchment and has remained open since this time.

The surf break at Kaituna Cut is located on the ebb tide delta (or bars) offshore the river mouth and has been reported to offer both right-breaking and left-breaking waves. Examples of the left-hand breaking or right-hand breaking waves at Kaituna Cut are presented in Figure 2-3 and Figure 2-4. The beach breaks adjacent to the river mouth have not been investigated as a part of this assessment.

The surf break is reasonably easy to access, since there is a road directly to the river mouth and plenty of parking on site.
Figure 2-2  Te Tumu Cut, location of Kaituna Cut Surf Break. Source Google Earth.

Figure 2-3  Right-hand breaking wave at Kaituna Cut. Source: Morgyn Bramley
Other surf breaks of note within the area (shown in Figure 2-5) are the following:

- Papamoa Beach - A sandy beach with a large number of variable beach breaks, 30 km to west of Kaituna Cut.
- Maketū Estuary entrance - A right-hand river mouth break and a right-hand reef break.
- Newdicks Beach – A sandy/rocky beach with a number of breaks.
- Little Waihi - A left-hand river mouth break.
- Pukehina Beach – A sandy beach with number of variable beach breaks.
2.2 Background and Objective of Study

Kaituna Cut has been identified by BoPRC as a surf break of regional significance in its proposed Regional Coastal Environment Plan, based on a report by Bailey Peryman (2011). The report provides an identification of significant surf breaks and development of associated evaluation criteria in the Bay of Plenty region.

Te Tumu Land Owners Group are challenging the inclusion of the Kaituna Cut as a break of regional significance as they feel its significance has been unsubstantiated in the Peryman report.

As a consequence of this challenge, BoPRC have commissioned DHI to undertake a preliminary assessment to confirm or question the findings of the Peryman report i.e. the identification of the Kaituna Cut Surf Break as having regional significance.

2.3 Overview of Assessment Methodology

This preliminary assessment consisted of the following:

- A brief overview of key surf principles and important parameters for assessing surfing quality.
- The coastal processes in the vicinity of Kaituna Cut i.e. the wave climate, winds, tides and morphological processes, which govern the quality of surf.
- A quantitative analysis of potential surf amenity of the Kaituna Cut break along with two nearby comparison locations. This included an assessment of the potential for good and exceptionally good surf conditions based on hindcast nearshore wave data and bathymetry.
Discussion of anecdotal observations of the surf break and how this compares with the quantitative analysis. The anecdotal observations were obtained from surf guide books, previous studies, available photos and surf community engagement.

It should be noted that the scope of the study covers a preliminary assessment only and does not include a detailed evaluation of surf quality at the site. This would require a detailed study of the break, which would typically include a high resolution wave model to simulate wave breaking for a range of conditions and using a program like OPTISURF to calculate key surfing parameters (i.e. length of ride and number of surfable waves etc) from the calculated wave field.

The following resources have been utilised for this study:

- **Spot X Surfing NZ** – another book providing individual break maps and overviews for hundreds of surf breaks around New Zealand.
- **Bailey Peryman Bay of Plenty Surf Break Study Report** – this report identifies significant surf breaks in the Bay of Plenty region.
- **Morgyn Bramley** – local surfer and member of Maketū Board Riders Club.
- **DHI Kaituna River Re-diversion and Ongotoro/ Maketū Estuary Enhancement Project Report** – Detailed modelling study to inform Assessment of Environmental Effects for partially re-diverting Kaituna River to Maketū Estuary. This included a long term wave hindcast time series and bathymetry data collected specifically for the study.
3 Overview of Key Surf Principles and Important Parameters for Surf Quality Assessment

This section provides a brief overview of some of the key surf principles and important parameters, which is most commonly used to determine the quality of a surf break. The following parameters are discussed:

- Wave height;
- Wave breaking intensity and pealing velocity;
- Length of wave ride;
- Wind speed and wind direction;
- Reoccurrence frequency; and
- Surfer skill level.

3.1 Wave Height

The wave height is one of the most important elements determining the level of surfing quality. The wave height also governs the minimum threshold for when a surf break can be considered surfable (depending to some degree on the surf craft used).

A large wave height increases the speed and level of excitement experienced during a wave ride for a surfer, but also generally makes the wave more challenging and potentially dangerous. Most surfers prefer a wave as large as possible up to the limit of their comfort zone governed by their skill level. As a rule of thumb, an intermediate surfer with a few years’ experience may be comfortable with waves up to 1.5 – 2.5 meters. Expert surfers would generally be comfortable in waves exceeding 4 m. Large waves are mostly only surfed by expert surfers, but often draw large spectator crowds if the surf break is not too far offshore.

3.2 Wave Breaking Intensity and Pealing Velocity

For surfing purposes, the wave breaking intensity type is a measure for the behaviour of the overturning/collapsing motion occurring during wave breaking. The wave breaker type is governed by the ratio between the wave height, wave period and the local bed gradient, which is called the Iribarren number (see Section 5.2 for formula).

For large wave height to wave period ratios and for mild bed slopes, wave breaking will occur as spilling breakers. Spilling breakers are the least energetic type of wave breaking, where the upper part of the wave crest collapses on itself and forms a roller of turbulent white water travelling the wave celerity. For smaller wave height to wave period ratios and for steeper bed slopes, the wave breaker type becomes a plunging. For plunging wave breakers, the wave crest reaches a greater steepness than spilling breakers before collapsing as an overturning “plunging” jet. In some instances, the overturning motion occurs so violently that the plunging jet forms a tubular shape (called a barrel) with the unbroken wave crest, in which an experienced surfer can position himself during his wave ride. The two types of wave breaker types have been illustrated in Figure 3-1.
A surfable wave requires the front part of the wave crest (wave face) to exceed critical steepness allowing the gravity component to become large enough for the surfboard to plane on the inclined free surface of the unbroken wave crest. Critical steepness is only obtained shortly before the occurrence of wave breaking. As a result, the transverse breaking pattern of a wave is required to be successive (either left to right or right to left) in order for it to be surfable.

Looking at the surf from the shore, a left to right breaking wave is called a left-hand wave and a right to left breaking wave is called a right-hand breaking wave. The transition zone between broken and unbroken wave is in surfing terminology called “the pocket”, which is the zone that the surfer must position himself in order to sustain his wave ride.

The successive breaking pattern of a surfable wave is called “wave pealing” in surfing terminology and its progression causes the pocket to continuously move away from the initial point of wave breaking initiation. The principle is illustrated in Figure 3-2. The speed of which it moves is referred to as the “pealing velocity”, $V_p$, and corresponds to the minimum average speed, $V_s$, that the surfer needs to sustain in order to avoid being outrun by the wave. The minimum critical wave steepness and the maximum surf speed are depending the surfer’s skill level.

The combination of wave breaking intensity and pealing velocity are governing parameters for both the maximum length and duration of each wave ride and the level of excitement experienced during a wave ride.
In the absence of information around pealing velocity, the peal angle can be used to infer the speed that a surfer needs to travel along a wave to stay in the pocket of the breaking wave (Hutt et al., 2001). The peal angle is the angle between the broken part of the wave as it travels towards shore and the path of the pocket of the unbroken wave as it travels towards the shore (see Figure 3-3). Typically a peal angle of greater than 70° is suitable for learners, while intermediate surfers have the ability to ride waves with appeal angle up to approximately 40°. Pealing angles of 30° are considered only suitable for very experienced surfers with peal angles below 27° approaching a close out (where the wave breaks and there is no longer a wave face to surf) and only rideable by the very best and experienced surfers (Hutt et al., 2001). Surfer skill level is discussed in further detail in Section 3.6.

3.3 Length of Wave Ride

The maximum wave ride length is determined by the distance where successive breaking (pealing) occurs and is also limited by the maximum speed that the surfer can maintain during the ride. The wave ride length is directly proportional to the duration the surfer can ride the wave and perform maneuverers. Surf spots offering long wave rides almost always contribute to a high surfing quality and is considered world class when combined with large wave heights and large breaking intensity.

The preferential weighting between each component is subjective for surfer to surfer. Some surfers will prefer a short ride on a large and intensively breaking wave, while others prefer a longer wave ride, even if the wave height is smaller and is breaking with less intensity.
3.4 Wind Speed and Direction

Surfers typically obtain the best surfing conditions during light winds from land, which prevent locally-generated wind-waves in favour of the longer period swell. These types of waves break with greater intensity, typically offer the longest rides, and are easier and more predictable to surf. Surfing can also occur in strong winds from seaward directions, but usually at the expense of significantly deteriorated and less predictable conditions.

3.5 Reoccurrence Frequency

When considering the importance of a surf break to the surfing community, the reoccurrence frequency of surfable conditions should be considered. When defining surfable conditions, it is necessary to distinguish between the reoccurrence of what satisfies the minimum requirements for being considered a surfable event, and what is considered a good surf event or an exceptionally good surf event.

The overall frequency of surfable days governs how often resident surfers and visiting surf tourists can perform their sport. As with most other active sports athletes, most surfers prefer to be able to go surfing at least 1-2 times per week on average, which also corresponds to at least a couple of guaranteed surf sessions during a typical 1-2 week surfing holiday.

A larger proportion of good surf conditions increase a surf spot's attractiveness in particular to more experienced surfers. It also makes the area more attractive to surf tourists. Exceptional surf conditions are usually considered rare and highly treasured events for most surf spots around the world. A regular occurrence of exceptional surf conditions can make a local area highly attractive place to live to active surfers and their families as well as a popular holiday destination for visiting surfers from all over the world.

There are some surf breaks around the world that although breaking inconsistently, are still considered significant surf breaks to their community. Good examples are Kirra (Gold Coast, Australia) and Waimea Bay (North Shore, Hawaii).

Consistent surf spots that are typically only suitable for learners are also often highly valued by the surfing community. These are seen a nursery breaks, where a surfer can learn the basics of surfing without putting themselves or others at risk.

3.6 Surfer Skill Level

It is also important to consider surfer skill level requirements when assessing a surf break. These can typically be categorised into the following three levels:

- Learner;
- Intermediate;
- Expert.

The main parameters that can be used to determine the skill level required to ride a wave are wave height and wave pealing velocity (or wave peal angle). The skill level refers not only to the surfer’s abilities while surfing a wave (i.e. a learner surfer maybe able to successfully ride laterally along the crest of a wave while an intermediate surfer is able to execute standard manoeuvres on a single wave) but the ability of the surfer to deal with potentially dangerous situations such as strong tidal or rip currents.
4 Coastal Processes in Vicinity of Kaituna Cut

This section provides an overview of the key coastal processes at the site, which govern the surfing quality in vicinity of Kaituna Cut.

4.1 Near-shore Wave Climate

The bathymetry in vicinity of Kaituna Cut has significant complexity due to a number of offshore islands (Motiti Island, Motunau Island and Motuhaku Island) and Okurei Point (see Figure 4-1). This plays a major role in the wave climate for the area of interest.

Figure 4-1   Bathymetry for area of interest. Source LINZ Chart NZ542.
For the Kaituna River Re-diversion and Ongotoro/ Maketū Estuary Enhancement Project (DHI, 2014) a wave model for the Bay of Plenty region was created and a 10 year hindcast of wave climate was generated. Wave time series were extracted along the Maketū coastline at the 15 m depth contour from the Regional Bay of Plenty wave model. Wave roses of this data are presented in Figure 4-2. It is apparent that Motiti Island and the other offshore islands have a sheltering effect on wave climate for waves from north westerly to north easterly directions. Further evidence of this sheltering effect is the salient to the west of Maketū and shallower depth values inshore of Motiti Island.

At the study site, there will also be a sheltering of waves from a north easterly direction due to Okurei Point with the most sheltering occurring at Maketū Estuary mouth.

To investigate the seasonal wave climate for the study site, monthly wave roses from the ten year wave time series off Okurei Point were generated. The monthly wave roses are presented in Figure 4-3 and Figure 4-4. From December to April the dominant wave direction is from the north east and is most likely dominated by swell generated waves (which has a greater wave period and better quality surf). From May to November, wind generated waves (smaller wave period and lesser quality surf) are more apparent and wave directions range from north westerly to north easterly directions. It can be concluded that the optimal swell conditions are likely to occur at Kaituna Cut for the months of December to April.

The influence of the complicated bathymetry for this area on the wave climate and the sheltering effect of Okurei Point is presented in Figure 4-5. This is the output from a local wave model (DHI, 2014) of the site for a significant wave event that occurred 16th April 2013. During this event there were significant wave heights greater than 3.5 m measured off Okurei Point. The wave heights to the east of Okurei Point along Pukehina Beach were significantly greater than to the west of Okurei Point.
Figure 4.2  Wave climate for 2000 – 2010 at 15m depth contour for Maketu coastline.
Figure 4-3 Monthly significant wave heights (Hs) from 15 m contour off Okurei Point (January to June).
Figure 4-4  Monthly significant wave heights (Hs) from 15 m contour off Okurei Point (July to December).
Figure 4-5  Predicted significant wave height field during peak of high energy wave event on 16th April 2013.

4.2 River Mouth Dynamics

River mouths are very dynamic in nature and are in a continually changing state controlled by complex current, wave and sediment transport dynamics. Littoral transport of sediment due to wave driven currents tend to close up the river mouth, with tidal flushing and river flows tending to scour the mouth open. Sediment transported to the mouth by coastal littoral transport and flushed seaward by ebb tide currents and river flows are deposited onto ebb tide bars (also called the ebb tide delta). It is on these bars that the surf break occurs. The state and alignment of these bars to the incoming wave direction determines the quality of the surf along with the swell and wind conditions.

An example of the dynamic nature of the river mouth is presented in Figure 4-6. Discovery Marine Limited (DML) undertook bathymetry surveys before and after a significant flow in the Kaituna River, with peak river flows of approximately 100 m$^3$/s. Before this period there had been a sustained period of low flow conditions. After the elevated river flows, the river mouth had widened and significant deepening occurred across the entrance.
4.3 Wind and Tide Conditions

As is typical with most surf breaks, it can be expected that Kaituna Cut requires calm or offshore wind conditions to produce the best surf conditions. The wind rose for wind data from Tauranga Airport for the period 2000 to 2010 is presented in Figure 4-7. Although this is 20 km from the surf break and there will be some local topographic effects, this provides a good overview of typical wind conditions for Western Bay of Plenty. The wind data indicates plenty of periods when winds are either offshore or very light (i.e. less than 5 m/s).
The river mouth is prone to strong tidal currents. The river mouth has typical current patterns for an ebb tide delta, where the ebb highest currents (in order of 1 m/s) are normally focused over a smaller area, while the highest flood tide currents (less than 0.5 m/s) are distributed across a larger area of the ebb delta. This is illustrated in Figure 4-8, which presents predicted peak ebb and flood tide currents for Te Tumu Cut from a calibrated hydrodynamic model (DHI, 2014).

### 4.4 River Flows

Since the break occurs at the mouth of the Kaituna River, surfing will either be compromised or not possible during periods of elevated flows for the river.
Figure 4-8  Predicted peak ebb (top) and flood (bottom) tide currents for Te Tumu Cut (DHI, 2014).
5 Quantitative Analysis of Kaituna Cut and Two Comparison Surf Breaks

This section provides a quantitative analysis of the Kaituna Cut break along with two other local comparison locations, Little Waihi and Pukehina Beach. This assessment included:

- The potential for good and exceptionally good surf conditions based on hindcast wave data;
- Potential wave breaking intensity; and
- Potential ride length and wave pealing angle.

5.1 Predicted Swell Frequency and Occurrence of Surfable Waves

In order to provide a realistic quantification of the frequency and distribution of surfable events, a predicted wave data time series was extracted from a wave model for the Bay of Plenty region (see Section 4.1) from the 15 m depth contour at three locations:

- offshore of Kaituna Cut;
- offshore of Little Waihi; and
- offshore of Pukehina Beach.

Little Waihi has been included in the analysis as a comparison surf spot, since it is also a river mouth break which is highly valued by the surfing community (Peryman, 2011), while Pukehina Beach has been included for a comparison against a beach break location.

The $H_{10}$ wave height has been used for any analysis, which is equivalent to the average height of the top 10% of wave heights. Wave roses of the extracted data are presented in Figure 5-1. Wave height ($H_{10}$) exceedance plots are provided for each of the wave data time series in Figure 5-2. The plots show that for wave heights larger than 1.0 m, the predominant wave direction for Kaituna Cut and Pukehina Beach is 20 to 40°, while for Little Waihi it is 30 to 50°. Pukehina Beach and Little Waihi are more exposed to a higher energy wave climate than Kaituna Cut.
Figure 5-1 Wave roses of extracted wave data at 15 m depth contour offshore of Kaituna Cut (top) and Little Waihi (middle) and Pukehina (bottom).
The time series were analysed with surf criteria established to provide the lower bounds of when surfing was expected to be good or very good.

This analysis only assesses when the offshore swell and wind conditions will be ideal for surfing and does not consider the transformation of the waves as they propagate further into the surf zone, which can have a significant impact on the incoming waves for this area (see Figure 4-5). It also doesn't consider the state of the river mouth bars, tide or river flows, which also play an important role in the quality of the surf. It should be considered a conservative upper limit for the potential for quality surf at each location.

There is no wind data close to the surf breaks, instead wind data from Tauranga Airport was used a substitute.

In addition it was set as requirement that surfing events could only occur during daytime hours and during episodes of offshore wind or light onshore wind. A minimum of two consecutive hours of sustained conditions was set as a requirement of a day to be justified to contain a surf event. An overview of the surf criteria requirements are given below.

**Minimum Surf Criteria (Good Conditions)**

- Minimum $H_{10}$ Wave Height ($H_{10}$) of 1.0 meter,
- Minimum Spectral Peak Period ($T_p$) of 10 seconds,
- The wind direction must originate from close to the South (110 to 290°) for Kaituna Cut or South East (140 to 320°) for Little Waihi and Pukehina Beach or wind speed must be less than 6 m/s,
- The event must last for at least 2 hours, and
• Occur during average daylight hours between 6 am and 6 pm.

In addition an increasingly stringent surf criterion was defined to provide a rough estimate of the distribution of surfing days were conditions were expected to be very good to excellent.

**Optimum Surf Criteria (Exceptionally Good Conditions)**

• Minimum Wave Height ($H_{10}$) of 1.8 meter,

• Minimum Spectral Peak Period (Tp) of 10 seconds,

• The wind direction must originate from close to the South (110 to 290°) for Kaituna Cut or South East (140 to 320°) for Little Waihi and Pukehina Beach or wind speed must be less than 6 m/s,

• The event must last for at least 2 hours, and

• Occur during average daylight hours between 6 am and 6 pm.

Wave conditions outside of this surf envelope generally consist of primarily of periods of strong onshore winds or small wind waves. Surfing is expected to be possible outside of the envelope, but is not expected to represent quality conditions.

The analysis indicated the following for Kaituna Cut (summarised in Figure 5-3):

A total of 10 years (3653 days) was included in the suitability assessment. A total of 510 (14.0%) of these days provided conditions fulfilling the minimum surf criteria which corresponds to approximately 4 days per month. Exceptionally good surf conditions occurred for 32 days (0.9% of the time) or approximately 3 days per year.

If this is further analysed for the December to April period only, when swell generated waves (and therefore higher quality surf) is most likely, a total of 424 (28.2%) of 1503 days provided conditions fulfilling the minimum surf criteria which corresponds to approximately 8 days per month. Exceptionally good surf conditions occurred for 23 days (1.5% of the time) or approximately 1 day every two months.

The analysis indicated the following for Little Waihi (summarised in Figure 5-4):

A total of 942 days (25.8%) over ten years provided conditions fulfilling the minimum surf criteria which corresponds to approximately 7 to 8 days per month. Exceptionally surf conditions occurred for 70 days (2.2% of the time) or approximately 7 days per year.

For the December to April period only, a total of 713 (47.4%) of 1503 days provided conditions fulfilling the minimum surf criteria which corresponds to approximately 14 days per month. Exceptionally good surf conditions occurred for 54 days (3.6% of the time) or approximately 1 day per month.

The analysis indicated the following for Pukehina Beach (summarised in Figure 5-5):

A total of 1018 days (27.9%) over 10 years provided conditions fulfilling the minimum surf criteria which corresponds to approximately 7 to 8 days per month. Exceptionally good surf conditions occurred for 82 days (2.2% of the time) or approximately 8 days per year.

For the December to April period only, a total of 750 (49.9%) of 1503 days provided conditions fulfilling the minimum surf criteria which corresponds to approximately 15 days per month. Exceptionally good surf conditions occurred for 62 days (4.1% of the time) or approximately 1 day per month.
Figure 5-3  Distribution of surf criteria analysis for Kaituna Cut for all year round (top) and only December to April (bottom).
Figure 5-4  Distribution of surf criteria analysis for Little Waihi for all year round (top) and only December to April (bottom).
Figure 5-5  Distribution of surf criteria analysis for Pukehina Beach for all year round (top) and only December to April (bottom).
5.2 Predicted Type of Breaking Wave

To assess the type of breaking wave that may occur at the two surf breaks, an assessment has been undertaken to determine the Iribarren number for a range of swell conditions at each of the surf breaks.

The Iribarren number ($N_i$) is a parameter that is often used for describing wave behaviour.

\[
N_i = \frac{\tan \beta}{\sqrt{\frac{H}{L_o}}}
\]

Where $\beta$ = is the slope angle;
$H$ = wave height at toe of slope;
$L_o$ = wave length

Typically for plunging breaking waves, which are good for surf, $0.4 < N_i < 2.3$ (Battjes, 1974). A higher Iribarren number theoretically corresponds with a more powerful wave.

To assess the bed slope angle for the three surf spots, available bathymetry data was analysed for each location. For Kaituna Cut, the best bathymetry data source which resolved the bars at the break was the DML survey (DHI, 2014), while for Little Waihi and Pukehina Beach it was LiDAR data (DHI, 2014). The bathymetry data is shown in Figure 5-6, Figure 5-7 and Figure 5-8.

The predominant wave direction was assessed from the wave roses for each location and is indicated on the figures. Bathymetry transects were then extracted along these lines to obtain an estimate of the bed slope for these locations. The profiles from these extracted bathymetry transects are presented in Figure 5-9.

![Figure 5-6 DML Bathymetry Survey at Kaituna Cut Surf Break. Depths in Moturiki Datum.](image)
Figure 5-7  LiDAR Bathymetry Survey at Little Waihi Surf Break. Depths in Moturiki Datum.

Mean Wave Direction = 40°

Figure 5-8  LiDAR Bathymetry Survey at Pukehina Beach. Depths in Moturiki Datum.

Mean Wave Direction = 30°
Figure 5-9  Beach profile data extracted from lines indicated in bathymetry surveys in Figure 5-6 to Figure 5-8. Depths in Moturiki Datum.

The approximate beach slope from the -1.0 m to -5.0 m contours at Kaituna Cut is 1:30, Little Waihi it is 1:55, and Pukehina Beach is 1:70.

The calculated Iribarren number for the three locations for a range of combinations of wave height and wave period are presented in Table 5-1. The Iribarren number for Kaituna Cut is higher than Little Waihi and Pukehina Beach which would indicate a more powerful wave for this location, although on occasion collapsing breakers maybe produced instead of plunging breaking waves.

**Table 5-1**  Calculated Iribarren number for Kaituna Cut, Little Waihi and Pukehina Beach for a range of combinations of wave height and wave period.

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<th>Wave Period (s)</th>
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<td></td>
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</tr>
<tr>
<td></td>
<td>2.0</td>
<td>1.48</td>
</tr>
<tr>
<td>Little Waihi</td>
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<td>1.14</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>0.93</td>
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5.3 Inferred Ride Length and Pealing Angle

The take-off locations for catching the wave depend on the shape and size of the ebb tide delta and the swell conditions. The potential length of ride for a location can be inferred by assessing bar sections that are at 30 to 60° to the incoming wave direction. This pealing angle can also be used to infer the skill level required for riding the wave (see Section 3.2). Once the pealing angle is less than 30°, the wave becomes very challenging to ride.

This analysis has only been undertaken for the bathymetry at one instance in time, which is appropriate to provide insight for a preliminary assessment, however a detailed assessment of the surf quality of the break would require analysis for different states of the dynamic river mouth bars.

Pukehina Beach has not been included in this part of the analysis since the surf along this stretch of coast will be very dependent on the location and state of the bars. There will be many locations along the beach with surfable waves, hence assessing the bathymetry at one location may not provide an assessment representative of the surf along the beach. Typically beach breaks have smaller ride lengths than river mouth breaks. The state of the bar will also determine the pealing angle and likely skill level required to ride the wave.

The assumed track of the breaking part of the wave (the pocket) has been indicated for Kaituna Cut (Figure 5-10) and Little Waihi (Figure 5-11), along with the mean wave direction +/- 10° (based on the predicted wave climate). The Kaituna Cut bathymetry indicates the potential for a left and right hander, while for Little Waihi although there is the potential for a right-hand breaking wave, the left-hand wave would most likely be the higher quality wave. Therefore the left-hand wave is the only potential breaking wave assessed for this break.

With the bar states indicated by the bathymetry, ride lengths of 50 to 100 m appear possible for both the left and right waves at Kaituna Cut, while for Little Waihi there is potential for ride lengths between 50 to 250 m.

The pealing angle of the left-hand breaking wave at Kaituna Cut, assuming a wave direction between 20 to 40°, is between approximately 20 to 40°, which is at a minimum only suitable for experts and on occasion will be not be surfable. This type of peal angle suggests a fast critical take, which does not allow much room for error when trying to catch the wave. However for a more northerly the swell, the potential for a surfable wave for the left-hand breaking wave would increase. The pealing angle of the right-hand breaking wave at Kaituna Cut, assuming a wave direction between 20 to 40°, is between approximately 30 to 50°, considered suitable for intermediate to expert level surfers, depending on the wave direction.

At Little Waihi assuming a wave direction of 30 to 50° the predicted pealing angle is between 30 to 50°, which is considered most suitable for intermediate to expert level surfers, depending on the wave direction.

5.4 Summary of Quantitative Analysis of Surf Breaks

The quantitative analysis indicates that Kaituna Cut has less consistent swell compared with Pukehina Beach and Little Waihi. The analysis predicts that ride length is less than Little Waihi, however the break has the potential for a more powerful barrel if the wind, tide and bar conditions are suitable. This type of wave is most often extremely desirable for expert level surfers.
Figure 5-10  DML Bathymetry Survey at Kaituna Cut Surf Break

Figure 5-11  LiDAR Bathymetry Survey at Little Waihi Surf Break
6 Discussion of Anecdotal Observations of Quality of Surf Break

6.1 Description of Surf Break from Surfing Community

The NZ Surfing Guide (Greenroom Surf Media Ltd, 2004) states that the Kaituna Cut is a fickle spot which can produce very hollow waves, but a strong southerly wind is required for epic (optimal) conditions. The book indicates the break is good with north, north-east and easterly swells and breaks best on low to mid tide.

Spot X Surfing NZ (Spot X publications, 2009) states that the break offers good tubes and plenty of grunt (power) but again refers to the spot being fickle due to the tidal currents and sand movement.

Morgyn Bramley, a local that regularly surfs at the break suggests that the right is probably the most common wave with a good left on the more northerly swells. Swell and wind conditions with the state of the sand bars are the most significant factors which determine the quality of the surf. When the surf is of high quality, there is typically a barrel with a steep and fast take off.

The predicted wave climate for the sit indicates easterly and northerly swell with an $H_{10}$ greater than 1 m would be infrequent for Kaituna Cut and it is the north easterly swell which will most frequently produce surf at the break. The quantitative analysis and understanding of the dynamics of the river bars, supports the assessment of the site as not very consistent. It is exposed to less swell than sites to the east around Okurei Point and when there is swell, the dynamic nature of bars may mean that the bar alignments do not promote good surf quality.

The observation of Morgyn Bramley that the right-hand wave is the most commonly surfed, while the left-hand break is better on more northerly swells, is supported by the analysis of the bar alignment corresponding to the typical wave direction and the associated wave pealing angles (see Section 5.3).

The suggestion that the best quality waves at Kaituna Cut are produced by favourable swell conditions coinciding with a strong southerly (hence offshore) wind seems reasonable. Figure 6-1 shows a hollow barrelling wave with the spray from top of the wave indicating a strong offshore wind.

Both the NZ Surfing Guide and Spot X Surfing NZ suggest that low to mid incoming tide is most optimal for surfing conditions. Observations from Morgyn Bramley, suggests that the state of the tide is not as restrictive as the books indicate. He observes that on the outgoing tide, surfers normally sit to east or west of the main flow. While on the incoming tide more paddling against current is required due to water propagating up the river. This is consistent with the predicted current patterns for the ebb tide delta (see Section 4.3), where the ebb highest currents are normally focused over a smaller area (of which surfers may sit to left and right of) while the highest flood tide currents are distributed across a larger area of the ebb tide delta.
6.2 Typical Skill Level Required for Break

A number of sources (NZ Surfing Guide and Spot X Surfing NZ, Morgyn Bramley) state that the break is suitable for experts only. This is mostly due to the barrelling powerful wave that is created on occasion.

Other hazards for the break are likely to be strong tidal currents, (which is supported by predicted tidal currents at entrance (see Section 4.3)), elevated river flows and since the spot is popular for fishing, entanglement in fishing lines.

The fact that the surf break is considered mostly for experts is supported by quantitative analysis which suggests a powerful barrelling wave on occasion with a critical fast take off required to catch the wave, due to the peal angles of both the left and right-hand waves.

6.3 Size of Surfing Community for Break

DHI were not able to obtain much photographic evidence or footage of surfers at the surf break. The feedback received was that there was a reluctance from the local community to provide photos of the surf, due to concerns around the potential to increase surfer numbers at the break.

There is very little information available that can indicate the numbers of surfers that typically can be found at the break when there are surfable waves or the size of the surfing community that typically frequent the break. The only photo provided (by Morgyn Bramley) of surfers at the break is shown in Figure 6-2, with three surfers visible.

The Peryman report (2011) states that the break is “significant to the local surfing community associated with areas such as Te Puke and Maketū and other breaks frequented by locals in this area”. Mr Bramley suggests that Kaituna Cut is less frequented than other breaks in the vicinity.
To obtain a proper estimate of the size of the surfing community that surf at the Kaituna Cut, an onsite survey would be recommended over a range of conditions at the site. This survey would also offer an opportunity to collect more footage of the break, to provide further evidence of the high quality surf that can occur at the break.

Figure 6-2  Surfers at Kaituna Cut. Source: Morgyn Bramley
Conclusion

BoPRC have commissioned DHI to undertake a preliminary assessment to confirm or question the findings of a report by Bailey Peryman (2011) which identified Kaituna Cut as a significant surf break within the Bay of Plenty region.

The quantitative analysis that formed the basis of this preliminary assessment indicated that the surf break at Kaituna Cut at its optimum is capable of producing barrelling powerful waves attractive to expert level surfers. Findings are supported by anecdotal observations of the surf break. The quantitative analysis also indicates potential rides of between 50 to 150 m. While the spot is inconsistent due to infrequent suitable swell, wind, bar and river conditions, the assessment confirms that on occasion, high quality surfing condition occurs at Kaituna Cut. During these circumstances it is considered likely that the surfing quality is higher at Kaituna Cut compared to adjacent spots used in the comparison.

There are several examples of inconsistent surf breaks around the world that are highly valued by the local community. Kirra only produces high quality surfing a handful times a year, but when the quality of the Kirra break was impacted by the Tweed River entrance sand bypass project (and the associated shortening of a groyne), the local community joined together and successfully convinced the city council to reinstate the groyne which was seen as critical for maintaining the break at Kirra. Waimea Bay only breaks in very large swell that only occurs a few times year typically during winter, however it is synonymous with big wave surfing globally and it is important to Hawaii from a both an economic and cultural point of view. On a smaller scale and closer to home, Omaha Bar on the east coast, one hour north of Auckland, is a bar break that requires an infrequent easterly swell to reach its true potential. There are a number of more consistent surf breaks along the east coast, however with suitable conditions, Omaha Bar produces a long, hollow left-hand wave. For this reason it is considered a break of regional significance popular with the Auckland surfing community (Greenroom Surf Media Ltd, 2004 and Spot X Publications Ltd, 2009).

Based on the preliminary study presented in this report, it is found to be plausible that the significance of the surf spot is comparable to that of nearby surf spots and shows the potential to on occasion provide high quality surf waves potentially superior to other nearby breaks. It is concluded that Kaituna Cut holds the potential be considered a regional significant surf spot as suggested in Perryman (2011).
8 Recommendations for Future Work

A key component of how significant a surf break is to the local and wider community is the number of surfers that surf at the break and the value it provides to spectators and to the cultural identity of the local community. Very little information was available to quantify this for this preliminary assessment. Further socioeconomic assessment of the value appreciation of the break is recommended.

The present study is inherently limited in its ability to describe surfing quality in its full level detail, however this preliminary assessment should suffice for determining whether the break is regionally significant (not considering the socioeconomic aspects). A detailed technical study maybe required as part of an impact assessment if there were proposed works that would dramatically change the characteristics of the break. These further studies would involve high-resolution bathymetry surveys, Boussinesq wave modelling and OPTISURF assessment. A detailed technical study would ideally be supported by measured surf tracks using board mounted high frequency GPS recorders.
9 References


Peryman, B. (2011); Bay of Plenty Surf Break Study. An identification of significant surf breaks and development of associated evaluation criteria in the Bay of Plenty region. Report prepared with assistance from Bay of Plenty Regional Council.

Spot X Publications Ltd, (2009); Spot X Surfing NZ.