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Carters Beach

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Buller District Council
P O Box 21
WESTPORT

Attention Mr S R Griffin

Dear Sir

REVIEW OF COASTAL EROSION – CARTERS BEACH

This report sets out a review of coastal processes along Carters Beach particularly in the region of Carters Beach township and to the east to the Buller River training walls. The requirement for the review has arisen from a request in connection with recent erosion of the shoreline in this area, which is impinging on the domain frontage and the edge of the coastal road to the Buller River mouth. The site lies in an area of coastline that has accreted significantly over the 100 years from 1885, but since then has commenced a period of retreat.

Investigations

Investigation undertaken as part of this assessment includes the obtaining and review of historical aerial photographs, and the searching and compilation of historical survey information. Dune scarp and vegetation line positions identified from these photographs and surveys were digitised and plotted electronically to provide a relative comparison of the coastline positions over time. The clarity of the aerial photographs is variable but those selected were of a suitable scale to provide adequate detail.

Aerial photography from 1938, 1959, and 2005 was used. A review of historical surveys held by LINZ and also of written historical records related in the main to the development of Westport harbour was carried out, and shoreline positions from 1868, 1884, 1910, 1936, and 1981 added. Coastline positions are shown on drawing DR-060106-003 relative to the 2005 aerial photography, with different scales of plot shown on drawings DR-060106-001 which shows in more detail the eroded section, and 002 which shows the plotted positions overlaid on the 1959 aerial photograph. Site photographs are incorporated in the text.

During a site visit on 31 March an inspection of the local coastline with detailed observation of the foreshore was carried out.

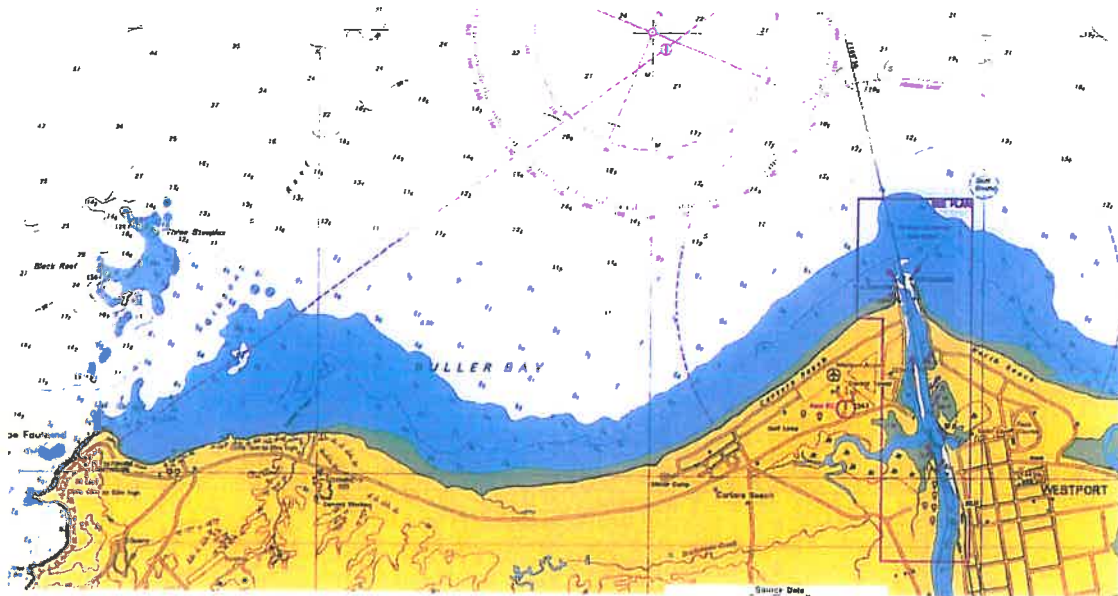
Site Description

Carters Beach lies to the west of the Buller River mouth and comprises the eastern end of the shoreline of Buller Bay which extends from Cape Foulwind to the river mouth. The bay shoreline is approximately 10 km in length, Carters Beach for the purposes of this review, confined to the eastern half.

While the bay is generally north facing, Carters Beach presents a gentle curve, gradually changing from north facing at the western end to NNW close to the Buller River. The land inshore of the beach

in the eastern half of the bay is low lying and flat. To the west this rises to significant mudstone cliffs to 30 m height in the vicinity of the cement works, which in turn give way to the hard granite deposits comprising Cape Foulwind.

The area subject of this report is the beach and adjacent flat land in the east of Buller Bay which has over the last twenty years shown evidence of coastal retreat, and more recently become of concern as this retreat has shown the potential to pose a threat to coastal assets.



Marine chart excerpt of Buller Bay – Carters Beach comprising eastern section
(from nz7132 Approaches to Westport)

The assets presently threatened include a gravel coastal road (Rotary Road) which runs between the Carters Beach township and the Buller River western training wall, and some well established trees along the Domain frontage at Carters Beach township. While presently clear of immediate threat, Westport airport boundary lies in places within 20 m of the erosion scarp. Evidence of retreat exists in the form of concrete debris on the beach, apparently the remains of concrete used to fill access tracks to prevent blowout.



Erosion scarp along Domain Frontage



Remains of concrete used to fill accessway blowouts

The beach itself comprises fine light grey sand devoid of gravel content. It is broad and slopes at about 1 in 30 across the upper tide range. The region has a large tide range (spring tides ranging 3.2 m) with a corresponding 80 to 100 m broad flat low tide expanse. At the time of inspection the upper beach was reasonably bare with little driftwood or flotsam buildup present. Large deposits of driftwood were evident however in the mouth of the drain that discharges to the beach immediately to the west of the motor camp.



Driftwood buildup in the drain mouth to the west of the Domain. Note the flax and marram grass vegetation further west.

The interpretation of this is that the beach had recently been swept clear of driftwood by high seas which had forced some driftwood into the stream mouth, the remainder being swept along shore. A fresh and steep to vertical erosion scarp varying in height from 0.7 to 2.0 m was evident along the beach boundary. No sign of a developed dune system providing sand storage and interchange with the beach system was evident, rather the inshore land comprises a flat plateau above the beach vegetated with various areas of mown grass, scrub and pasture.



Erosion scarp to the east of the Domain, clean sand with thin vegetation layer

The erosion scarp was evident in varying degrees from Bradshaws Road in the west to opposite the airport terminal in the east, a 2 km length of coastline. The most significant evidence of erosion was over the central section between the Motor Camp and opposite the Golf Club clubhouse. Over this section Rotary Drive deviates towards the sea, and this section of the coastal road is now directly exposed to damage.



Erosion scarp relative to Rotary Drive



Exposed road edge (vegetation placed in attempt to protect the bank)



Road edge, limited rock toe protection

Comparison of Coastline Positions

Aerial photographs from 1938, 1959, and 2005, a GPS survey from 2006, and historic surveys and records from the later 1800's were reviewed to establish suitable sources of data to illustrate comparison of historical shoreline positions. The aerial photography available provides a good coverage since 1938, with enduring landmarks allowing a good match of the photographs from each period, and in turn with the GPS survey work. The most complete data accessed covers the coastline in front of the Carters beach township, adding survey data from 1981 and 1936. The 1981 vegetation line position provides the most seaward position recorded from the data to hand. It should be noted that each set of data provides a discrete snapshot of the coastline position at one time. Continuous data are not available, and while more data than sourced for this study may be available, information spread evenly over the time period has been selected as indicative and to meet cost constraints.

Comparison of the digitised data shows a marked and reasonably regular seaward progression of the line of the foreshore vegetation from the 1880's to 1959. The 1981 shoreline positions in the vicinity of the township indicate that this seaward growth continued to that time. Between 1981 and 2005 it is clear that retreat of this shoreline commenced with the loss of up to 40 m in this period, and apparently a further 3 to 5 m between the 2005 aerial photograph and the 2006 GPS survey. These relative positions are shown on the attached drawings

History of Foreshore Modifications

The history of this section of shoreline is one of significant change brought about by the development of harbour works at Westport which include the construction of training walls on the Buller River which have extended the position of the river mouth seaward from its natural position by about 1500 m. A number of written documents recording the intent and progress of these extensions are in existence and have been referred to as part of the background to this report. In summary, the construction of these structures commenced in 1886 with 1340 m of wall constructed on the west bank and 1830 m on the east bank. The walls were extended between 1913 and 1920 with 160 m added to the western bank and 215 m to the eastern bank. In 1931 a 30 m extension to the eastern wall was completed, and further extensions to both walls were completed in the 1960's with another 91 m added to the western wall and 183 m added to the eastern wall. At this stage the two training walls were the same length and remain in the same position now.

The effect of the gradual construction of the training walls over 80 years on coastal processes has been to build out the beaches on both sides of the river with the result that substantial accretion has occurred. Immediately to the west of the Buller mouth this buildup is a maximum of about 1300 m, reducing with distance to the west with the former shoreline being built out by about 400 m in the vicinity of the Carters Beach township. These changes are best illustrated by the attached drawings. The sequence of aerial photographs shows how the establishment of assets in the form of roads and facilities closely followed the growth of the shoreline.

A number of studies of the coastal processes acting in the vicinity have been carried out over the years with the main focus on the operation of the river port in terms of maintaining safe and practical navigational access under the combined conditions imposed by sea and river. These reports provide assessment of the interaction between river and coastal processes with particular emphasis on the transportation of sediment across the river mouth and the processes related to bar formation. Of particular interest to this study is the present understanding that an average net quantity of 900,000 cubic metres of sediment is transported from west to east annually.

Nature of the Erosion

The nature of the erosion observed at Carters Beach is that of extensive general retreat over a long section of shoreline rather than an isolated and focussed erosion event.

The eroding faces exposed along this foreshore comprise mainly clean sand, in some places including large logs that were incorporated as the foreshore built out under the influence of the breakwater extensions. Generally the vegetation on these eroding sections is confined to pasture grasses with shallow root systems and limited capacity to reinforce the exposed material under wind and wave attack. In areas where there is a more dense cover of vegetation the rate of retreat appears to be no different, any benefit being provided by more competent root systems being lost by the collapse of the bank as the trees fall when undermined.



Buried logs becoming exposed with foreshore retreat

At each end of the eroded section dense and uncontrolled vegetation exists including sand binding marram grass. Where this type of material has been undermined, the vegetation has generally slumped down the face of the bank and remains in position to re-establish itself on the bank face.



Marram grass vegetated section showing signs of recovery

Potential Causes of Erosion

A review has been made of the potential causes of erosion at Carters Beach. This has been targeted towards factors that can influence coastal processes and which may have changed over the last few years.

It is clear that the most significant influence on coastal processes in the area over the last 100 years has been the development of the Buller River training works. The advance of the coastline has followed the sequence of extension of the walls seaward with rapid growth of land area which was converted to grazing, the establishment of the gold course and airport, and the seaward development of the Carters Beach township.

Following the completion of the last extension works in the 1960's the coastal advance continued as indicated by the 1981 aerial photograph. Around this time it appears that the coastline reached a position of maximum seaward alignment relative to the established river mouth discharge position, and has subsequently retreated by in the region of 40 m in the intervening 25 years.

The nature of the relatively fast growth seaward was such that the accreted land is flat and has yet to have a new shoreline stabilised in a reasonably fixed position. It has thus not had an opportunity to establish a dune system that allows a storage buffer of sand to accommodate short term demand of sand under storm conditions at a position that will allow the recovery and storage of sand under more benign conditions. It is interesting to note that wither side of the eroding section the dune faces are much more substantially vegetated with species including marram grass and flax, and following erosive episodes they remain in place ready to re-establish.

While the shoreline vegetation may be a factor in the present erosion process it is not considered to be an initiating component of the present situation. Similarly, no isolated event in terms of the river training works that can be directly linked to this erosion phase has been identified, only that perhaps the coastline is still to reach a stable equilibrium position following massive change.

To put the issue in perspective the general coastal setting is one of constant movement of sediment to the north, as previously pointed out the net annual movement of sediment up coast estimated at 900,000 m³/year. The loss, for example, of 10 m³ per metre from 2,000 m of the Carters Beach frontage over one year is a total of 20,000 m³, a very small proportion of the general and ongoing transportation process. It must also be recognised that the total transport volumes are average figures, so when supply of sediment to the system from sources further south falls for any reason the potential exists for the system to recover material from exposed sources such as Carters Beach to maintain the process.

Other possible causes or erosion have been traversed, in particular the operations related to the port and river mouth. Discussions with Captain David Barnes, recently Harbour Master for many years have been useful in providing confirmation that no significant changes have been made to dredging and dumping procedures over recent years, and although shoaling of the bar has been a problem in terms of navigability over the last year or so, this was considered to be more an issue of lack of flushing river flows rather than coastal process changes. Captain Barnes did suggest that he felt that the frequency of westerly sets across the river mouth (the long term sediment transport trend is to the east driven by predominating south westerly winds) had increased in recent times and suggested that a review of wind records be made to determine if any increase in winds east of north could be identified on the basis that such a change, as well as generating an increase in westerly current flow, would provide a different direction of wave attack at Carters Beach.

Ten years coverage of wind records from the Westport Airport site were obtained and reviewed. No changes in the distribution of direction were identified, although it is recognised that the directions recorded are only at 15 degree intervals. More subtle changes that could still have an affect on wave direction can not be identified from the data available. Captain Barnes also noted his observation that a degree of retreat of the shoreline had also occurred to the east of the river mouth, but this was less obvious than at Carters Beach largely because of its lower profile.

In summary, at this stage we have not been able to identify any single specific cause of this erosion.

Options for Mitigation

The erosion at Carters Beach extends over 2,000 m in length requiring major commitment to provide any serious intervention. Options for mitigation of the exposure of land and assets include; do nothing, move the assets, attempt to assist with the natural stabilisation of the shoreline through planting and sand accumulation, and the establishment of 'hard' protection in the form of a rock seawall or groynes.

Hard protection of discrete sections of the shoreline (eg the Rotary Drive section) is problematic in the 'end effects' or the concentration of wave energy at unprotected sections adjacent to the protection

works can exacerbate erosion of these adjacent areas. To overcome this problem the protection would need to extend the full length of the erosion zone plus enough of a buffer to ensure that end effects were minimised. The cost of such works would be difficult to justify, particularly given the undeveloped nature of the area to be protected. Resource Consent for this work, which by its extent would be a 'restricted coastal activity' requiring approval from the Ministry of Conservation, would be difficult to obtain.

At this stage it is suggested that realistic options for mitigation are limited to a combination of the remaining less invasive options in conjunction with a detailed monitoring of the erosion process. Such measures that should be considered are:

- realign the threatened section of Rotary Drive to remain consistently clear of the erosion scarp
- establish a planting and landscape programme with the objective of stabilising the erosion face, accumulating wind blown sand, and providing a degree of reinforcement to the top of the bank. Advice should be sought on planting preferences in terms of the use of particular species (nature spinifex and pingao vs marram) that will encourage dune formation
- establish a monitoring baseline that can be regularly compared to provide information on the success or otherwise of the work undertaken, and to provide ongoing assessment of the risk to assets (including the airport).

Conclusions and Recommendation

Investigation to date has not identified any single or obvious cause of the present state of erosion of Caters Beach which is evident over a 2 km front. It is considered likely to be part of a process of establishing an equilibrium position following the long term development of the Buller River training walls. The volumes of material being lost annually through erosion are small in comparison to the changes arising from the training works, and to the overall sediment transport regime and may be related to changes in the availability of sediment to the coastal system elsewhere.

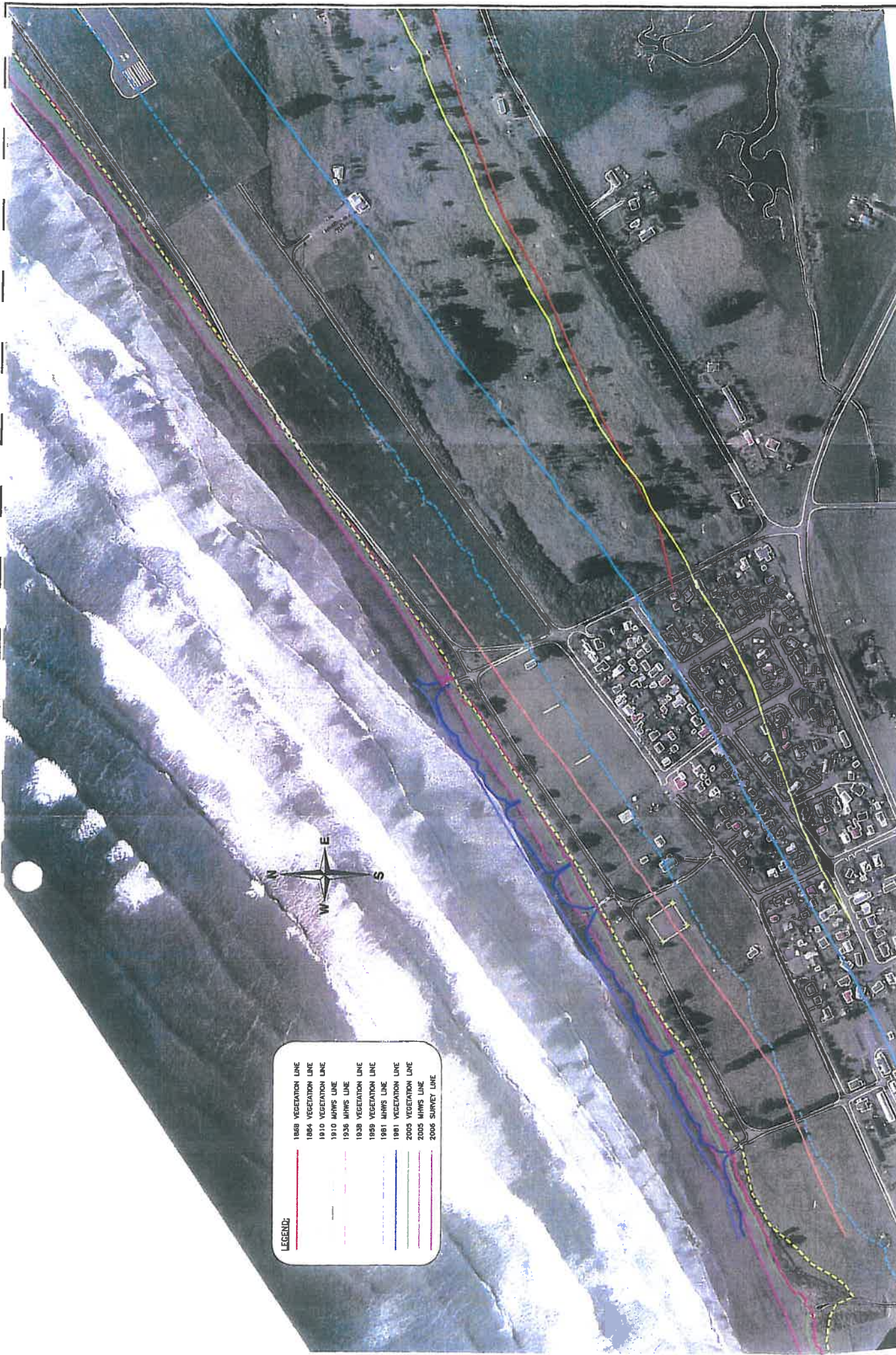
Mitigation of erosion by hard (rock) protection works would be expensive and difficult to justify in terms of obtaining consent. Practical options for mitigation include the realignment of Rotary Drive, the setting up of a landscape and planting programme with the intention of stabilising the existing bank positions and allowing the accumulation of and binding of sand along the toe as part of the initiation of dune formation.

It is clear that the situation is a matter of concern in terms of the exposure of assets should erosion continue. Regular monitoring and further ongoing investigation to provide a better understanding is justified.

Yours faithfully

OCEL Consultants NZ Limited

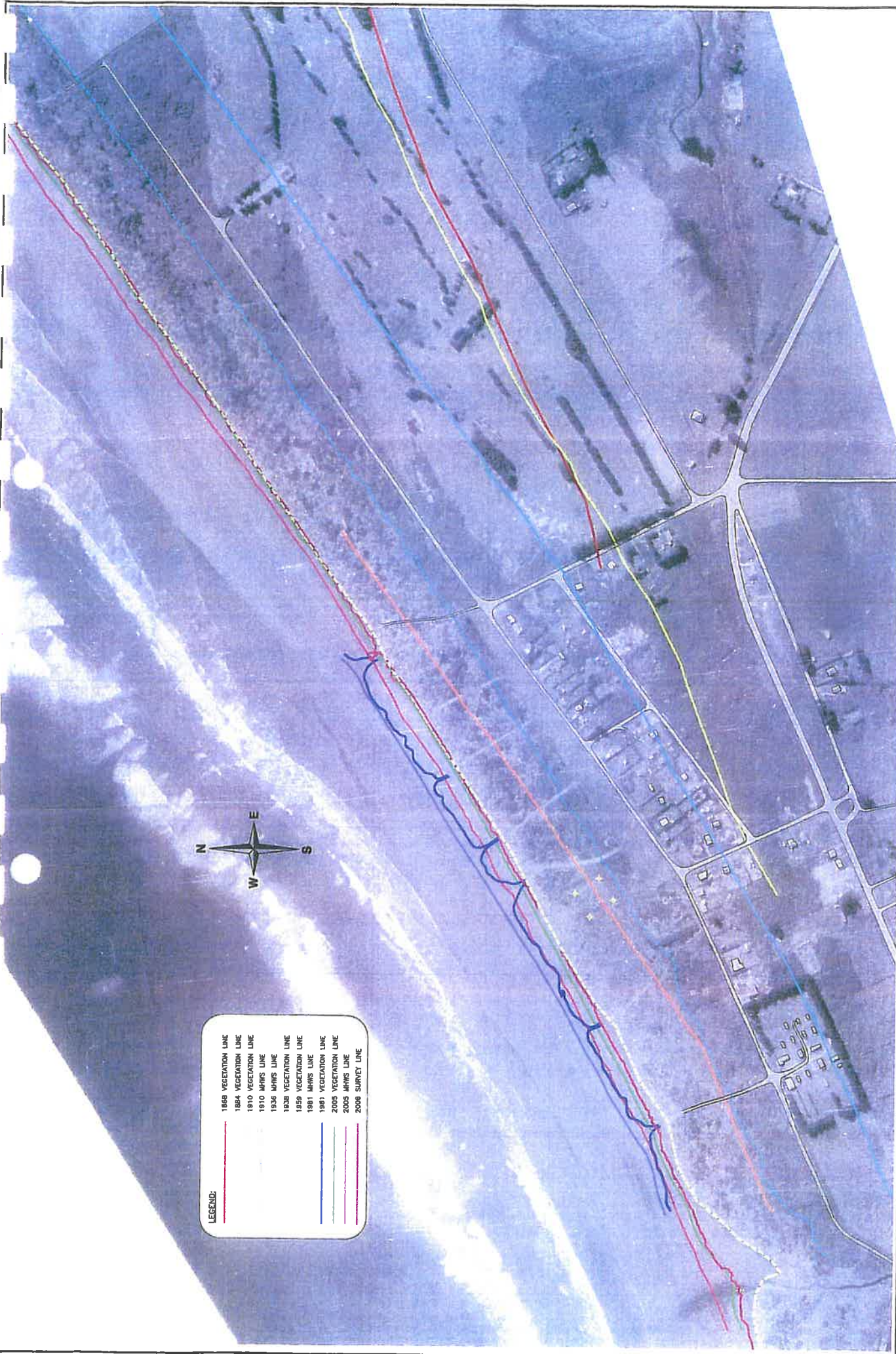
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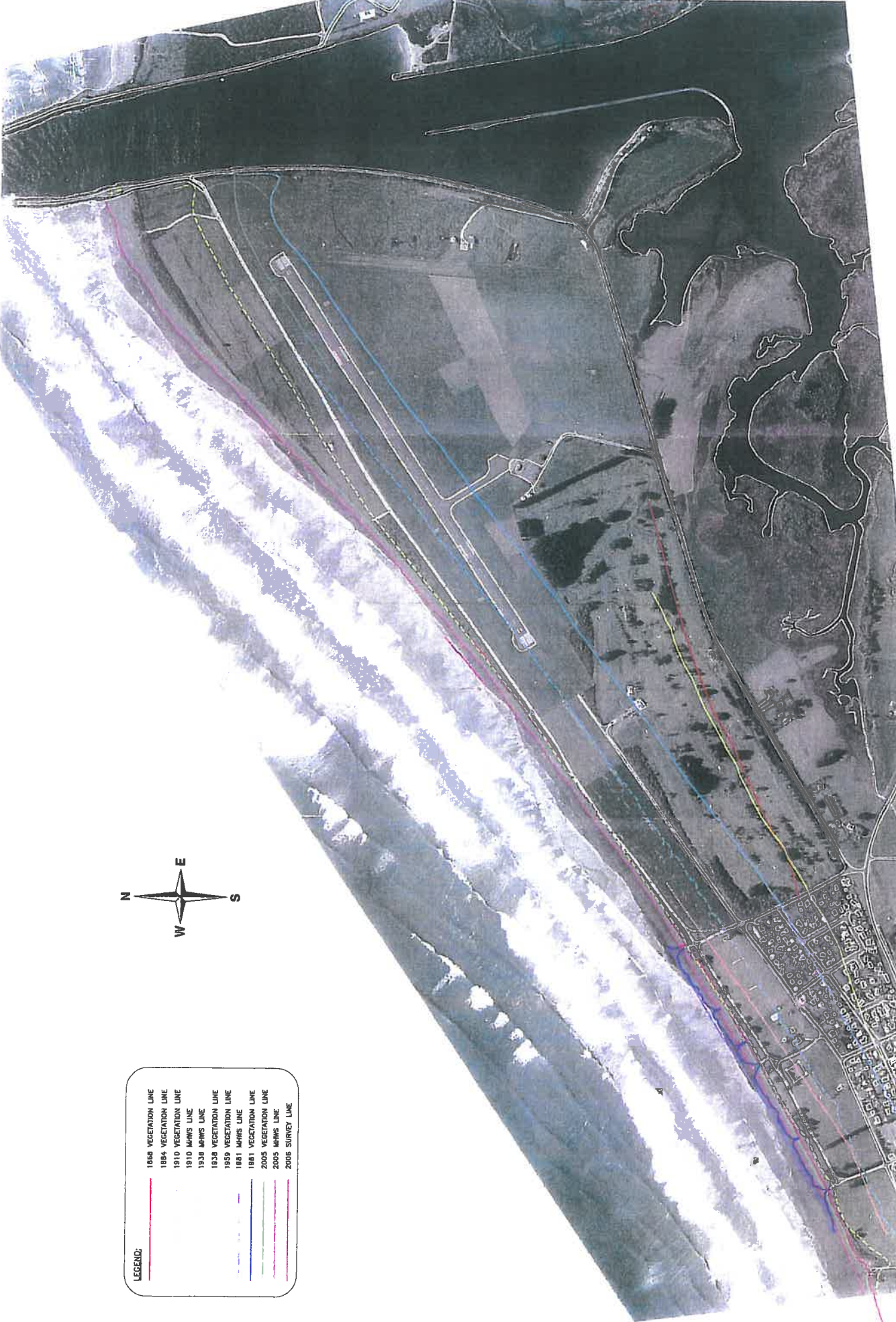
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 - 1864 VEGETATION LINE
 - 1910 VEGETATION LINE
 - 1910 MHWs LINE
 - 1936 MHWs LINE
 - 1938 VEGETATION LINE
 - 1999 VEGETATION LINE
 - 1981 MHWs LINE
 - 1981 VEGETATION LINE
 - 2005 VEGETATION LINE
 - 2005 MHWs LINE
 - 2006 SURVEY LINE

Scale (A3)	1:5000	AKMID 2/18/06	AKMID 2/18/06-001
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Rev.	-		
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- LEGEND:**
- 1888 VEGETATION LINE
 - 1884 VEGETATION LINE
 - 1910 VEGETATION LINE
 - 1910 MHWS LINE
 - 1936 MHWS LINE
 - 1938 VEGETATION LINE
 - 1959 VEGETATION LINE
 - 1981 MHWS LINE
 - 1981 VEGETATION LINE
 - 2005 VEGETATION LINE
 - 2005 MHWS LINE
 - 2008 SURVEY LINE



Scale (AD)		ACAD Plotname	
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Amendments 01/08			



LEGEND:

	1886 VEGETATION LINE
	1884 VEGETATION LINE
	1910 VEGETATION LINE
	1938 MHW LINE
	1930 VEGETATION LINE
	1989 VEGETATION LINE
	1981 MHW LINE
	2005 VEGETATION LINE
	2006 MHW LINE
	2006 SURVEY LINE

Scale (AS)
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Amendment