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Auckland Harbour Bridge

Assessment of Effects on the Environment of Steelwork Maintenance by Abrasive Blasting Methods

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Works Consultancy Services Limited
8th Floor, Bledisloe House
24 Wellesley Street
AUCKLAND

Phone: (0-9) 309 6863
Fax: (0-9) 377 6125

AUCKLAND HARBOUR BRIDGE

ASSESSMENT OF EFFECTS ON THE ENVIRONMENT OF STEELWORK MAINTENANCE BY ABRASIVE BLASTING METHODS

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EXECUTIVE SUMMARY

The Auckland Harbour Bridge is an essential feature of the State Highway Network. It is sited in a marine environment and although it is protected by a five coat paint system its steel construction is vulnerable to deterioration and corrosion. A regular painting maintenance system is employed and involves abrasive blasting for surface preparation. Blast products comprise spent blast media (basalt) and paint flakes (dominantly zinc-chromates). This material is dispersed by air and water and settles onto land (Northcote Point and Westhaven) or the Waitemata Harbour.

A number of impacts from the abrasive blasting were identified. These included the deposition of blast product in various receiving environments and noise impacts. Because of the modified state of the receiving environment they have a low to moderate sensitivity to blast product and noise inputs.

Though the abrasive blasting procedures have been refined over the last thirty years to reduce environmental and health risks, a number of mitigating methods to further reduce identified environmental impacts have been proposed and investigated.

1 STUDY BACKGROUND

1.1 DESCRIPTION OF BRIDGE STRUCTURE

As part of the State Highway network, the Auckland Harbour Bridge is owned by the government land transport agency, Transit New Zealand. Works Consultancy Services Limited (Consultancy Services) are responsible under a professional services contract for the overall management of the bridge including the bridge maintenance contract. Serco Group New Zealand Ltd (Serco) are the Bridge Maintenance Contractors.

The Auckland Harbour Bridge was opened in 1959 as a one kilometre long, four-lane bridge connecting Auckland's North Shore with the downtown Central Business District. The original structure is a steel truss to which steel box-shaped extensions were added in 1969 to cope with increasing traffic volumes. The Auckland Harbour Bridge is a crucial component of New Zealand's State Highway One network and Auckland's urban motorway system. The bridge is the only conveniently located link between Auckland's north and south shores. The benefits of the bridge to the greater community are estimated to be millions of dollars from the savings in both travel time and the vehicle operating costs for some 42 million vehicle crossings annually.

The Harbour Bridge is sited in a marine environment making it vulnerable to paint deterioration and corrosion. These problems are potentially very serious because the Bridge is constructed from steel. An undamaged coating is necessary to prevent corrosion of the steel and subsequent loss of structural steel area which may eventually lead to potential failure of the structure. A continual programme of maintenance painting is required to preserve the integrity of the coating system. The programme involves spot-blasting and repriming the deteriorated areas of paint while leaving the sound paint intact. The entire section being maintained is then topcoated. The majority of the spot-blasting is dry sand-blasting. In limited areas (with red lead primer) wet sand-blasting is used.

Photographs of the Bridge structure and painting maintenance activities are shown in Appendix A.

1.2 RESOURCE CONSENTS

In accordance with the Resource Management Act 1991 requirements (summarised in Appendix B), resource consents are required from the Auckland Regional Council for the discharge of blast product from the abrasive blasting operation on the Auckland Harbour Bridge.

Three resource consents have been applied for from the Auckland Regional Council in accordance with Section 88 of the Resource Management Act 1991. They are:

- A permit to discharge into air.
- A permit to discharge onto land.
- A coastal permit (including discharge into coastal waters).

This assessment of effects on the environment has been prepared to accompany these applications and has been prepared in accordance with the Fourth Schedule to the Resource Management Act 1991. The general requirements of the assessment include:

- A description of the activity, including the nature of the discharge.
- Description of any alternative locations/methods and demonstration that the proposed activity is the best practicable option.
- A description of the sensitivity of the receiving environment and assessment of the possible environmental effects.
- A description of mitigation methods to be undertaken.
- Identification of affected parties followed by a process of consultation.
- Independent review of the assessment at an appropriate level.

As the assessment will be reviewed by Council Officers as part of the resource consents procedure it was decided that an independent review of the assessment was not necessary at this stage.

Although three separate consents are being sought, it was decided that it was appropriate to submit a single assessment of effects on the environment. The holistic approach of the Resource Management Act 1991 supports the need for only one assessment as the source and type of discharge is similar for all of the consents, and the four receiving environments are inter-related. However, to aid evaluation of the assessment of effects, the actual impacts on the different receiving environments are studied separately within the assessment. The assessment can be used for all relevant statutory procedures.

2 STEELWORK MAINTENANCE

2.1 THE COATING SYSTEM

The coating system presently in use on the Auckland Harbour Bridge consists of an initial surface coating of zinc applied by hot spraying at the time of construction over 99% of the bridge area. The purpose of this zinc layer was to provide cathodic protection to the steelwork where water was able to penetrate the overlying paint system. This zinc spray is not typically re-applied during routine maintenance painting but is conserved during blasting as much as possible.

A small area (approx 600 square metres) of red lead primer was applied, also at the time of construction to the steelwork of Span 7 (adjacent to Westhaven anchorage). Red lead primer was the most effective high performance paint available at this time and was applied to this small area where the application of zinc spray was not possible. No red lead primer has been used since on the Auckland Harbour Bridge.

Overlying the zinc coating is the current paint system. This takes the form of three primer coats and two topcoats. The three primer coats (each approximately 70-100 microns in thickness) comprise a zinc chromate pigment within an alkyd (varnish-linseed oil based) binder, plus solvents. Again, as with the zinc metal spray, the zinc is designed to sacrificially corrode in preference to the steel. The chromates are included in a passivating role i.e. they slow the rate of corrosion. The two topcoats are micaceous iron oxide (MIO) pigment, again in a alkyd (or phenolic) binder. The purpose of these coats is both for aesthetic reasons, and to act as a barrier coat minimising the amount of water able to penetrate to the steel surface. The presence of water is a fundamental requirement for the corrosion process. The total thickness of these topcoats is in the order of 180 to 220 microns. They do not contain any known toxic elements.

This paint system covers a total area of some 110,000 square metres at an average thickness of 770 microns (0.77 mm). The average thickness of zinc chromate primer ranges from 45% to 62% of the total paint thickness. The total volume of paint on the bridge is some 85 cubic metres. This is made up of 4.4 cubic metres of zinc (hot spray applied), 43.1 cubic metres of zinc chromate primer, 0.6 cubic metres of red lead primer and 36.9 cubic metres of MIO topcoat.

2.2 MAINTENANCE PAINTING

Maintenance painting differs from painting of new structures in that only a small area of the steel surface receives the full five coat paint system. The extent of this area is defined by the area of defective paint, either due to rusting of the steel, zinc corrosion or flaking of the paint layers. On the Auckland Harbour Bridge, the percentage of the painted surface that must be blasted back to bare steel is typically in the range of 0.1% to 5% dependent on rust severity in different sections of the Bridge. It is only over this area that the paint flakes are discharged in to the environment by blasting.

Fundamental to the performance of any paint system is the surface preparation i.e blasting of the steel surface prior to application of the paint system. Abrasive blasting of some form is necessary to:

(a) Completely remove deteriorated paint, rust and zinc corrosion products. The presence of any of these 'defects' will greatly reduce the life of any paint system. This is especially true in the coastal marine environment of the Auckland Harbour Bridge.

(b) Provide a suitable anchor pattern (profile) on the steel surface to which the paint can adhere. This 'roughening' of the steel is critical to the success of the paint system. The choice of abrasive in terms of grading and hardness to achieve a suitable surface profile can be very difficult.

The life of a paint system is highly dependent on the degree of surface preparation attained. The surface preparation specification is for a 'Near White' finish, or less than 5 % rust after blasting. 'Near White' is accepted internationally as the minimum standard for a high performance paint system and can only be achieved by abrasive blasting.

The abrasive media currently employed for sandblasting on the Auckland Harbour Bridge are Dricon Envirogrit superfine (used predominantly), Mintech Fineblast and Dricon Envirogrit Standard (used occasionally). All three types of media consist of crushed basalt and differ substantially only in their particle size gradings. They do not contain any known toxic contaminants or free silica in excess of 1% and have such low concentrations of soluble materials that they can be considered inert. All the abrasives are relatively hard and therefore produce only limited amounts of dust, and have high specific gravities which further reduce the dust nuisance and impact on the built environment by lowering the length of time which the abrasive particles remain in the air. Detailed data sheets provided by the manufacturers are included in Appendix C together with the results of laboratory tests commissioned by Consultancy Services from Central Laboratories.

The abrasive media listed above have been selected from the wide range of materials which are available because they pose no hazards to workers' health, they have no adverse environmental effects, they perform satisfactorily in the workplace and they are economically viable.

2.3 SURFACE PREPARATION-ABRASIVE BLASTING TECHNIQUES

A range of surface preparation methods can be used during painting maintenance. In domestic applications, sanding, wirebrushing and other light power tool cleaning methods are usually satisfactory. In light industrial applications power tool methods, solvent cleaning techniques and abrasive blasting are also employed. However in heavy industrial applications, such as the Bridge, blasting preparation is the only satisfactory method (see Section 2.2). These blasting techniques and their suitability for the Bridge are summarised below:

Water Blasting

Water blasting, while able to remove loose paint and rust (at very high pressures), is not an abrasive blasting method. It has been considered but due to its inability to achieve a surface profile on the steel surface or between coats, it is not a satisfactory process for the Bridge.

Dry Blasting

Dry blasting is a process in which abrasive media are projected onto a steel surface to remove surface contaminants and to provide a roughened surface for paint adhesion. This is the standard abrasive blasting process which is currently used on the Bridge (see Section 2.2).

Wet Blasting

In wet blasting, abrasive is injected into a pressurised water stream after the water is pressurised. The process eliminates dust but inhibitors must be used to prevent the steel from rusting as it dries. Inhibitors are generally sodium and/or potassium chromate, dichromate or phosphate which have significant adverse environmental impacts. They are highly toxic products which require very careful handling and application. In addition, water soluble inhibitors can have serious detrimental effects on paint coatings. Regardless of the generic type, the inhibitor used must be compatible with the current paint system. Equipment costs are approximately the same as for dry abrasive blasting but production is slower and more abrasive media is required.

The net effect of wet blasting is not to reduce the amount of blast product entering the environment but to limit its drift. The material, therefore, is less dispersed but impacts on fewer areas. The considerable amounts of inhibitor which would be discharged into the environment and the safety hazards involved in handling it make wet blasting unsuitable for use on the whole of the Bridge although it is used occasionally for small areas such as Span 7.

Vacuum Blasting

Vacuum blasting combines standard abrasive blasting procedure with a recovery system. Abrasive is blasted through the nozzle of the blast gun onto the surface to be cleaned. Dust, debris and abrasive are contained by a recovery cone and drawn into a reclaimer which recycles the abrasive and passes air and dust through to a dust collector. Not all types of abrasive are suitable for recycling in this manner. Vacuum blasting can provide nearly dust-free performance and reduce the waste generated by 95 percent but its successful operation is heavily dependent on the operator. Good control of the nozzle must be maintained although the addition of a vacuum hose makes handling more difficult than standard blasting. Vacuum blasting is therefore fatiguing.

Vacuum blasting is slower than conventional abrasive blasting because nozzle speed must be slowed to permit vacuuming to operate properly. Examples of practical applications of vacuum blasting cited in the literature note that there is a major downgrading in the level of surface preparation produced by vacuum blasting compared to standard methods because vacuum blasting is very difficult to use on angled surfaces, edges and complex geometries.

It would be extremely difficult to achieve the uniform high standard of surface preparation required for coating application because the truss form of the structure with its associated angles, edges and corners is not suited to the procedure. It should be noted that the consequence of inadequate surface preparation is failure of the coating system with subsequent premature maintenance requiring further blasting. Vacuum blasting, therefore, is not a viable option for the Bridge.

Containment of Blast Products

This procedure is used in conjunction with blasting methods to contain the material produced during the blasting process. Technical literature describes containment procedures where the entire work area is enclosed in synthetic textile to limit dust drift. While this may be a useful technique for small scale blasting, it is not a practical proposition for the Bridge. The size of the structure, the differing geometries of the work areas (such as box extensions, upper chords, stringers, king posts, etc), the visual impact, the localised wind conditions and the significant time delays involved in using containment mean that total enclosure is not practical on the Bridge.

2.4 NATURE OF THE DISCHARGE

The discharge produced by the abrasive blasting operation is a mixture of 99% spent abrasive media and 1% paint debris by volume, either in a dry form or suspended in water if wet blasting is used. The abrasive media currently in use is crushed basalt, a naturally occurring substance with no known toxic effects. Garnet, another naturally occurring sediment, has been used in localised areas but currently, it is very expensive (approximately 10 times the cost of crushed basalt).

The paint particles from blasting (except on the red lead painted part of Span 7) contain, on average, 39 % micaceous iron topcoat, 55 % zinc chromate primer and 6 % zinc spray. The average composition of paint particles from the lead painted section of Span 7 is 56 % iron oxide topcoat, 39 % primer, 2 % zinc spray and 3 % red lead paint. Laboratory tests on the blast product (the combined discharge of paint debris and abrasive media from the blasting process) have yielded the particle size grading contained in Appendix D. The majority of the material (70 percent) falls within the 850 to 180 micron particle size range.

On average, based on current maintenance practices, 75 cubic metres of blast product is discharged annually. Of this, 1.02 cubic metres is paint debris while the remainder consists of blast media (basalt grit). The paint debris consists of 0.05 cubic metres of zinc spray, 0.40 cubic metres of iron oxide topcoat and 0.56 cubic metres of primer with a small amount of lead paint which varies depending on the maintenance programme. The upper limit of the total volume of paint which would be removed from the area painted with red lead is 6.93×10^{-4} cubic metres. Even this small quantity will never be discharged at one time because the entire area of red lead paint would not be programmed for maintenance painting at one time, due to the contractor's resource constraints (such as equipment and labour). The zinc and chromate contained in the primer are effectively encapsulated and therefore are not in an active available form for uptake by organisms.

2.5 FUTURE PAINTING SYSTEM

The existing paint system has generally performed well over the past 34 years. It is an easy system to apply and, when used correctly, exhibits excellent corrosion resistance. However, there are reasons for changing the system. The chief of these are as follows:

- The chromate in the existing primers is a 'confirmed' carcinogen and has been banned for use in paint materials in Australia. There are a range of non-toxic alternatives that may be suitable for use on the Bridge and that exhibit satisfactory corrosion resistance properties.

- It is desirable to find a more cost-effective high performance coatings system that would reduce maintenance costs over time.

- The oil based primers are inherently slow drying. This characteristic is further emphasised by the on-site weather conditions particular to the Bridge, ie cold and wet. This slow drying is slowing painting progress and disrupting the maintenance programme.

Consultancy Services have been investigating systems to replace the continued use of the zinc chromate primers. In 1987, the former Ministry of Works and Development, in consultation with DSIR, initiated investigation into alternative coatings. Forty different systems were selected and placed on an exposure rack on the Bridge. Monitoring and reporting on performance of these systems has led to development of full scale paint trialling on the structure. These painting trials were commenced in late 1992. These trials necessarily extend over a period of at least two years in order to fully assess the performance of the coating systems. Therefore it is not expected that a new paint system would be introduced until about three years from now. Inherent in changing to a more cost-effective coating system is the important benefit of reduced abrasive blasting in the future.

3 SENSITIVITY OF THE RECEIVING ENVIRONMENT

3.1 THE AIR ENVIRONMENT

The blast product does modify air quality as described in Section 4.2. This modification is only very temporary, however, and the ultimate receiving environments are the land and marine environments. The sensitivities of these environments are described below.

3.2 THE LAND ENVIRONMENT

The Auckland Harbour Bridge spans the Waitemata Harbour with its southern end adjacent to Westhaven Marina and its northern end located within a residential area on Northcote Point.

Waitemata Harbour is Auckland's main commercial and recreational harbour. To the east of the Bridge is the Port of Auckland on the southern side and the Devonport Naval Base on the northern side. These areas are the main destinations for ships entering the Waitemata Harbour. Approximately eight cargo ships pass underneath the Harbour Bridge per year. These are destined for the Chelsea Sugar Refinery which is located at Birkenhead. Anchorage is prohibited within approximately 2000 m of the bridge in the main channel.

The Harbour is very popular for various recreational pursuits including yachting, boating and fishing. A high number of leisure crafts pass underneath the Bridge every week on their way to, or from, the Hauraki Gulf. Westhaven Marina, Auckland's largest marina, is located immediately to the east of the southern end of the Bridge. The area around Northcote Point is zoned Recreation C in the Auckland Regional Transitional Coastal Plan. This zoning recognises and provides for the present use and expansion of the swing mooring areas.

Surfcasting near the southern abutment of the bridge is popular while the reserve on Northcote Point is often used by family groups. Recreational use of the Harbour Bridge surrounds has not been quantified though it is predicted that usage would be higher during non-working hours especially during the summer months.

The area in the vicinity of the southern end of the Bridge is zoned Recreation Six (Boating Harbour) in the Auckland City Transitional District Plan. A large amount of this land is designated for motorway, public boat harbour facilities, or public boat harbour access, storage and parking purposes. Permitted uses in this area are restricted to those which are necessary for the enjoyment and use of the area, or are associated and compatible with the permitted marine activities. This includes a number of commercial activities in the area including marine brokers and a cafe, yacht clubs, washdown areas and maintenance facilities. Though zoned as Recreation, because of the activities

permitted the area has characteristics more in keeping with a commercial/light industrial zone.

Northcote Point, in the vicinity of the Bridge abutment, is zoned Recreation One (Recreational Reserve) or Residential Two in the North Shore City Transitional District Plan (Northcote Section). The Motorway is designated and there is an additional designation for a 'Ministry of Works and Development' Depot. This depot is now used by Serco and the status of this designation will need to be addressed when notices of requirements are called for by North Shore City Council for the new district plan. The area is characterised by a number of older houses and a large grassed reserve at the tip of the Point. For Residential Two zones the transitional district plan states, "The use and development of land in this zone is subject to limitations between uses, protecting the unique character of the Northcote Point and securing a pleasant and harmonious residential environment". The Bridge is a significant use of the Point and the limitations imposed by it need to be taken into account be other users.

Since the establishment of the Bridge, the built environment in the vicinity of the Bridge has been subject to a moderate to high background noise level and the nuisance effect of traffic grit and wind blown soil and sand. Despite these ongoing impacts commercial development has occurred at Westhaven Marina and Northcote Point continues to be a very popular residential area.

It can be summarised that the existing built environment has a moderate sensitivity to noise and dust impacts while the recreational environment has a low sensitivity to these impacts.

There are a number of domestic gardens associated with the residential houses on Northcote Point. The reserve is grassed although there are a number of native and domestic tree and shrub specimens around the southern perimeter. The land directly underneath the Bridge on Northcote Point is an informal carpark with a soil and sand base. At the southern end of the Bridge the open spaces are either grassed or tarsealed. These areas have a low sensitivity to noise and dust inputs.

3.3 THE MARINE ENVIRONMENT

The zoning of the Waitemata Harbour in the vicinity of the Bridge, as outlined in the Auckland Transitional Regional Coastal Plan (Waitemata Harbour Maritime Planning Scheme Section), is given in Figure 1.

Two habitat zones and one conservation zone are in the area which may be affected by blast product dispersal. The remainder of the area is either zoned for recreational uses (boat moorings, marina etc) or unzoned.

Conservation zones are identified to:

(a) Preserve areas which collectively contain significant examples of the range of major habitat types and combinations of habitats present within the maritime planning area.

(b) Provide special areas for education, research, viewing and wildlife appreciation.

(c) Preserve examples of rare habitats supporting relatively rare species with the aim of retaining maximum habitat and species diversity, and encouraging the presence of uncommon animals and plants.

Habitat zones are identified for:

(a) The matters set out above for conservation zones but where the areas or examples are of lesser quality or value.

(b) To protect concentrations of particular habitats or species, such as certain areas of mangrove afforestation and salt marsh

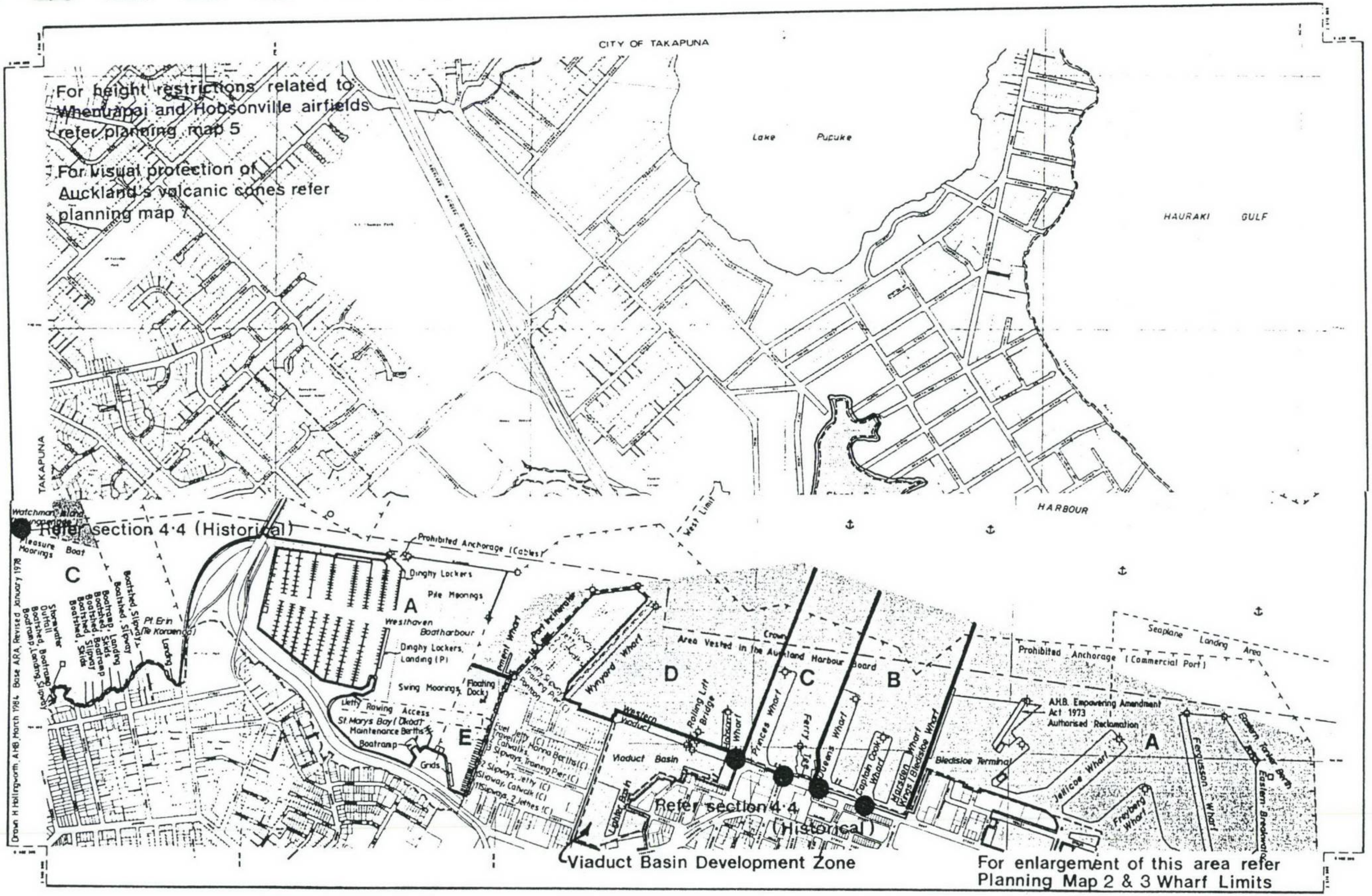
(c) To protect areas which make a significant contribution to the continued health and quality of areas zoned conservation.

(d) To provide buffer zones or additional protection to conservation zones.

Shoal Bay is a conservation zone because of the extent and quality of its marine, maritime, land and freshwater vegetation, all aspects of habitat including variety, succession and rarity, and the overall variety of species present.

The adjacent Sulphur Beach habitat zone is zoned for the same reasons except for the overall variety of species present. This area also has importance to fish species either as a migration path or as a food source. The Ngataringa Bay habitat zone has importance in regards to its vegetation, habitat as well as being an important area for marine and land birds for roosting and breeding.

These habitats have a low to moderate sensitivity to noise and dust impacts because of they are already modified as a result of 140 years of development in the contributing catchments



WAITEMATA HARBOUR MARITIME PLANNING SCHEME

MAP 1 PLANNING PROVISIONS

0 Scale 1 : 20,000 1000 m

R11 3·1 **4·1** 5·1
4·2

PUBLICLY NOTIFIED JUNE 1985 OPERATIVE 23rd DECEMBER 1987

4 ASSESSMENT OF ACTUAL OR POTENTIAL EFFECTS OF ABRASIVE BLASTING

4.1 DISPERSION OF BLAST PRODUCT

The terms 'blast product' and 'blasting product' refer to the mixture of abrasive media and paint debris, which is described in detail in Section 2.4, produced as a discharge by the blasting procedure.

The abrasive blasting product is discharged initially into the air around the Bridge. The particles are dispersed by air circulation before settling onto the surrounding environs. The deposition of the blast product was approximated using estimated rates of blasting and the wind rose for Auckland City given in Figure 2, in Internal Report AHB 1:1993. The calculations show that most of the material removed from the Bridge is deposited initially to the north east of the bridge, although it is redistributed by waves and currents and secondary wind dispersion.

The majority of the blast product settles in the harbour. However a small amount settles on the land adjacent to the Bridge. 'Redistribution' occurs when such deposited product is redispersed by wind circulation and this may continue for long periods after the initial deposition. Blast product settling on the water is dispersed by waves and tidal currents. Much of the finer material is flushed from the harbour by the strong tidal currents which run beneath the Bridge. The remaining material is deposited on the seabed in locations where eddies are formed and on sand banks and mudflats when the tide recedes. Given the airborne deposition pattern and the tidal streams and eddies in the Waitemata Harbour, any blast product which is retained in the harbour is likely to settle in the regions shown in Figure 3.

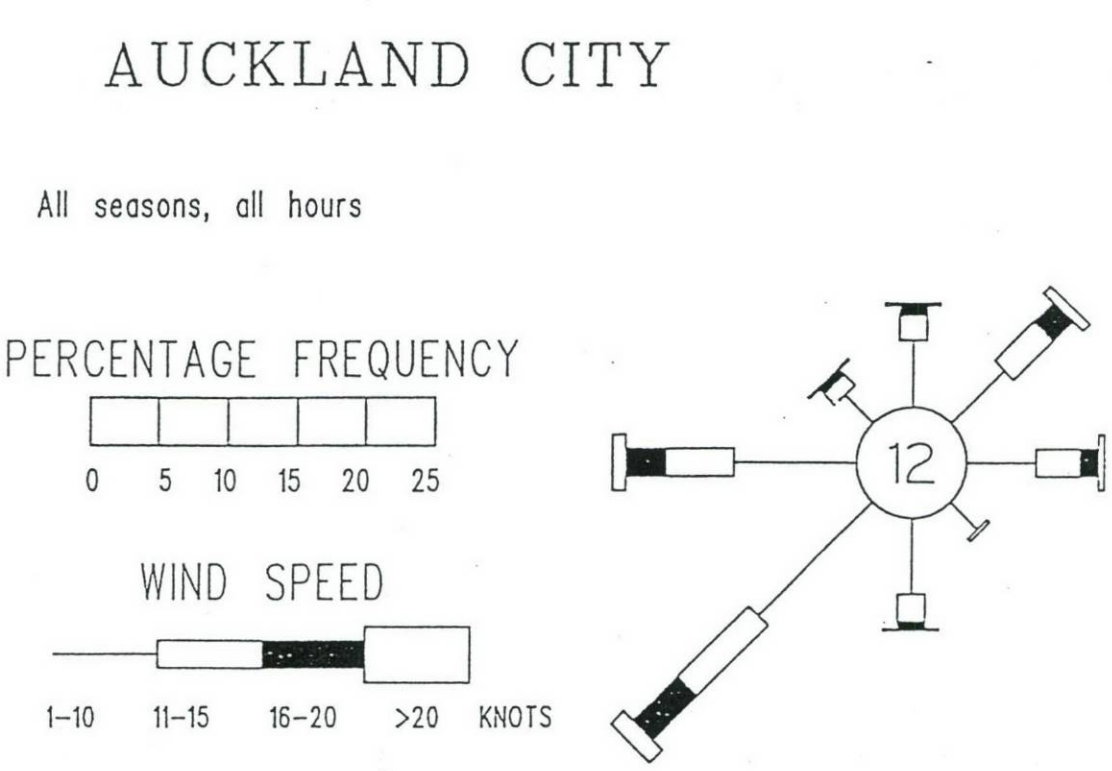


Figure 2: Windrose for Auckland City

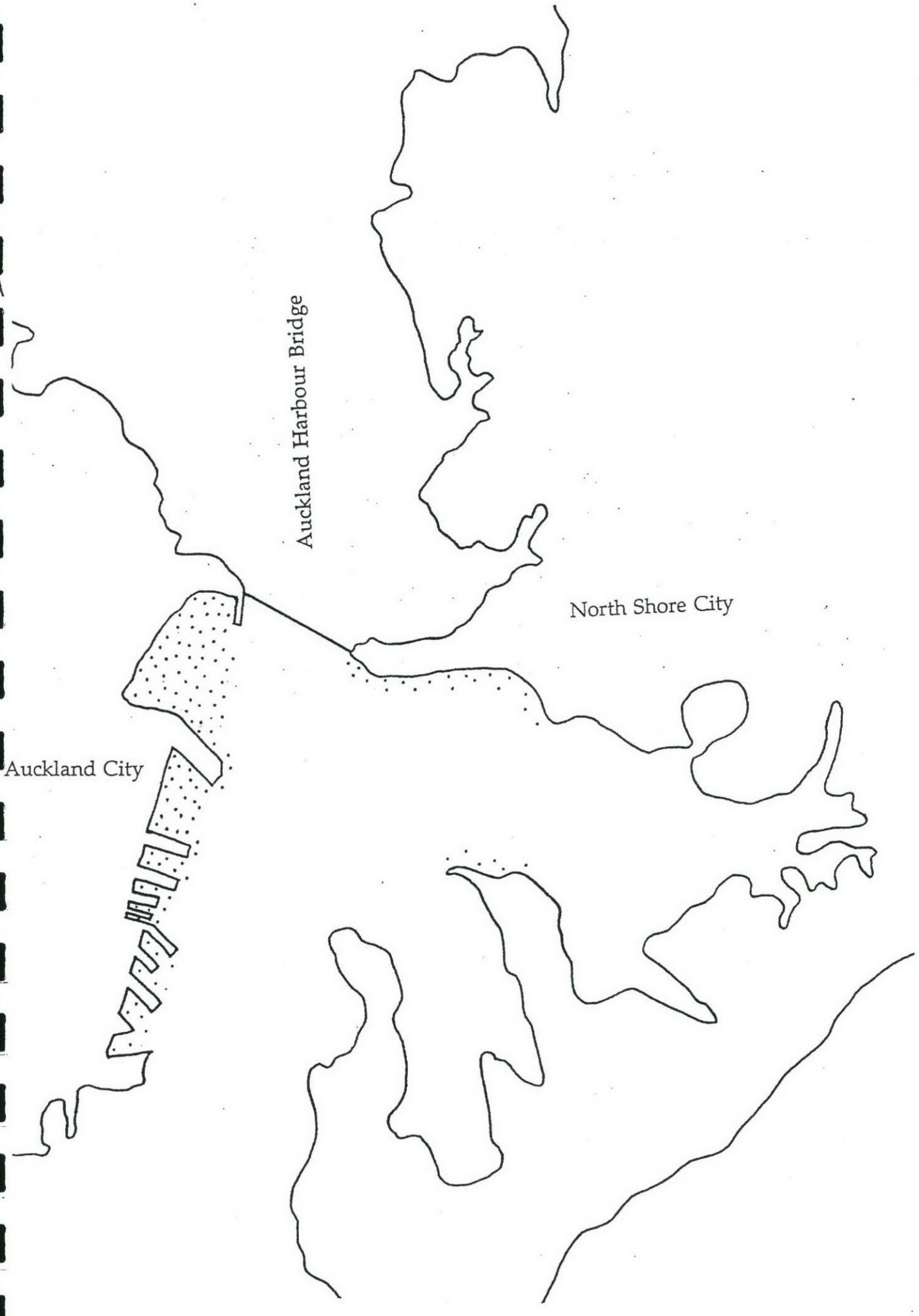


Figure 3: Approximate Deposition of Blast Product

4.2 EFFECTS ON THE AIR ENVIRONMENT

The wind conditions, shown in Figure 2, which prevail on and around the harbour bridge are likely to give rise to high air quality in terms of particulate pollution. With modal wind speeds of 6 to 10 metres per second, pollutants are rapidly dispersed resulting in an atmospheric environment which has a low sensitivity to inputs. The predominant wind directions transport blast particles in a easterly and north-easterly direction down the harbour and towards Shoal Bay, away from the populated areas. No monitoring has been carried out in the Auckland Harbour area so ambient air conditions are not known.

While the discharge has a significant effect on air quality close to the discharge source, wind conditions rapidly disperse the material to low concentrations and the relatively high density of the blast product means that it falls out of suspension rapidly. It therefore has negligible effect on the wider atmospheric quality. The inert and/or encapsulated nature of the particles in the discharge, and the very low levels of free silica in the blast media mean that it does not pose a health hazard.

It is recognised that deposition of the blast product has been a source of nuisance in the environment around the Bridge. Mitigating steps to combat this nuisance are proposed in Section 7.

4.3 EFFECTS ON THE MARINE ENVIRONMENT

Relevant testing of water quality and harbour sediments is reported in impact assessments completed in 1988 and 1989 (Environmental Impact Assessment, Bayswater Marina, 1988; The Effects of the Proposed Americas Cup Development on Marine Habitats, 1989).Water and sediment quality, as far as the relevant materials are concerned, are not considered to have changed significantly between 1988 and 1993. No major changes to contaminant sources or inputs into the harbour are known. In summary, the current aquatic and submarine environment is in a substantially modified and moderately polluted state.

Paint removal from the Bridge since its construction is not likely to have significantly contributed to existing pollution levels for several reasons. Firstly, the current maintenance practice of spotblasting only deteriorated areas of paint has been followed since repainting of the bridge began in the late 1960s. The areas where spotblasting was undertaken have comprised, on average, 5 percent of the total section being painted. Secondly, the frequency of repainting of any given section of the Bridge varies from approximately 6 years to 18 years (this equates to the entire bridge being repainted only once since it was built).

Given that 60 percent (170 million cubic metres) of the water in the harbour is exchanged each tidal cycle and that flushing in the vicinity of the Bridge is excellent with tidal velocities reaching 1.0 metre per second on the ebb tide, much of the fine blast product is removed from the harbour by tidal action.

The effect of the blast product on water quality is minor because of the inert and/or encapsulated nature of the blast product constituents. The blast product has little detectable effect on the existing suspended load of the harbour water and its turbidity since the estimated amount of material added in each six hour tidal cycle (0.7 tonnes) is 0.029 percent of the total natural suspended load carried by the harbour (2500 tonnes). There is minimal increased sedimentation due to the deposition of the blast product of which approximately 75 cubic metres are generated annually (0.15 percent of the 50,000 to 60,000 cubic metres of sediment entering the harbour yearly).

The amounts of lead, zinc and hexavalent chromium that entering the harbour do not significantly increase the existing levels because much of the blast product is removed from the harbour due to its good flushing characteristics. Present concentrations of lead, zinc and chromium in bottom sediments around the Bridge generally fall within the moderately polluted classification of the USEPA criteria for bottom sediments, although chromium and lead levels in St Mary's Bay and Bayswater indicate a heavily polluted environment for these heavy metals. Natural erosion of Waitemata sandstone which forms cliffs around the harbour contributes significantly to the high levels of chromium: typically sandstone contains 35 ppm chromium.

4.4 EFFECTS ON THE LAND ENVIRONMENT

The primary impact on the built environment is the dust nuisance caused by the settlement of the finer fraction of the blast product on property including housing, commercial buildings, boats and vehicles. At present, traffic dust and soil from exposed areas at the south bridge abutment have significant impacts on property. Generally the additional effect of the blast product in the existing environment is minor, although circulation/eddies around the abutments cause measurable nuisance effects in specific locations. 'Redistribution' (refer to Section 4.1) also contributes to this nuisance impact.

The impacts of the abrasive blasting operation will have a negligible effect on the open spaces at both the northern and southern ends of the Bridge. A light coating of dust over small sections of vegetation may occur occasionally. This coating will not have an adverse impact on the vegetation and is washed off during the next rainfall.

Blast product which settles on sealed sections of the land generally finishes up in the local gutter system. This material is then either collected by routine road sweeping services or is flushed through the stormwater drainage system.

4.5 NOISE IMPACTS

Noise levels at the southern end of the Bridge are moderate with major contributions from boat maintenance and traffic. The environment at the northern abutment is quieter, being subject to lower traffic noise levels. On the bridge itself, levels vary from moderate to high depending on traffic volumes. Noise levels are considerably higher during the day, particularly during the two traffic peaks, than at night. All the above factors, combined with the recreational and commercial nature of activities at the southern end mean that this environment is less sensitive than the residential area at the north end of the Bridge.

The existing environments are significantly polluted by traffic noise from the Bridge and, at the south end, by boat maintenance. Sandblasting operations generally take place between 7.00 am and 4.30 pm although occasionally they are scheduled during the night because of the limits imposed by traffic usage of the Bridge. The blasting is not a continual process, because of occupational safety requirements and practical constraints. From observations under various climatic conditions and traffic volumes, blasting is barely detectable against the existing environment from distances greater than 200 metres.

Noise impacts on neighbouring areas depend on the position and time of the blasting operations. The frequency of blasting on the bridge within 200 metres of the abutments is low since repainting is required, on average, at six yearly intervals. Blasting below the bridge deck is not detectable against the ambient noise as far as travellers in vehicles on the bridge are concerned. Blasting on the overarch and handrails has a moderate but localised impact which can be significantly reduced by closing vehicle windows. Given these factors, it is considered that the noise impact of the blasting is low.

4.6 CULTURAL IMPACTS

The discharge of waste into a water body is generally unacceptable to the tangata whenua for spiritual and cultural reasons. The reason for this is that discharges generally degrade the taonga (resources) and mauri (life-force) of the water body.

The discharge of blast product from the Bridge is not adversely viewed by the Ngati Whatua (the tangata whenua of the area) as long as the discharges have been reasonably minimised. The reason for this is that the discharge volumes are minimal and widely dispersed. Ngati Whatua have recognised the need for continual blasting of the Bridge and accept that some discharge in the water and onto the land is required.

4.7 OCCUPATIONAL HEALTH IMPACTS

Current work practices on the Bridge comply with the Construction Act (1959) and in particular blasting practices comply with the Abrasive Blasting Regulations (1958). Compliance with this legislation is the primary method for safeguarding the health of the workers. However additional monitoring of work practices and regular health checks for the workers are employed to ensure that occupational health impacts are minimised. The new Health and Safety in Employment Act (effective from 1 April 1993) will place even greater emphasis on worker safety.

4.8 ECOLOGICAL IMPACTS

Within Sulphur Bay, Shoal Bay and Ngataringa Bay the existing air, water and bottom sediment quality are not noticeably reduced by the abrasive blasting operation. Therefore it is reasonable to assume that the biomass supporting capacity of the ecosystems within these areas are not adversely affected by the blast product discharges.

A second Conservation Zone, Meola Reef, lies to the south west of the Bridge. It is seldom affected by the discharge because winds which transport particles in this direction are infrequent (see Figure 2) and tidal flows are directed away from the reef for 60% of the tidal cycle. Due to the dilution of the blast product of any material falling within the main channel, no impacts on the marine ecology are expected.

The Auckland Regional Council in its Regional Coastal Plan Discussion Document states, "...the governing factor in the management of the harbour will be its maintenance as a viable ecosystem". It can be concluded that the discharge of the blast product will not affect the integrity of the Harbours ecosystem as a whole.

5 DEMONSTRATION OF THE BEST PRACTICAL OPTION

Sections 2, 3 and 4 described the issues relating to

- technical features of surface preparation by abrasive blasting
- the sensitivity of the receiving environments to abrasive blasting processes
- the actual and potential effects of abrasive blasting

All of these issues need to be carefully considered in order to establish the best practical option. For this assessment the issues have been consolidated into seven key parameters as tabulated below. These parameters have been weighted equally because of the complexity of valuing them individually. The attributes are assigned a score on a 1-5 scale (1 being poor and 5 being excellent). The option with the highest total score is the best practicable option in terms of the attributes considered. The scoring is based on extensive past experience and recent literature reviews.

Table 1 : Best Practical Option for Abrasive Blasting

Method	OSH	SPrep	Cont	Pract	Env	Time	C/E	Total
Dry	5	5	2	5	3	5	5	30
Wet	3	5	4	4	3	4	3	26
Vacuum	5	2	5	2	5	3	2	24
Cont	4	5	5	1	5	2	1	23

Key:

OSH:	Occupational safety and health requirements
SPrep:	Adequacy of surface preparation
Cont:	Degree of containment or reduction in drift of blast product
Pract:	Operational practicality of method
Env:	Impacts on the natural and built environment
Time:	Time involved in preparation and blasting
C/E:	Cost effectiveness of procedure
Total:	Sum of the seven assigned parameters
Dry:	Dry abrasive blasting
Wet:	Wet abrasive blasting
Vacuum:	Vacuum blasting
Cont:	Containment of blast area using synthetic textile sheets

The table demonstrates that dry abrasive blasting is the best practical option. However, despite its disadvantages, wet blasting has been used to remove red lead because of the higher toxicity of the blast product.

6 CONSULTATION WITH AFFECTED PARTIES

6.1 AFFECTED PARTIES

Consultation was undertaken with identified affected parties to ascertain their perceptions of the blasting operations. The list of people required to be consulted was requested from the Auckland Regional Council.

Affected parties identified were:

- Ports of Auckland Ltd
- Department of Conservation
- Commercial interests at the western end of Westhaven Marina
- Northcote Point residents
- Ngati Whatua

A number of laminated copies of a letter outlining the activity and inviting submissions were posted in public places beneath the southern end of the Bridge.

This letter (Appendix E) was also distributed to the affected parties. It outlined the need for the activity, the discharge composition and volume, and the reason why consultation was being undertaken. Affected parties were invited to submit their viewpoints by phone or writing.

Three oral replies and four written replies (Appendix F) were received. Of the written replies three were from commercial interests at Westhaven Marina (Dunsford Marine Ltd, Taylor Marine Brokers and Ports of Auckland Ltd) and one from a Northcote Resident. The Ports of Auckland submission only referred back to previous correspondence between themselves and the Auckland Regional Council requesting an Environmental Impact Assessment. The oral submissions were from representatives of the Ngati Whatua and from the Commodore of the Royal New Zealand Yacht Squadron.

6.2 PERCEPTIONS OF AFFECTED PARTIES

The response from local residents was minimal and much less than initially anticipated. From this response it appears that many of the residents accept that the impacts are an acceptable inconvenience associated with living in close proximity to the Harbour Bridge. Though the impacts may be of nuisance value residents have not indicated that they are of significant scale to be viewed as a major impact on their property or lifestyle. The Commodore of the Royal New Zealand Yacht Squadron noted that though they are affected, the impacts are minor and irregular and are accepted by members as a consequence of being situated adjacent to the Bridge.

The majority of complaints in regard to the Auckland Harbour Bridge in recent years have come from commercial interests in Westhaven Marina. This is quite understandable as it is often perceived that any adverse impacts arising from work on the Harbour Bridge may affect customer numbers or enjoyment at affected commercial properties. Recent complaints from this area have focused on dust and noise and this is reflected in these submissions.

The main concern voiced in the submissions was the impact of "sand" and "grit" on neighbouring properties. This included blast material landing on cars, in house gutters and within buildings. These impacts are more of a nuisance value although the cost of cleaning up this material especially from house guttering and swimming pools does have an economic cost. No mention was made as to whether this nuisance impacted on the commercial interests of nearby businesses. The health aspect of the blast material was raised in one submission.

A secondary concern noted in two submissions was the noise generated by the blasting operation. However, one of these submissions did state, "The worst excesses of noise intrusion have not been from the sandblasting but from the resealing programme which involved the removal of asphaltic concrete from the steel plate carriageway with a sandblasting process". It needs to be noted that this procedure is not being considered as part of this application.

The action of contractors and their lack of accountability was also perceived as a problem especially in relation to cleaning up procedures.

In response to these concerns three of the submissions have considered possible permit conditions. The relevant conditions that have been requested are summarised below. The issues associated with the matters which these proposed conditions address, have been studied in this report. The relevant sections are given in brackets.

(a) That the active work areas are screened with appropriate material to prevent the aeolian dispersal of blast material (Section 2.3).

(b) That all abrasive-blasting near the southern end of the bridge only be undertaken when the wind is from the north, north-east and south-east (Section 7.3).

(c) That only wet-blasting be undertaken along the first 200 m of the southern end of the Bridge (Section 2.3).

(d) That controls are placed on noise levels and hours of blasting to reflect the nearby landuses (Section 4.5).

(e) That the Contractor be obliged to clean-up blast product, or to take reasonable precautions to protect those parts of private property which will be more sensitive to the blast property (Section 7.4).

It also needs to be remembered that a number of facilities have been established near the Bridge which, in retrospect, are inappropriately located. The maintenance of these facilities are the responsibility of the owners and not Transit New Zealand or their contractors.

6.3 CONSULTATION WITH THE TANGATA WHENUA

Ngati Whatua were identified as the tangata whenua of the area. Initial contact was made with Kaipara Consultants who act as consultants to Ngati Whatua. They understood that Ngati Whatua would have no major concerns. However, they did request that direct contact be made with Orakei Marae. A letter was sent to Ngati Whatua O Orakei Maori Trust Board requesting their viewpoints. In their oral response they noted that they were not concerned at the abrasive blasting operation as long as all reasonable precautions to limit the dispersal of the blast product were undertaken.

7 MITIGATION OF IDENTIFIED EFFECTS

7.1 IDENTIFIED EFFECTS

The identified effects are discussed in Sections 4 and 6. In summary,the principal effects are:

- negligible effect on atmospheric quality
- nuisance impacts on the land, being mostly dust problems and low noise level nuisance
- no noticeable degradation of existing water quality (the current aquatic and submarine environment is already in a substantially modified state)
- minimal increased sedimentation on the seabed due to deposition of the blast product
- minimal adverse impacts on the marine ecology
- minimal adverse impacts on occupational health
- minimal adverse effects on public health and safety

7.2 SCREENING OF WORK AREA

Screening of the work area would contain the bulk of the blast product and would also reduce noise. Containment of the blast area has been discussed in Section 2.3 but the size of the structure, the differing geometries of the work areas (such as box extensions, upper chords, stringers, king posts, etc), the visual impact, the localised wind conditions and the significant time delays involved in using containment mean that enclosure is not practical on the Bridge.

7.3 LIMITATION OF BLAST ACTIVITIES

The dust nuisance arising from the deposition of the blast products may be mitigated if blasting is confined to specified wind conditions. Current blasting procedures confine blasting to wind speeds of below 7 m/s, irrespective of wind direction. Even if these conditions were modified to confine blasting to calm conditions or offshore wind directions, the reductions in dust nuisance would be lessened by the effects of local eddies. Also, implementing such conditions would impose severe production and economic costs. Furthermore, such measures have no benefit in mitigating dust nuisance from 'redistribution'.Therefore it is not considered that this is a cost effective measure for mitigating the dust nuisance.

7.4 REMOVAL OF BLAST PRODUCT

One of the most effective mitigation methods for dust nuisance is the ground collection of the blast products. Blast product will be swept and collected from the bridge structure and/or carriageway regularly. The blast product will be collected and disposed of in a manner which minimises adverse environmental effects. The disposal of blast product in this way will significantly lessen the dust nuisance.

7.5 PUBLIC NOTIFICATION

Proactive public notification is a cornerstone of the management of the Harbour Bridge. Currently public notification involves newsletter drops and personal visits to residents. In line with this practice, occupiers and residents will be informed by newsletter drops when blasting is programmed for sections of the Bridge adjacent to the north and south shores.

7.6 MONITORING OF BLASTING ACTIVITIES

While the overall impacts of dry abrasive blasting on the bridge are generally minor, the management of the Bridge take seriously their environmental responsibilities and propose that the blasting activities be monitored. To further identify and address the nuisance impacts a file of all written complaints with regard to the blasting process will be kept, and any groups or individuals with grievances will be advised to submit a written complaint. The file will be subject to on-going assessment by the applicant with a view to identifying problems caused by the blasting. All reasonable steps will be taken to ameliorate the problems.

The Auckland Regional Coastal Plan may incorporate the concept of setting environmental baseline limits as a management tool for protecting the environment and resources of the Harbour. Setting specific baselines to monitor the impacts from the blast product is not feasible because of the wide range of sources and types of contaminants entering the harbour.

8 CONCLUSION

The Auckland Harbour Bridge is an essential feature of the State Highway network. It is sited in an marine environment and because of its steel construction is vulnerable to deterioration and corrosion. The steel is protected by a paint system but a continual programme of maintenance is required to preserve the integrity of the coating system. For practical and economic reasons the maintenance system is a localised treatment procedure (spot blasting and localised repair) rather than a repaint process. The abrasive blasting process is an essential part of the surface preparation for maintenance painting and it is demonstrated to be the best practical option for the Harbour Bridge.

The abrasive blasting procedure involves some discharge of blast material into the air. This blast product is dispersed in the air before settling on either the land or the Waitemata Harbour. The material which lands on the water surface either settles on the seabed or foreshore. Under the Resource Management Act 1991 this blast material is defined as a contaminant and resource consents are required from the Auckland Regional Council to allow for the discharge of the blast product and its subsequent settling onto land or water. This assessment has been prepared in accordance with the Fourth Schedule to the Resource Management Act and is submitted as part of the three resource consent applications.

The assessment evaluates the available options for abrasive media blasting, the physics of the blasting process and discharges, the sensitivity of the receiving environments, the actual and potential environmental effects, and submissions from consultation with affected parties.

The identified impacts were:

- negligible effect on atmospheric quality
- nuisance impacts on the land, being mostly dust problems and low noise level nuisance
- no noticeable degradation of existing water quality (the current aquatic and submarine environment is already in a substantially modified state)
- minimal increased sedimentation on the seabed due to deposition of the blast product
- minimal adverse impacts on the marine ecology
- minimal adverse impacts on occupational health
- minimal adverse effects on public health and safety

Because of the modified state of most of the receiving environments they generally have a low to moderate sensitivity to blast product and noise inputs. The dispersed nature of the blast product in the receiving environments means that environmental impacts are minimal. There are no health hazards posed by the blast product since the particles are inert or encapsulated and not available for uptake by organisms. The levels of

free silica in the abrasive media are less than 1%, in accordance with occupational health guidelines and therefore pose no threat to worker or public safety. Consultation was undertaken with affected parties. The main issues raised were dust and noise and these concerns have been addressed in this report.

REFERENCES

Auckland Harbour Bridge: Blasting Media Tests, Central Laboratories Report 93-24730. Central Laboratories, Works Consultancy Services, Wellington. February 1993.

Auckland Harbour Bridge: Blast Product Tests, Central Laboratories Report in preparation. Central Laboratories, Works Consultancy Services, Wellington. March 1993.

Environmental Impact Report, Bayswater Marina. Various authors. 1988.

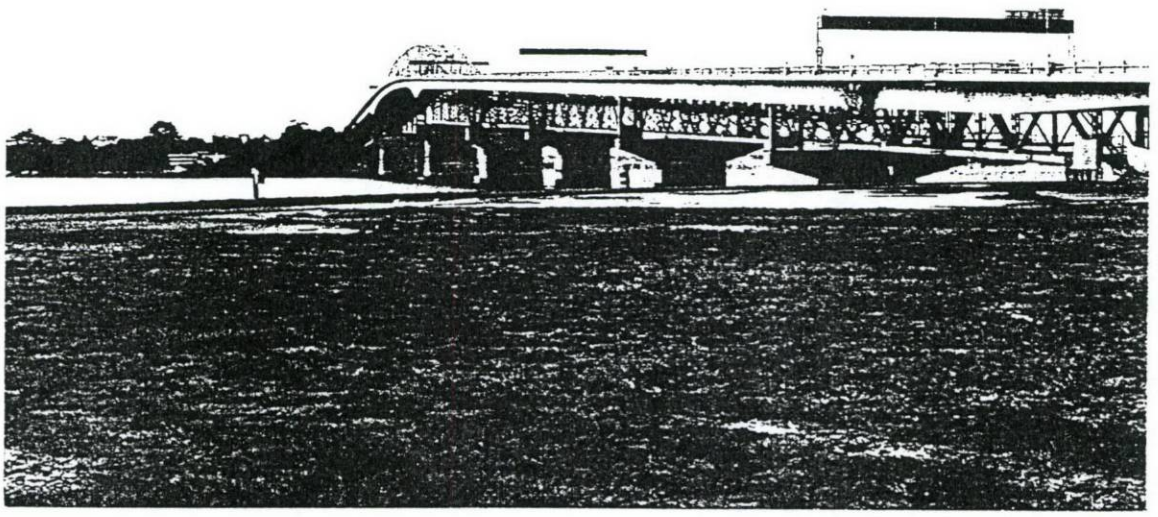
Internal Report AHB 1:1993. Works Consultancy Services Internal Report. March 1993.

The Effects of the Proposed Americas Cup Development on Marine Habitats. Bioresearches. 1989.

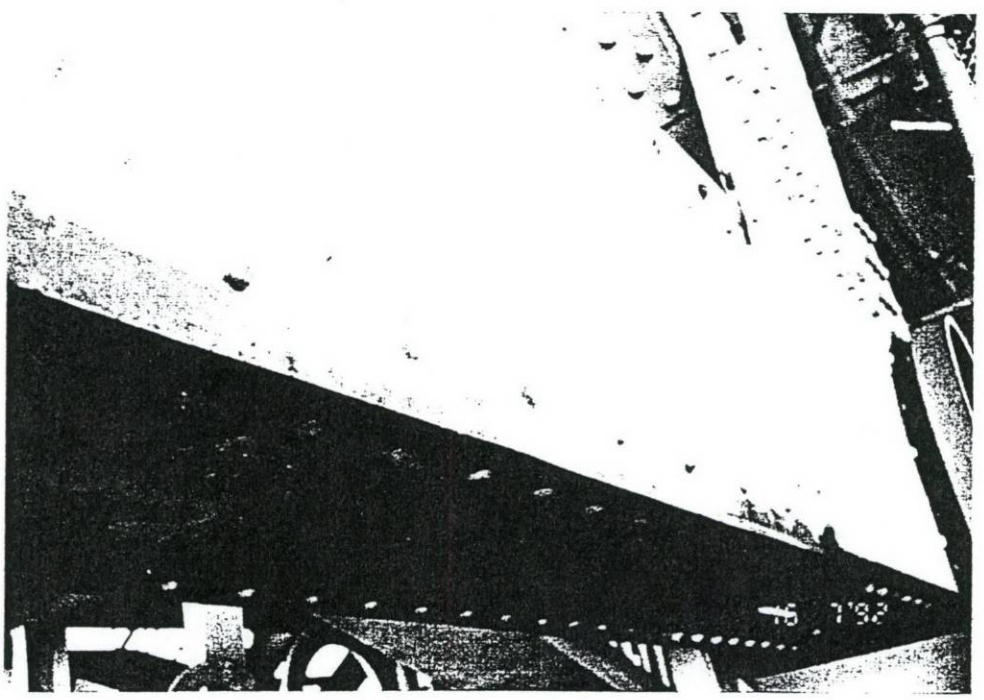
APPENDIX A

Photographs

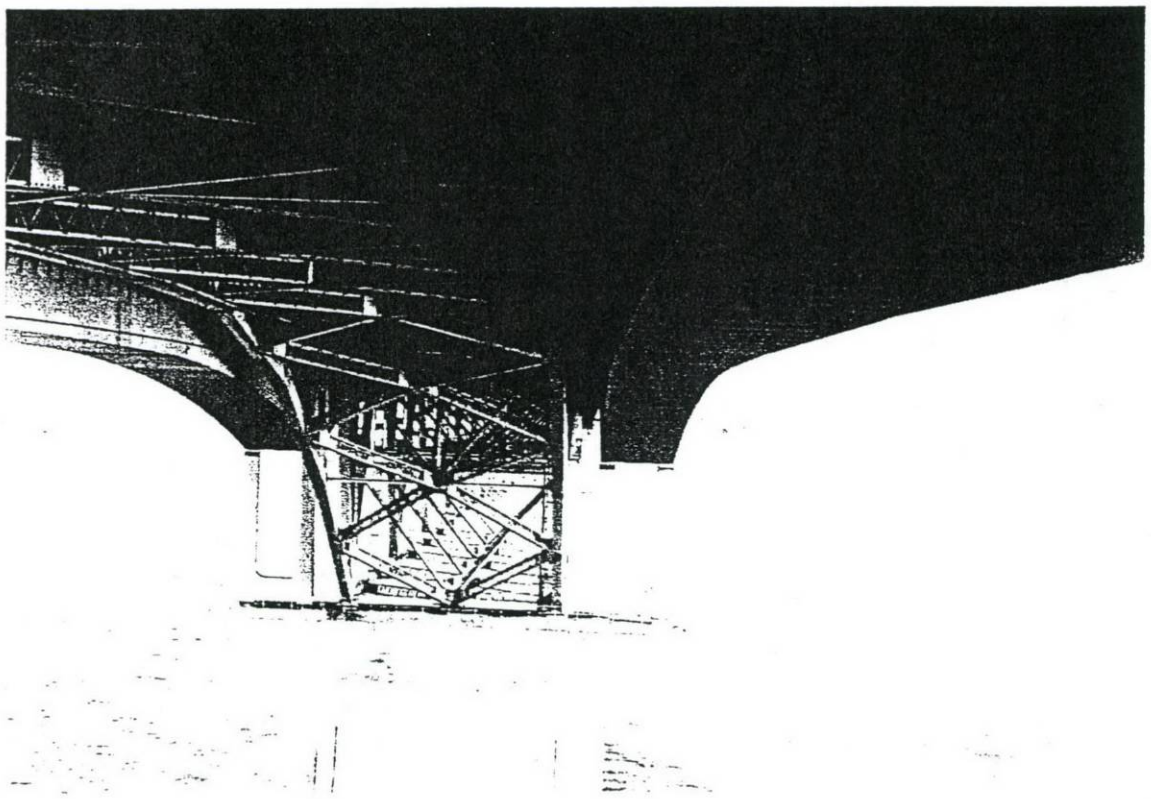
Appendix A: Photographs



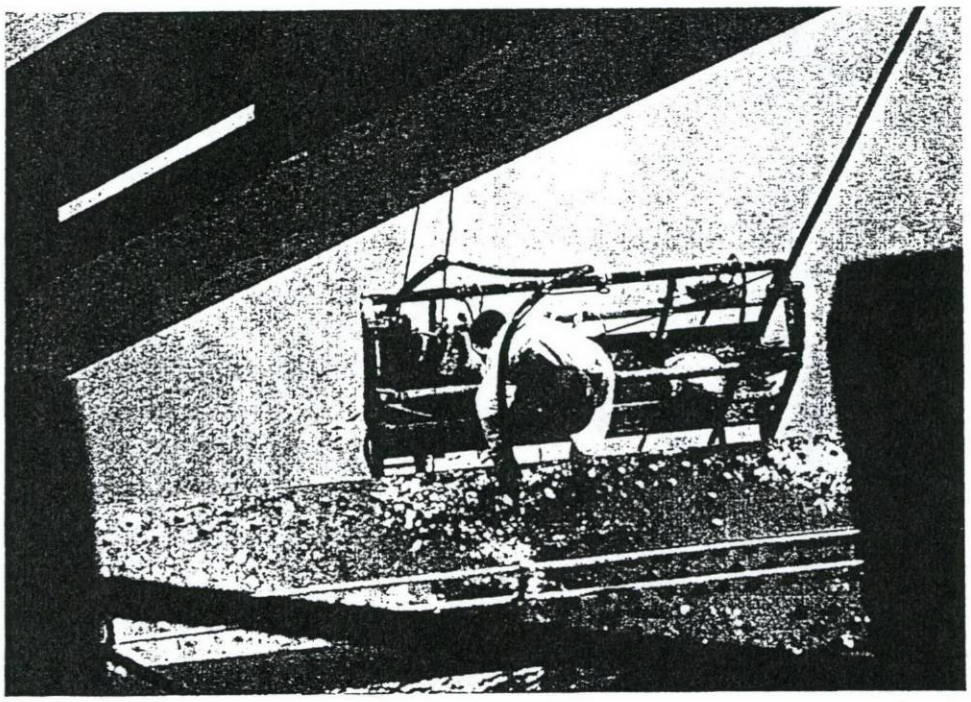
The Auckland Harbour Bridge viewed from the south end.



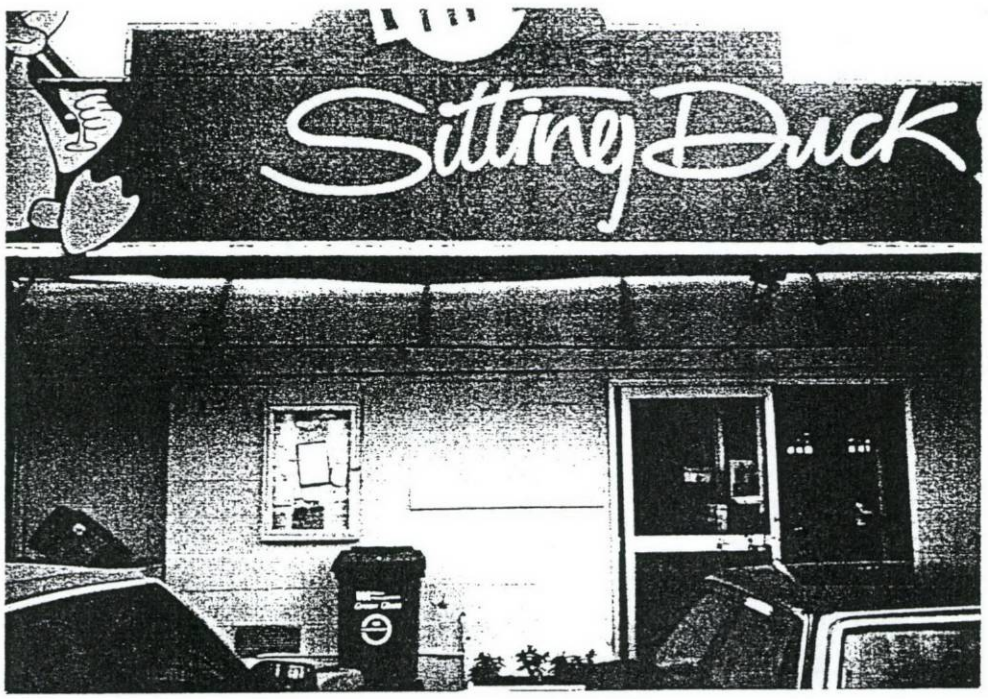
An area of corrosion on the bridge prior to blasting.



View of the steelwork beneath the bridge deck showing the complex geometry and access difficulties.



Abrasive blasting about to commence.



The noticeboard at Sitting Ducks Cafe at Westhaven Marina.

Close up of the noticeboard showing the letter to affected parties in the bottom right corner.

APPENDIX B

Summary of the Legal Framework

SUMMARY OF THE LEGAL FRAMEWORK

The Resource Management Act 1991 (RMA) defines a contaminant as:
"any substance (including gases, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that whether by itself or in combination with the same, similar, or other substances, energy, or heat-
(a) When discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or
(b) When discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged".

Based on this definition, the blast product (a combination of the blasting material and removed paint) which is being discharged into the air before settling on land or water can be defined as a contaminant. The discharge of contaminants into the environment is controlled under Section 15 of the RMA:
"Section 15.Discharge of contaminants into environment -

> *(1) No person may discharge any -*
> *(a) contaminant or water into water; or*
> *(b) contaminant onto or into land in circumstances which may result in that contaminant (or any other contaminant emanating as a result of natural processes from that contaminant) entering water; or*
> *(c) contaminant from any industrial or trade premises into air;* or
> *(d) contaminant from any industrial or trade premises onto or into land -*
> *unless the discharge is expressly allowed by a rule of a regional plan, a resource consent, or regulations."*

An Industrial or Trade Premises is defined in the Act as:
"(a) Any premises used for any industrial or trade purposes; or
(c) Any other premises from which a contaminant is discharged in connection with any industrial or trade process -..."

An Industrial or Trade Process is defined in the Act as:
"Includes every part of a process from the receipt of raw material to the dispatch or use in another process or disposal of any product or waste material, and any intervening storage of the raw material, partly processed matter, or product".

Sandblasting can be defined as an industrial or trade process under this definition.

Therefore, under Section 15 of the RMA the discharge of blast product (a contaminant) into water (Section 15(1)a), into air (Section 15(1)c) or onto land (Section 15(1)d) unless expressly allowed by a rule of a regional plan, a resource consent, or regulations. As the Transition Regional Plan does not include relevant rules and the discharge is not covered by any appropriate regulations, resource consents are required to permit the discharge of the blast product into the air and onto land or water.

The requirements for a fourth resource consent, a coastal permit allowing deposition of blast product on the foreshore and seabed, were unclear. Section 12 of the RMA details restrictions on use of the coastal marine area. Of particular relevance to the abrasive blasting is part 1(d):

"(1) No person may -

> *(d) deposit in, on, or under any foreshore or seabed any substance in a manner that has or is likely to have an adverse effect of the foreshore or seabed;*
> *unless expressly allowed to do so by a rule in a regional coastal plan or a resource consent".*

Following negotiations between the Auckland Regional Council and Consultancy Services, the Council decided that the discharge into coastal waters and the deposition of material on the seabed or foreshore could be covered adequately by a single coastal permit.

APPENDIX C

Data Sheets of Blast Material and Laboratory Tests

MINTECH (N.Z.) LTD.
121 CARBINE ROAD, MT. WELLINGTON,
P.O. BOX 62 118, MT. WELLINGTON,
AUCKLAND, NEW ZEALAND.
TELEPHONE: (09) 276 1360.
TELEX: NZ 21 051 MINTECH.
FAX: (09) 276 1391.

MINTECH

INDUSTRIAL MINERALS

SAND - S.A.E. Fines Provisional Data SDB820 1090

A sand with no free silica (quarts) processed at Waitakere.

Typical Chemical Analysis		Per Cent
Silica	SiO_2	49.0
Aluminium Oxide	Al_2O_3	17.32
Ferric Oxide	Fe_2O_3	10.84
Calcium Oxide	CaO	7.41
Magnesium Oxide	MgO	6.01
Sodium Oxide	Na_2O	2.50
Potassium Oxide	K_2O	0.33

Typical Physical Properties

Particle Size Analysis

95% between 0.5 - 0.15mm
All passing 0.5mm

Pack

25 Multiwall paper bags or bulk by arrangement

Dricon Envirogrit

Dricon Envirogrit

Dricon Environgrit is an environmentally friendly, no hazardous blasting material for use in mobile, static, air or wet blasting applications.

Dricon Envirogrit is a clean, abrasive material containing no free silica and practically free of dust particles.

Environmentally Friendly

Dricon Envirogrit meets the New Zealand Occupational Health and Safety guide-lines for blasting grit of less than 1% free silica. Other mineral components in Dricon Envirogrit are of no concern from the point of view of toxicity. (Refer geologists report at rear)

Because Dricon Envirogrit is clean and dust free it can be used in confined spaces or where dust has previously prohibited commercial blast cleaning operations.

Performance

Dricon Envirogrit is recommended as a substitute for quartz bearing sands in most blast cleaning operations. The combination of a high bulk density, the angular nature of each particle, and the high content of effective particles per batch, makes Dricon Envirogrit a very efficient and cost effective blast cleaning material.

Dricon Envirogrit produces the same and in some cases better cleaning performance than quartz bearing sands due to less material being required to clean a given area than softer sands such as pitt and river sand.

Manufacturing Procedure

Dricon Envirogrit is manufactured from a special quarried rock. The rock is crushed to produce the desired shape for blast cleaning. The material is screened before passing through a wet dedusting operation that removes particles less than 400 microns. The material is then dried and rescreened before being packaged. Dricon Envirogrit is available in bulk one or two tonne bags and standard 25 kg Multiwall paper bags.

Cont/.....

Size Range

	Particle size (mm)	*Specific Gravity*	*Bulk Density*
Course	4.2mm - 2mm	2.5	1.5
Standard	2mm - 0.4mm	2.6	1.6
Fine	1.2mm - 0.4mm	2.6	1.6

Average Profile On Mild Steel

50 : 75 microns

Environment

Conventional blast cleaning equipment can be used with Dricon Envirogrit.

Dricon Envirogrit is not recommended for cleaning delicate surfaces such as gloss or vintage car bodies.

Recycling

Dricon Envirogrit may be reclaimed for reuse providing the following points are taken into account.

1. The abrasive must be dry.
2. Abrasive must be re-screened to sieve out foreign matter etc.
3. Abrasive will not give the same profile of surface roughness as when first used.
4. Abrasive may contain dust and contaminants in recycled material harmful to health.

Surface Coatings

Conventional industrial costing may be used on surfaces blast cleaned with Dricon Envirogrit. Methods at application should be checked with a paint manufacturer.

IT IS RECOMMENDED TO BLOW DOWN STEEL WITH AIR BEFORE PAINTING

KRTA Limited Engineers Architects Scientists Planners

25 Teed Street Newmarket Auckland New Zealand
PO Box 9806 Ph (09) 520 6069 Fax (09) 520 4569

150 Willis Street Wellington New Zealand
PO Box 3582 Ph (04) 847725 Fax (04) 852666

Envirogrit

We have reviewed data on samples of this material, with the objective of assessing its suitability as a sandblasting material from the point of view of free silica content.

A rock of this chemical composition would be very unlikely to contain free quartz as part of the main body of the rock, either as phenocrysts or in a crystalline groundmass. This is confirmed by the petrology, where no quartz or other silica species such as tridymite or cristobalite was reported in any of the thin sections. Given the thoroughness of the examination, based on the detailed nature of the petrology, it is safe to say that any quartz present would have been reported, even if present at sub-percent quantities.

In some cases, the vesicles in such rocks can be infilled with secondary ("deuteric") minerals, which are of different composition to the rock as a whole, and may include some quartz even though the rock as a whole is undersaturated with respect to quartz. However, the samples examined in this study include some with infilled vesicles, and no quartz was found. Nor was quartz found as joint-filling material. The coverage of samples appears sufficiently representative to say that this possibility can be ruled out.

No quartz was observed in five of the samples analysed by XRD. The sixth sample did contain quartz and tridymite. However, this samples was of a small inclusion in the rock, which was presumably analysed because it was atypical. It may have been a piece of thermally metamorphosed sandstone. Such inclusions were not otherwise reported, and can be assumed to be so rare that they would make an insignificant contribution to the bulk composition of the rock as quarried.

It can therefore be concluded that "Envirogrit", would easily meet the criterion of less than 1 % free silica which is the New Zealand Occupational Health and Safety guideline for blasting grit. Nor would any of the other mineral components be of concern from the point of view of toxicity.

The material has one further advantage: its composition is such that it can be expected to have a higher bulk density than the sands generally used for blasting grit in this country, and so would settle out of the air more rapidly.

KRTA Limited

J V Lawless
Senior Geologist

TABLE 1: Results of Testing

Sample	Sieve Analysis, % Passing						Free Quartz Estimated %	Soluble Material (%)	Soluble Chlorides (%)	As Received Moisture Content (%)
	1.4 mm	1.0 mm	850 µm	300 µm	180 µm	150 µm				
4-93/4 Mintech "Fineblast"	100	100	100	60.8	21.7	13.2	<1	0.063	0.0006	0.2
4-93/5 Mintech "Rom"	58.9	38.3	28.9	1.9	1.7	1.6	<1	0.000025	0.0002	0.3
4-93/6 Firth Dricon "Standard"	100	98.9	89.4	25.1	11.6	8.5	<1	0.023	0.0010	1.1
4-93/7 Firth Dricon "Superfine"	100	100	100	42.5	6.6	3.3	<1	0.035	0.0018	0.2

APPENDIX D

Particle Size Grading of Blast Product

Blast Product Particle Size Distribution

Sieve size	Individual Mass Retained (g)	Individual % Retained	Cumulative % Retained
1.4 mm	0.03	0.01	0.01
1.0 mm	0.09	0.04	0.05
850 µm	0.17	0.08	0.13
300 µm	60.42	29.73	29.86
180 µm	81.70	40.19	70.05
150 µm	16.07	7.91	77.96
pan	44.78	22.03	99.99

APPENDIX E

Public Letter

February 1993

Dear Sir/Madam

SAND BLASTING OF THE AUCKLAND HARBOUR BRIDGE

Since the Auckland Harbour Bridge was opened in 1959, maintenance has involved regular dry and wet sand (or abrasive) blasting to remove old paint and rust before maintenance painting. This maintenance painting programme involves leaving the intact paint and spot-blasting and repriming the deteriorated areas of paint only. These areas are then topcoated. The sand-blasting was previously undertaken without the need to gain consents or permits from local Councils.

When the Resource Management Act became law in October 1991 the discharge of the 'blast' material from the bridge into the air became an activity which requires specific consent. To allow for the continuation of the sand-blasting operation resource consents are required from the Auckland Regional Council.

As part of the application for these resource consents an assessment of the effects on the environment is being prepared. This involves consulting with identified affected parties.

Works Consultancy Services Ltd has been commissioned by Transit New Zealand to prepare this assessment and to consult with affected parties.

The consents, if granted, will only regularise the on-going practice. There will be no changes to the present sand-blasting operations or the material being discharged. In effect you will not notice any changes in material being discharged from what has occurred during the past 33 years. It needs to be also noted that this sand-blasting is a necessary part of the maintenance programme which is required to keep the Auckland Harbour Bridge operational for the 42 million vehicles which pass over it annually.

The 'blast' material comprises of sand and paint flakes containing small amounts of chromate, zinc and lead. Red lead primer was only used in 1959 as the initial primer on a small area near the south end of the bridge and is covered by a minimum of five coats of paint. Only a small proportion of the original red lead primer remains.

The average volume of total paint removed from the bridge annually is 1.1 cubic metres. The 'blast' material is well dispersed by air currents with much of it finally settling in the Shoal Bay area or further down the Waitemata Harbour. Scientific studies to date indicate that there are no adverse environmental effects from the distribution of this material.

As a part of the consultation process you are invited to express your viewpoints or concerns. Written submissions should be sent to:

Works Consultancy Services Ltd
PO Box 5848
Wellesley St
Auckland

Attn: David Hay

or if you prefer, you can phone David Hay on (09) 3096863.

Your comments on this matter will be welcomed. Because of the short time-frame set by the Auckland Regional Council we require your replies by the 1st of March 1993.

Yours faithfully
Works Consultancy Services Ltd

Noel Hawkins
Project Manager

APPENDIX F

Written Submissions

METRO PLANNING LIMITED

24 February 1993

David Hay, Esq.,
Works Consultancy Services Ltd
P O Box 5848
Wellesley Street

Dear Mr Hay

SANDBLASTING - AUCKLAND HARBOUR BRIDGE
RESOURCE MANAGEMENT ACT 1991

I am writing to you on behalf of my clients s9(2)(a) Northcote. They have received your invitation for public comment on the proposed continuation of sandblasting operations of the Auckland Harbour Bridge and the consequential resource consent which will be required to continue that activity.

They have owned this property since 1961 and have experienced 32 years of uncontrolled, sandblasting maintenance on the harbour bridge. In summary, their experience has been that their property has suffered from the complete lack of protection for residential properties during any sandblasting works carried out in the past. There has been no regard for wind conditions or wind direction by the contractors who have often irresponsibly disposed of bulk material over the edge of the bridge or their work gantries. More importantly, they have been concerned and often horrified at the actions of sub contractors who appear on the whole to be answerable to no-one.

The result of this uncontrolled work has been that the general residential area under the steel superstructure of the bridge on Northcote Point is covered by a layer of sand and paint litter when the sandblasting work is in progress. The litter fills up house gutters which have to be cleared regularly to avoid

excessive corrosion and has on several occasions loaded my client's swimming pool with toxic debris. This material is very difficult to remove from the pool without emptying it completely. The domestic pool vacuuming system is not designed to remove such a heavy load of small particles. The hours of work in which sandblasting is undertaken also needs to consider the residential area below the bridge. The extremely noisy industrial processes involved in sandblasting should not be permitted to extend beyond 10 pm nor commence before 6.30 am. The worst excesses of noise intrusion have not been from sandblasting but from the resealing programme which involved the removal of asphaltic concrete from the steel plate carriageway with a sandblasting process. I note that you are not applying for a consent related to this activity at this stage.

While it is accepted by my clients that the bridge must be maintained, it must also be accepted by the authorities that some conditions of consent are now required to protect the neighbourhood from adverse effects which were previously uncontrollable and outside of any consent authority. I consider that the following matters should be included in any proposed conditions of consent which arise from your statement of effects planning report which will be accompanying this application. My suggestions are as follows:

a) That the active working areas are screened with appropriate material to prevent the free airdrift of sand and paint litter.

b) That controls are placed on noise levels and hours of operation to reflect the residential environment beneath the bridge superstructure on the Northcote Point side. Obviously these controls will not apply where the working area is remote from the residential environment.

c) That the contractor be obliged to take reasonable precautions, where necessary, to protect those parts of private property which will be more sensitive to the accumulation of the airborne sandblasting and paint litter. For example, covering private swimming pools should be obligatory under the conditions of consent.

d) That the contractor be obliged to clean up private property and the local reserve areas in the event of the proposed containment and operational controls failing in any way whatsoever.

e) That stringent and effective operational controls be placed on the contractor and subcontractors to meet the conditions of consent including the daily cleanup of their screened work areas when in the vicinity of the Northcote Point residential area.

These are the kind of matters that require conditions of approval to be written in the appropriate manner and to be attached to any notified application. If such conditions are well prepared and clearly presented it is quite likely that the anxieties of the Northcote Point neighbourhood which arise from their previous bad experiences with sandblasting, could be allayed.

Please take notice that s9(2)(a) [redacted] want to be notified of any application whatsoever relating to maintenance on the Auckland Harbour Bridge whether or not the application is notified. Please feel free to contact me if you require any further information.

Yours sincerely,

Brian William Putt

Brian William Putt

taylor
MARINE BROKERS

Westhaven Marina, TAYLOR SHIPBROKERS (1989) LTD. Phone 3761-083, Fax 360-2479. P.O. Box 47-322, Auckland.

23 February 1993

Works Consultancy Services Ltd,
P.O. Box 5848,
Wellesley Street,
AUCKLAND.

ATTENTION: MR DAVID HAY

Dear Sir,

RE: SAND BLASTING OF THE HARBOUR BRIDGE

Being the nearest premises to the Auckland Harbour Bridge we are frequently affected by sand-blasting.

Our cars are regularly covered with grit and occasionally flecks of new paint.

We appreciate that the bridge needs painting but the continuous blasting noise, grit, plus paint particles must be a serious health hazard.

Our suggestion to alleviate the problems would be:

1. All sand-blasting near the southern end of the bridge to be done when the wind is in the hemisphere of North through East to South.

2. Only wet sanding to be done for the first 200 metres of Southern end of the Bridge (Westhaven rock wall).

3. Drop sheets to be used when painting.

4. Airless type spray guns used to minimize spray mist.

5. Alternate blasting from close in to further out to give us a spell from the terrible noise generated by sand blasting (i.e. the continuous blasting 8 hours per day, week after week, becomes very hard on the ears and makes everyone on edge). Alternatively, and more favourable to us, sand-blast (particularly Westhaven end of the bridge) outside normal business hours.

We appreciate the opportunity to have our concerns and viewpoints assessed and evaluated and look forward very much to hearing some favourable results.

Yours faithfully,
TAYLOR MARINE BROKERS

s9(2)(a)

DIRECTOR

taylor
MARINE BROKERS

Westhaven Boatharbour, TAYLOR SHIPBROKERS (1989) LTD. Phone 3761-083, Fax 360-2479 P.O. Box 47-322, Auckland.

26 February 1993

Works Consultancy Services Limited,
P.O. Box 5848,
Wellesley Street,
AUCKLAND.

ATTENTION: MR DAVID HAY

Dear Sir,

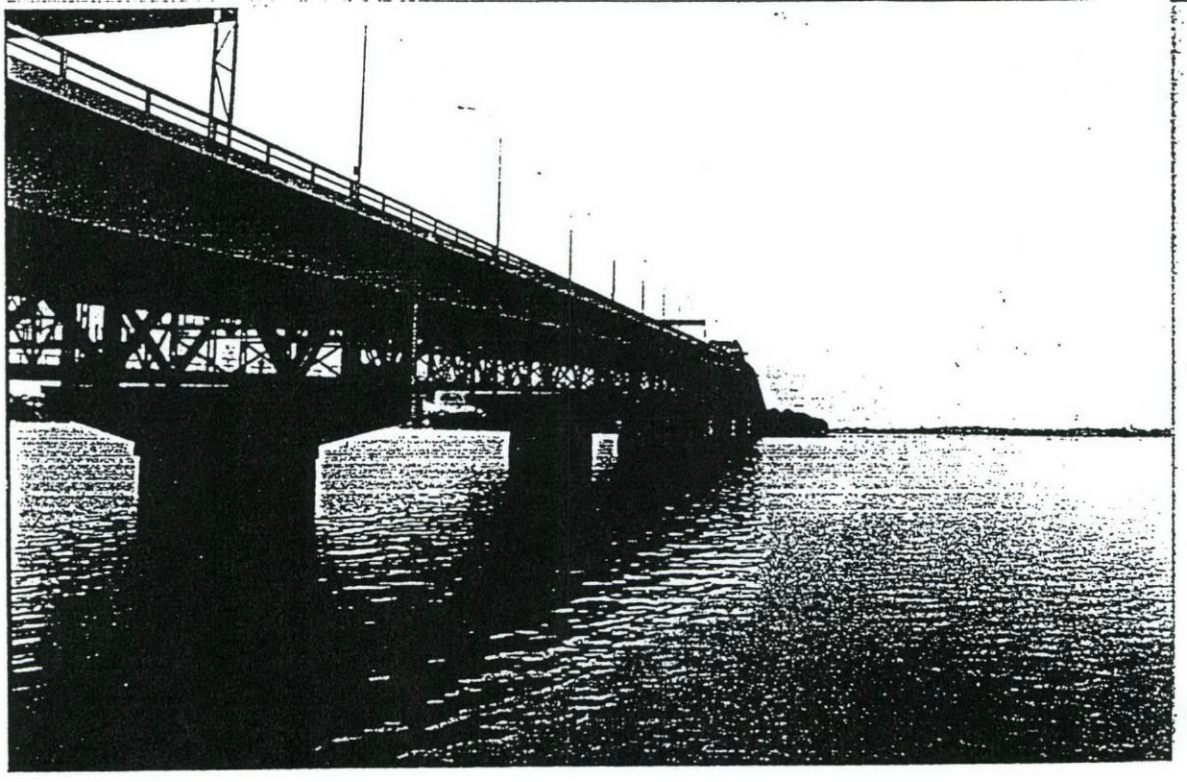
RE: SAND BLASTING OF THE HARBOUR BRIDGE

Further to our letter dated 23 February 1993, herewith please find a photo we took between the 8th and 12th February 1993 demonstrating the cloud of dust created by the sand blasting of the Auckland Harbour Bridge. This dust settled directly over our cars and office premises. We have two restaurants adjoining us ("Sitting Ducks" and the "Ponsonby Cruising Club") and their food, staff and clientele would also be affected by both the inhaling and settling of the dust.

Yours faithfully,
TAYLOR MARINE BROKERS

s9(2)(a)

DIRECTOR.



Marine & Cargo Surveyors
Assessors & Loss Adjusters
Ship Surveyors
Yacht & Launch Surveyors
Salvage Contractors
Container Surveyors
Nautical Consultants

Marina Control Building
Westhaven Drive, Westhaven
Auckland, New Zealand

Private Box 46-216, Herne Bay

Telephone 09 378 1254
Facsimile 09 378 1258

DUNSFORD MARINE LIMITED

OUR REF FGG:jmb
25 February 1993

The Manager
Works Consultancy Services Ltd
PO Box 5848
Wellesley Street
AUCKLAND

ATTENTION : DAVID HAY

Dear Sir

Re: SANDBLASTING OF THE AUCKLAND HARBOUR BRIDGE

It is understood that blasting is a necessary requirement for the on-going maintenance of the bridge. It has been advised in your circular that there will be no change to the present sandblasting operation or material being discharged. This material and paint flakes containing small amounts of chromate, zinc and lead are advisedly well-dispersed by air currents with much of it settling in the Shoal Bay area or further down the Waitemata Harbour. It is further advised that the red lead primer is confined to a small area near the south end of the bridge and that only a small area remains.

Our office is situated in close proximity to the south end of the bridge and is affected by the sandblasting with wind-blown grit invading the premises and coating vehicles parked in the vicinity.

It is not understood why this should occur if adequate note is made of prevailing wind directions and the maintenance plan adjusted accordingly. It is also wondered if any study into the method of blasting has been undertaken to determine whether high pressure waterblasting, for example, at the southern end of the bridge might assist in reducing the extent of wind-borne contaminants.

In summary, it is not considered acceptable to assume that the status quo of practices undertaken over the last 33 years be continued without appropriate investigation of alternatives in order to achieve improvement of pollutant levels experienced.

Yours faithfully
DUNSFORD MARINE LIMITED

s9(2)(a)

MANAGING DIRECTOR

FAXED

PORTS OF AUCKLAND

Port Property & Development

Port Property & Development —
Ports of Auckland Ltd.,
Princes Wharf, Quay St, Auckland 1.
P.O. Box 1560, Auckland 1.
Telephone: (09) 366-0055
Facsimile: 064 (09) 3075-822

Reference

24 February 1993

Works Consultancy Services Limited
P O Box 5848
AUCKLAND

By Fax : 377-1625

Attention : Noel Hawkins

Dear Sir

SAND BLASTING OF AUCKLAND HARBOUR BRIDGE

I refer to your letter dated February 1993 received in this office at 4.00 pm on 22 February 1993.

The Port Company has previously lodged submissions with the Auckland Regional Council requesting further information be provided by the applicant so that the effects, if any, on the environment from the sandblasting operation can be properly evaluated. These details are still awaited and I look forward to receiving this information at the earliest opportunity so that the Port Company can respond.

In the meantime, Ports of Auckland Limited may well oppose any discharge into air and/or water in terms of Section 15 of the Resource Management Act 1991.

Yours faithfully

s9(2)(a)

PORT PROPERTY