Oceana Gold (New Zealand) Limited

Macraes Phase III

Assessment of Environmental Effects

MAB-453174-226-1015-V1:axm

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1. Executive Summary

Oceana Gold (NZ) Limited ("OceanaGold") is New Zealand's largest producer of gold. OceanaGold operates two large opencast mines at Macraes Flat and Reefton, and also an underground mine at Macraes Flat. The ore produced by all three mines is processed at Macraes Flat. OceanaGold commenced operations in New Zealand at Macraes Flat in 1990 and has been operating continuously since that time. Presently, the company directly employs over 800 people in New Zealand, comprising the work forces for the three mines, together with staff based in Dunedin. A current condition on a land use consent requires that any mining activity, including processing of ore, is to cease at Macraes Flat by 30 August 2012. At this time most of the jobs and revenue associated with the gold mines at Macraes and Reefton will cease, and the extensive indirect benefit the mines bring to the district and region will also end.

However, recent exploration success and a sustained high gold price have resulted in OceanaGold reviewing its long term mine plan for Macraes. The mine life at Macraes can be economically extended to at least 2020 and beyond by expanding some areas of current operations and reopening areas previously mined over the last 20 years. If mining is expanded in this manner it will result in a larger footprint for open pit areas, requirements for new waste rock stacks and construction of a new tailings storage facility.

The expansion of mining operations from 2012 to around 2020 is to be called "Macraes Phase III Project" (MPIII). The main features of MPIII will be:

- A new tailings storage facility (called Top Tipperary Tailings Storage Facility – "TTTSF")
- Expansion of existing Frasers Pit, Round Hill Pit, Southern Pit and Innes Mills Pit
- Reclamation of tailings from within the SP11 Tailings Storage Facility and relocation to the Reclaimed Tailings Stack (RTS)
- New waste rock stacks and extensions to existing rock stacks at Back Road Waste Rock Stack and Frasers East and West Waste Rock Stacks
- Continuation and expansion of Frasers Underground mine

As a result of these expansion works, the Macraes-Dunback Road and Golden Bar Road will need to be realigned and a new freshwater storage dam in Camp Creek (a tributary of Deepdell) will be constructed to supplement naturally occurring low flows in Deepdell Creek for water quality purposes.

The existing processing rate at the plant of approximately six million tonnes per annum will remain the same as will the intensity of operations on the site.

The current mine closure strategy for Macraes includes the ongoing development of a Heritage and Art Park. OceanaGold has undertaken a review of this closure strategy and discussed it extensively with the local Macraes community and has come to the conclusion, in conjunction with the community, that the consented Heritage and Art Park is not a sustainable proposition to provide future benefits to the community, as was intended.

Therefore, as part of this application for MPIII, a revised closure strategy for the mine has been developed which will involve redirecting funds previously committed to the Heritage and Art Park towards the funding of a Community Trust, which will be focused on enhancing the future well being of the Macraes community.

MPIII will have significant positive implications both locally and nationally. Rather than most of the jobs, expenditure and revenue associated with the Macraes and Reefton mines ending at 2012 or thereabouts those benefits will now continue to at least 2018 (the current economic life of the mines), with capacity to extend to 2020 and beyond. These benefits include employment, wages and salaries, associated expenditure in East Otago, Otago, the West Coast and beyond, an increased rating base for the Waitaki District Council, diversity of the East Otago, Otago and West Coast Regional economies and a wide range of community initiatives and socioeconomic benefits. MPIII will also have benefits at a national level with additional royalty payments continuing to 2018 and beyond.

Effects on landscape and visual values, traffic, noise, dust and vibration have been assessed and are of a similar nature to effects currently related to existing operations, and considered accepted.

Large scale mining results in the mobilisation of naturally occurring metals and other substances from the rock mass. These can find their way through groundwater and overland drainage to the surface water bodies in and around the mine area, giving rise to impacts on surface water quality. This is an expected consequence of hard rock mining, and has been an aspect which OceanaGold has actively managed since mining commenced. A detailed assessment of effects on water quality of receiving water (pit lakes, streams and rivers) has been undertaken by Golder Associates. The Golder assessments recommend a package of measures that will manage water quality outputs to ensure there is compliance with appropriate standards at the various relevant monitoring points. Accordingly, aquatic ecology values downstream from the Macraes Mine and existing abstractive uses are not at risk. Part of the package includes construction of the storage dam on Camp Creek (a tributary to Deedpell Creek) to be used to supplement natural low flow periods. The effect of the Camp Creek dam on the aquatic ecology values in the immediate vicinity will be minor.

There will be minor and temporary changes to downstream water availability. This will not have an adverse impact on aquatic ecology values and will have a minor effect on water users in the Upper Tipperary Catchment.

MPIII's land disturbance footprint will have an unavoidable impact on terrestrial ecology values and some heritage and archaeology values. However, original plans for footprints have been amended in the course of consultation and completion of technical reports for this Assessment of Environmental Effects ("AEE"), in order to avoid some sites of significance relating to these values. The residual effects of these footprints will be mitigated by the setting aside of land with similar habitat values, and heritage sites for protection in perpetuity. It needs to be recognised that there are constraints on the ability to avoid impacts on land-based values, since mining and associated infrastructure needs to be based on the location of the gold resource.

In summary, MPIII represents a significant opportunity to further promote the sustainable management of the Macraes area. It will provide for the continuation of a range of major benefits relating to employment and socio-economic well-being. The extended life of the Macraes Mine will continue to support the infrastructure and activities of local communities though rating and other direct and indirect contributions. Reefton ore will continue to be processed at Macraes, extending the life of the Reefton Gold Mine. At a national level, royalty payments on gold recovered will provide a return to the government on the Crown-owned mineral resource.

Potential adverse effects are of a similar nature to those currently managed by OceanaGold. Comprehensive modelling and monitoring, combined with operational management and

careful post-mining planning will result in adverse effects being avoided, remedied or mitigated appropriately and in accordance with accepted industry standards.

2. Introduction

2.1 Background

The Macraes Mine is located approximately 30 kilometres (km) to the northwest of Palmerston in the Otago Region of the South Island, New Zealand. The mining operation is located 1 to 2 km to the east of the Macraes township and is predominantly surrounded by farmland.

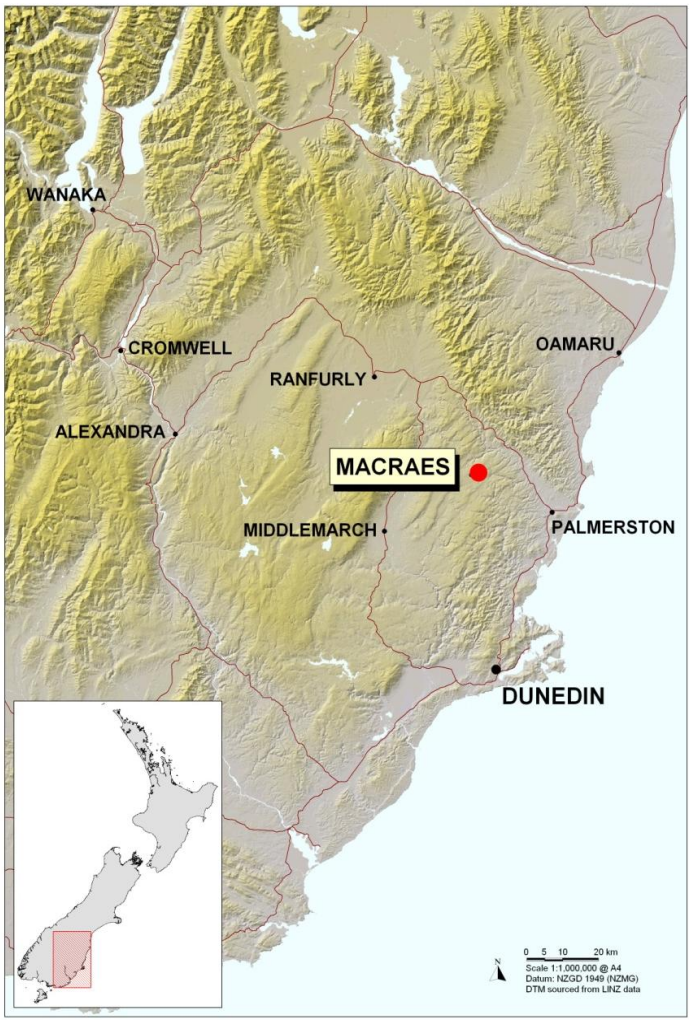
The Macraes Mine was commissioned in 1990 following the construction of a gold processing plant to treat ore mined from open pit mining methods. The processing plant capacity has increased since 1990 through continual upgrades and now processes nearly 6 million tonnes of ore per annum, including ore concentrate sourced from OceanaGold's Reefton Gold Mine.

Mining operations continue using open pit methods combined with an underground mine that has been operating since 2006.

The Macraes Mine is the largest goldmine in New Zealand and since the commencement of operations over 3 million oz of gold has been produced.

OceanaGold's successful exploration programme has recently extended the operational life of the mine from 2012 to 2018, and the resource consents sought by OceanaGold will allow this extended mine life and its attendant benefits to the local and regional communities, to be realised, with capacity to extend further to 2020 and beyond.

Figure 1: General Location of the Macraes Project



2.2 Oceana Gold (New Zealand) Ltd Operations

Oceana Gold (New Zealand) Limited is a wholly owned subsidiary of Oceana Gold Corporation (OGC). OGC is a publicly listed company on the Australian, New Zealand and Toronto stock exchanges. It has a current market capitalisation of ~ NZ$1.2 billion.

OceanaGold currently provides 813 jobs for permanent staff and contractors between its Macraes and Reefton operations. Of this total, the Macraes operation has a total of 563 employees and contractors engaged at the site and a further 28 engaged in Dunedin.

Operations at the Reefton Gold Mine commenced in 2007 and the total Reefton workforce is currently 222.

The Macraes mining and exploration tenements cover a contiguous area of 27,492 hectares.

This application is in respect of the expansion and extension of operations at the Macraes Mine, however, the ongoing operations at the Reefton Gold Mine are dependent on

processing of ore concentrate at the processing plant at Macraes. If mining and processing of ore at the Macraes Mine ceases in accordance with the current resource consents in 2012, mining at Reefton will also cease.

2.3 Project Outline

OceanaGold has reviewed the future of the Macraes Mine in light of current knowledge of the gold resource and the economic value of continuing to mine. The current resource consents were based on completion of mining by 2012. However, with the current high sustained gold price, the mine life can be extended to at least 2018 and potentially to 2020 and beyond. To enable mining to continue beyond 2012 consents are required as follows:

- A new tailings storage facility (called Top Tipperary Tailings Storage Facility ("TTTSF")) will be constructed in the upper Tipperary catchment basin. It will result in an increase of 51Mt of total consented tailings storage capacity (from 81Mt currently to 132Mt);

- Reclamation of tailings from within the current SP11 tailings storage facility. The tailings will be relocated to a stack within the footprint of the existing Mixed Tailings Impoundment called the Reclaimed Tailings Stack ("RTS") with any residual, reclaimed tailings being stored within the new TTSF;

- New rock stacks and extensions to existing rock stacks will be constructed, increasing the total consented tonnage from 850Mt to 1,180Mt. The existing Back Road Rock Stack will be substantially expanded to the east of the Round Hill/Southern Pit locations. Frasers East and Frasers West Rock Stacks will be linked by a new rock stack called Frasers South Rock Stack and an extension added to the north of Frasers East Rock Stack called Frasers North Rock Stack;

- Macraes-Dunback Road will be realigned from near Hocking Road following the legal (but unformed) Macraes Back Road alignment north before turning west to run along the divide between the Deepdell and Tipperary catchments and rejoining the current alignment adjacent to Innes Mills Pit, (near the old Golden Bar haul road traffic lights);

- Golden Bar Road will be realigned for the last 2.5km before rejoining Macraes-Dunback Road;

- Expansion of existing pits to include the following; Frasers Stage VI, Round Hill – Southern Pit Extension, and Innes Mills Stage V;

- Continued down dip (North Easterly) development of Frasers Underground mine;

- A new fresh water storage dam in Camp Creek (a tributary of Deepdell Creek) that will be filled from flood flows. The dam will be used to maintain a permanent residual flow during dry periods in Deepdell Creek;

- Surface water on the expanded mining infrastructure will be managed with diversions and new silt control dams;

- The existing processing rate of approximately 6 million tonnes per annum (including processing of Reefton ore concentrate) will remain, and the intensity of operations on site will remain similar to current levels; and

- A revised closure strategy to replace the Heritage and Art Park which will comprise: two lakes formed from pit excavations; trails and tracks; formation of a Community Development Trust; gifting Stanley's Hotel and the Managers' house to the Trust and provision of a significant fund to the Trust to support local community initiatives and encourage business development. Such initiatives could include upgrading Stanley's Hotel and upgrading the town water supply, but ultimately that will be at the discretion of the Trust.

A detailed project description is outlined in section 5. This expansion project is called "Macraes Phase III" ("MPIII").

2.4 Statutory Consents Required (new and existing)

2.4.1 Otago Regional Council ("ORC") Consents

The following new consents will be required from the ORC for the MPIII project:

Back Road Waste Rock Stack

- Discharge of waste rock and contaminants to land in circumstances where it may enter water
- Disturb, deposit material and reclaim the bed of unnamed tributaries of Deepdell Creek (construction phase)
- Divert unnamed tributaries of Deepdell Creek (construction phase)
- Discharge stormwater into unnamed tributaries of Deepdell Creek

Frasers Waste Rock Stacks (one set of new consents will cover the existing Frasers West and East Rock Waste Rock Stacks as well as the proposed Frasers South and North Waste Rock Stacks)

- Discharge of waste rock and contaminants to land in circumstances where it may enter water
- Disturb, deposit material and reclaim the bed of unnamed tributaries of North Branch Waikouaiti River (construction phase)
- Divert unnamed tributaries of North Branch Waikouaiti river (construction phase)
- Discharge stormwater into unnamed tributaries of North Branch Waikouaiti River
- Divert runoff/seepage to Frasers Pit (long term)

Top Tipperary Tailings Storage Facility

- Place a dam and disturb the bed of Tipperary Creek and its tributaries for building the dam (construction phase)
- Dam water in the TTTSF
- Discharge mine tailings to land and water
- Divert Tipperary Creek and unnamed tributaries (long term as not reclaiming land))
- Take groundwater when dewatering impoundment to keep water levels down
- Disturb the river bed and place silt pond dams (construction phase)
- Discharge sediment when building silt ponds (construction phase)

- Dam water in silt ponds
- Discharge water from the silt ponds
- Land use for injection well
- Taking of surface water
- Discharge from TTTSF into Frasers Underground via injection well

SP11

- Land use consent for the removal of a dam structure

Reclaimed Tailings Stack

- Discharge of tailings to land/water

Camp Creek Reservoir

- Disturb the bed of Camp Creek to place the dam (construction phase)
- Discharge silt whilst placing the dam (construction phase)
- Divert water whilst placing dam (construction phase)
- Damming water
- Non-consumptive take of water to fill dam
- Discharging water from dam

Frasers Pit, Innes Mills Pit, Southern Pit and Round Hill/Golden Point Pit

- Divert water around pits
- Taking ground/surface water to dewater pits
- Discharge of waste rock to land
- Damming water in pits to create 2 lakes (Frasers/Innes Mills and Round Hill/Golden Point)
- Taking water to fill lakes

Air

- Discharge permit required to reflect the MPIII project activity. There is an existing air discharge permit which covers all mine related activities. A new consent will be sought for the additional areas required for MPIII.

Frasers Underground

- Take groundwater
- Discharge water (consents are required for greater volumes of water for dewatering Frasers Underground).

Erosion and Sediment Control

- Disturb beds of waterways (for small silt ponds, diversion stormwater).

Existing Consents

Consents requiring amendment will include the air discharge consent for the current mining operation (requires variation of the monitoring conditions to be consistent with MPIII requirements) and a range of other consents with monitoring requirements under Schedules I and II. These amendments are to standardise parameters monitored and compliance limits.

Consents related to the existing Frasers West and East WRS will be surrendered as they will be replaced by the new Frasers WRS consents.

Consents specifically relating to Golden Point Pit will be replaced by those for Round Hill Pit as the two pits will be interlinked. Consents for a wetland in Golden Point Pit will be surrendered as Golden Point and Round Hill Pit will ultimately form a connected pit lake.

Consents relating to Frasers West and Murphys Creek Silt Ponds will remain but require variation of the condition stating the consents they will be exercised in conjunction with.

Consents relating to Lone Pine Water Storage Reservoir, Maori Tommy Silt Pond, Orica Water Storage Dam, Northern Gully Silt Pond, Northern Gully WRS's, Deepdell North and South pits, WRS and silt ponds, Golden Bar pit, WRS and silt pond, Taieri River water extraction, processing of Reefton ore concentrate and mineral exploration will remain unchanged as they are not impacted by the MPIII project.

There will be potential consequential changes to other consents due to cross referencing with new consents.

2.4.2 Waitaki District Council ("WDC") Land Use Consents

Land Use Consent LRC 96/98 (Macraes Expansion) and Land Use Consent LRC 96/99 (Golden Point) issued by the Waitaki District Council ("WDC") are proposed to be replaced by a new land use consent that will incorporate the current mining operation requirements under LRC 96/98 and LRC 96/99 and the proposed MPIII project. The Heritage and Art Park consent LRC01/21 will be replaced by conditions on the new land use consent relating to the revised closure strategy.

The new landuse consent will also need to authorise the realignment of Macraes-Dunback Road and Golden Bar Road necessitated by the location of MPIII elements. However the preliminary earthworks for the Macraes-Dunback road realignment have been consented already to enable works to commence.

Additional approvals will be required pursuant to the Historic Places Act 1991 the Building Act 2004 and the Local Government Act 1974 for works affecting historic sites, construction of WRS and dams and the realignment of public roads.

Land Use Consents LRC 99/54 (Deepdell North) and LRC 99/55 (Deepdell South) will also require variation to amend the Heritage and Art Park conditions.

Land Use Consent LRC 10/52 relating to the processing of Reefton ore concentrate will be unaffected.

2.5 Legal Description

The legal description for land upon which aspects of the proposed for MPIII will be located are **attached** as Appendix 1.

3. The Mineral Resource

3.1 Mining History

The earliest alluvial mining in the district commenced at Murphys Flat in 1862, with Macraes Flat, Deepdell and some parts of Horse Flat being worked soon after. Murphys Creek was the major early alluvial workings and there is evidence that all of its tributaries were being worked in the 1860's. The Murphys Creek alluvial workings are reasonably well preserved and are considered to be of historic significance.

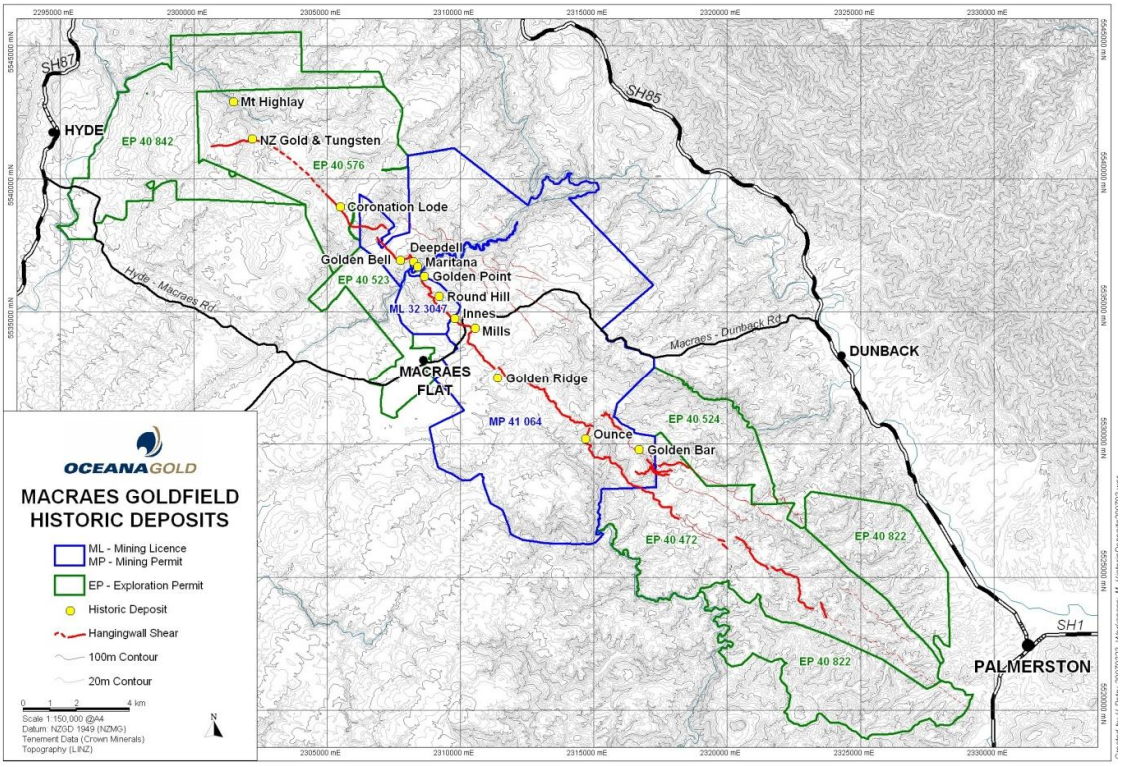
Lode quartz mining commenced in the 1860's, but the scale of operations was very small. The Golden Point/Round Hill lode system was not discovered until 1889. Development of Golden Point commenced in 1889 and it became established as a significant scheelite and gold producer. From 1890 to 1933, it produced an estimated 13,000 ounces of gold and 800 tons of scheelite. Other nearby areas mined included Maritana, Golden Bell and Deepdell but quantities were small.

Some areas continued to be mined after 1939 as tungsten was in demand during the Second World War but gold prices were sharply reduced during this time. The scale of operations at this time was small and work was discontinuous, as a result records of production of ore at this time are poor.

The first lode worked in the Macraes field was probably the Duke of Edinburgh, described by Ulrich (1875). In 1888, the Highlay Reef was discovered on the Mareburn, and the lode was soon traced to Golden Point, where it was opened out in 1889. Further prospecting soon resulted in the opening of other mines along the lode, some of them, however, being little more than surface workings.

The historical mines that have been worked, given in order eastward, are Mount Highlay, New Zealand Gold and Tungsten, Coronation, Golden Bell, Maritana, Deepdell, Golden Point, Round Hill, Innes, Mills', Griffins, Golden Ridge, Ounce and Golden Bar.

Figure 2: Macraes Historical Mining Areas



The modern era tenements at the Macraes Mine were initially owned by Golden Point Mining Limited and BHP Gold Mines (New Zealand) Limited, a subsidiary of BHP Gold Mines Limited. During December 1989, Macraes Mining Company Limited (MMCL) obtained 100% ownership of these tenements. On May 14, 1999, Macraes Mining Company Limited changed its name to Gold and Resource Developments (New Zealand) Limited and again to GRD Macraes Limited on June 30, 2000. Finally on May 18, 2004, the name was changed to Oceana Gold (New Zealand) Limited.

Mining at Macraes by OceanaGold commenced in 1990 along with commissioning of a process plant capable of processing 1.5 million tonnes of ore per year. Successive upgrades over the last 20 years have resulted in an increase in throughput rate to nearly 6 million tonnes per annum. The first open pit to be mined was Round Hill in 1990, thereafter followed over the next 20 years by Southern, Innes Mills, Frasers, Golden Point, Golden Bar and Deepdell North and South pits.

Underground operations at Frasers commenced in 2006 using a contractor. Since July 2010, underground operations have been undertaken using OceanaGold's own work force.

The processing plant includes an autoclave for pressure oxidation of the ore. Since 2007, flotation concentrate from the company's Reefton Gold Mine has been transported by rail and road and processed through the Macraes autoclave as an integral part of the Reefton operations. To date, approximately 3.2 million ounces of gold have been produced.

3.2 Geology and Mineral Resources

Mineral resources and reserves are updated annually. The most recent estimate was undertaken as at 31 December 2010. In simple terms, a resource is an estimate of material (in this case, gold) that has a reasonable prospect of economic extraction. Reserves are a subset of these resources and have been estimated from a detailed economic analysis in accordance with established and accepted international standards to determine their economic viability having regard to all known factors (eg financial, mining, metallurgical, environmental, governmental, legal).

The most recent resource estimate for the company's Macraes tenements is 144 million tonnes containing 5.2 million ounces of gold. The reserves as at 31 December 2010 account for 45 million tonnes of the resource.

These reserves form the basis of the mine plan and sequencing to 2020 set out in this AEE.

3.3 Rationale for Expansion

Recent exploration success and a sustained high gold price have prompted OceanaGold to review its long term mine plan. Recent studies have shown that the mine life can be extended to at least 2018, with capacity to extend further to 2020 and beyond.

Economic studies have shown that it is economic to expand some areas of current operations and to re-open some of the areas previously mined over the last 20 years. Today's gold price is significantly higher than it was even a few years ago allowing these previously mined open pits to be mined deeper. This will result in a larger footprint for the open pit areas and associated waste rock stacks.

In addition, an extension of the mine life to 2020 necessitates the construction of another tailings storage facility and new waste rock stacks as the existing storage facilities and waste rock stacks have insufficient remaining capacity.

Ongoing exploration for new gold discoveries over the life of the mine may further define new areas of economic interest. Consenting of MPIII will lengthen the mine life considerably, which will also allow ongoing expenditure on exploration programs to be planned with more certainty.

4. Existing Environment

4.1 Landscape

A detailed landscape and visual assessment of the proposed Macraes Phase III expansion has been undertaken by Opus International Consultants Ltd. The "Oceana Gold (NZ) Ltd Macraes Gold Project Macraes Phase III – Landscape and Visual Assessment" is attached as Appendix 2.

Macraes Flat sits within a rural upland landscape of rolling hills with moderate relief and with characteristic broad ridge crests.

Pastoral farming is the broad land use in the area, followed by gold mining. Macraes Flat is located on the eastern edge of the schist country and the broader historic goldfields of Central Otago. The presence of the relatively large scale Macraes Mine is a noticeable and culturally interesting element in the current landscape.

The long term local cultural landscape feature of Macraes Flat is the township itself with its hotel, school, churches and clusters of houses and various outbuildings and shelterbelts. There are a number of historic buildings and features which also form part of the landscape. These relate to the history of the area as a centre for both farming and mining and are discussed in more detail elsewhere in this AEE.

Three named waterways have their sources and/or upper tributaries within the MPIII site – Murphys Creek to the south, Tipperary Creek to the east and Deepdell Creek to the north. The headwaters of the North Branch of the Waikouaiti River are contained in the low flats between Frasers East Waste Rock Stack and the Macraes township.

Many of the various aspects of the MPIII will be located to the east and south of the current Frasers Pit which is currently the central and most publicly visible feature of the Macraes Mine.

The broader Macraes Flat landscape is not an Outstanding Natural Feature nor, in the context of the Waitaki District, is it an Outstanding Natural Landscape or Outstanding Landscape area.

4.2 Biophysical Environment

4.2.1 Climate

The presence of the Southern Alps, extending the length of the South Island, has a major effect on the climate of the Otago region, as does the ocean, and produces distinct climatic contrasts from west to east.

Rainfall at the Macraes Mine is slightly seasonal, with the greatest rainfall occurring during the summer months of December and January. Throughout the remainder of the year the rainfall is relatively consistent. Rainfall at the Macraes Mine is monitored at three locations. The Glendale and Golden Point sites receive average annual rainfall of approximately

628mm and 659mm respectively. The Deepdell site receives an average of approximately 518mm rainfall annually.

4.2.2 Botanical Features

The proposed MPIII development is situated within the Macraes Ecological District (ED), which is one of the two Ecological Districts that make up the Lammerlaw Ecological Region. Macraes ED is characterised by gently sloping land (mostly below 600m), with higher ridges rising over 800m.

Past vegetation cover of the Macraes ED comprised montane short tussock grading into subalpine tall tussock with areas of hardwood forest (including a podocarp element), Kanuka forest and Coprosma-flax scrub. Destruction of the forest cover began with natural fires around 2500 years ago and was exacerbated by Polynesian (800 to 400 years ago) and European settlement (1840AD). The area has been heavily modified by 120 years of farming. As a result the present vegetation of the Macraes ED is of a highly modified nature with approximately 50% of the district dominated by improved pastureland.

The wider Macraes area in which mining takes place and is locally known as Macraes (i.e. Macraes Flat) has a high diversity of threatened and uncommon plants and is considered a stronghold for several threatened plant species. These species of interest are widespread in the Macraes ED. The footprint that will be disturbed by MPIII may have an effect on some individuals of these plant species.

A full botanical assessment of the MPIII proposal has been undertaken by Ryder Consulting. The "Oceana Gold (NZ) Ltd - Macraes Gold Project Macraes Phase III – Botanical Assessment" is attached as Appendix 3. The assessment describes the existing environment for each area affected by the MPIII proposal, as summarised below.

Camp Creek

The rounded hill tops and more shallow gullies of Camp Creek have been converted into improved pasture, while the tops of the gully sides have been modified into rough pasture. Tussock grassland is present in a complex mosaic of scrub, rough pasture and rock outcrops. Scrub generally occurs on steeper slopes and towards the gully bottom and can be divided into matagouri scrub, mixed indigenous scrub and adventive scrub. Riparian vegetation is present in the wetter gully areas.

In general, the indigenous plant species within these vegetation types are those that are resilient, common and widespread. However, three comparatively rare plant species were observed growing on the rocky cliffs and bluffs along the true right of Camp Creek. These were the 'Declining' coral broom (*Carmichaelia crassicaulis*), the 'Naturally Uncommon' sprawling turpentine (*Dracophyllum uniflorum*) and 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*).

Back Road Waste Rock Stack

This area comprises a mixture of exotic pasture, tall tussock and short tussock grasslands and indigenous scrub. Improved pastureland occurs along the flat plateau at the tops of the gullies and in the shallower gully sides. It is dominated by agriculturally important grass and clover species and some adventive herb species.

Unlike the improved pasture, the rough pasture is not as highly developed. It is the most common vegetation type found throughout the study site and often occurs in combination with the other vegetation types. The rough pasture is generally dominated by exotic grass species.

Some important plant species recorded at the site include Hookers mountain daisy, Spaniard (*Aciphylla subflabellata*), *Gingidia grisea*, *Lobelia perpusilla* and coral broom.

'Locally notable' remnant forest species, including kowhai and broadleaf occur in the deeper less accessible gullies to the north (towards Deepdell catchment) as do cabbage tree (*Cordyline australis*) and mountain flax (*Phormium cookianum*).

Two ephemeral wetlands occur along the ridgeline and two ridetop swamps are located to the southern edge of the Back Road Waste Rock Stack ("BRWRS").

Top Tipperary Tailings Storage Facility

Vegetation and habitat types present at the TTTSF site include improved pasture land with tussock grassland in the wetter gullies, matagouri (*Discaria toumatou*), scattered hard tussock (*Festuca novae-zelandiae*) and silver tussock (*Poa cita*) in the shallower gullies, narrow-leaved snow tussock (*Chionochloa rigida*), golden Spaniard (*Aciphylla aurea*), *Olearia bullata*, prickly shield fern (*Polystichum vestitum*), and native broom (*Carmichaelia petriei*) in the steeper gullies and wetland type vegetation dominated by red tussock on the valley floor to the north of the Macraes-Dunback Road. Rocky cliffs and bluffs on the true left of the gullies contain additional species of indigenous vegetation. A small population of the 'declining' spaniard (*Aciphylla subflabellata*) was observed at the bottom of one of the gullies to the east at NZTM E1402099 N4973887.

The 'Naturally Uncommon" Hookers mountain daisy is found in the rocky cliffs and bluffs on the true left of the gullies.

Frasers North Waste Rock Stack

The rounded hills and flatter land of the proposed Frasers North Waste Rock Stack ("FNWRS") have been converted into improved pastureland and are dominated by pasture and adventive weed species common to this vegetation type around Macraes Flat. To the north of the Macraes-Dunback Road is a small radiata pine (*Pinus radiata*) plantation.

The steep gully sides consist of a mosaic of rough pasture and tussock grassland. The 'Naturally Uncommon' Hookers mountain daisy (*Celmisia hookeri*) was common in the inaccessible cliff faces and rock bluffs around the FNWRS.

Frasers South Waste Rock Stack

The proposed Frasers South Waste Rock Stack ("FSWRS") site is currently dominated by pastureland with indigenous diversity confined to gullies. The rounder hill tops and the sides of the gullies have been converted into improved pastureland with high producing pasture species.

The true right of the gullies are generally steeper and dominated by tussock grassland and rocky cliffs. The 'Naturally Uncommon' Hookers mountain daisy is found within these rocky cliffs. The true left sides of the gullies are generally shallower and have been converted into pastureland, nearly to the gully floor with areas of matagouri present.

Round Hill Extension

The Round Hill Extension area is dominated by improved pasture species and colonising weed species common in the Macraes area.

Round Hill - Southern Pit Extension

The proposed site for this pit extension has very low biological values due to its already highly modified state and the lack of indigenous plant species.

Innes Mills Stage V

The western site of the proposed Innes Mills Stage V comprises a plateau dominated by improved pasture species and colonising weed species. To the southeast of the proposed extension are a few scattered indigenous tussocks including the narrow-leaved snow tussock (*Chionochloa rigida subsp. rigida*) and hard tussock (*Festuca novae-zelandiae*). To the south of the extension is a gully with additional indigenous species including matagouri and golden spaniard (*Aciphylla aurea*).

The Macraes-Dunback Road bisects the eastern site of the proposed pit extension. The north and south side of the road are dominated by improved pasture species, with an area of tussock grassland to the south of the road. The tussock land has greater indigenous diversity with a small area of tussock land dominated by narrow-leaved snow tussock and *Chionochloa hybrids* (*Chionochloa rigida x rubra*) and small–leaved pohuehue (*Muehlenbeckia complexa*) interwoven into the base of the tussocks.

Frasers Stage VI

Rough pasture makes up the flatter slopes of the Frasers Pit site. A small tussock grassland occurs in shallow depressions to the east and west of the haul road.

A small stand of exotic mature pine trees (*Pinus* spp.) is situated below the tussock grassland. Another stand of mature trees is situated towards the east of the site, located around an old homestead.

A small gully to the north-east of the site has higher indigenous diversity. The 'Naturally Uncommon' Hookers mountain daisy occurs on the cliff face on the true left.

4.2.3 Avifauna and Herpetofauna

Ryder Consulting has undertaken a full study of the existing avifauna and herpetofauna of the Macraes mining area. The "Oceana Gold (NZ) Ltd Macraes Gold Project Macraes Phase III – Avifauna and Herpetofauna Assessment" **attached** as Appendix 4.

As part of the study, existing information on the bird life of the Macraes area was sourced from various publications, reports and surveys. These identified that 53 species of birds have been recorded from Macraes Flat and the surrounding area. Of these 32 are indigenous and the remaining 21 are introduced. Seven species are listed as "threatened" and a further five are "at risk", based on the New Zealand threat classifications. The black fronted tern (*Chlidonias albostriatus*), black-billed gull (*Larus bulleri*), bittern and the banded dotterel (*Charadrius bicinctus*) are all ranked "Threatened – Nationally Endangered", and are at risk from introduced predators, human disturbance and the spread of exotic plants within their breeding areas. The New Zealand Falcon (*Falco novaeseelandiae "eastern"*), ranked

"Threatened – Nationally Vulnerable" is relatively numerous in the Macraes ED and the area is considered a stronghold to the species.

Species listed "At risk – Declining" recorded at the site include the New Zealand pipit (*Anthus novaeseelandiae*), pied stilt (*Himantopus himantopus*) and South Island pied oystercatcher (*Haematopus ostralegus*) and "At Risk – Naturally Uncommon" black shag (*Phalacrocorax carbo*) and little shag (*Phalacrocorax melanoleucos*).

Seven species of lizards have been recorded at Macraes Flat. Macraes Flat is notable for its high diversity of lizards, with the highest number of "Oligosoma" species (six) occurring sympatrically. Two notable species are the Otago skink (*Oligosoma otagense*) and grand skink (*Oligosoma grande*), which are currently ranked "Threatened - Nationally Critical". The Macraes ED is the last remaining stronghold of these threatened species. It should be noted that neither of these lizards species are known to occur within, or close to, the areas to be disturbed. Both the green skink (*Oligosoma chloronoton*) and the Otago Large gecko (*Hoplodactylus sp. "Otago Large"*) are listed "At Risk – Declining".

Bird and lizard communities within the Macraes Flat area were surveyed between 7 October and 1 November 2010. The survey included all sites designated for the development in the Macraes Phase III project. The results of that survey are set out below.

Camp Creek Storage Dam

Twenty bird species were observed during the 2010 survey of the area upstream of the proposed dam location. The majority of these species were introduced passerines such as blackbirds, dunnocks, song thrushes and assorted finches, all of which are common and non-threatened. However, eight native species were observed, including the New Zealand Falcon, which is listed as "Threatened – Nationally Vulnerable". South Island Pied Oystercatchers were also seen with juveniles present.

Banded Dotterels were not seen during the 2010 survey, but are known to breed on pasture habitat in the surrounding area. Banded Dotterels are listed as 'Threatened – Nationally Vulnerable". While Black Shags were not seen they are known from Deepdell Creek and may also utilize Camp Creek as a feeding habitat. Black Shags are listed "At Risk – Naturally Uncommon".

Camp Creek contains a large amount of suitable lizard habitat, with numerous rock outcrops surrounded by indigenous scrubland, tussock grasslands and pastures. Many McCann skinks and a number of common skinks were observed. No geckos were observed.

Green Skinks were found less than two kilometres to the north of the proposed Camp Creek storage dam so there is a possibility that they may also reside within this site. Green skinks are listed as "At Risk – Declining".

Back Road Waste Rock Stack

The open tussock grassland of the BRWRS supports relatively low numbers of birds, the most abundant being the introduced skylark and yellowhammer, with smaller numbers of New Zealand pipits. Other smaller passerines such as dunnock, chaffinch, greenfinch and starling were seen feeding in the tussock, whilst Australasian harrier hawks were commonly seen hunting over the area.

Two ephemeral wetlands occur within footprint of the proposed BRWRS. South Island pied oystercatcher and paradise shelduck were observed utilizing these wetlands and both

species had juveniles present. Southern black-backed gulls were observed feeding in rough pasture near the wetlands.

The gullies within the BRWRS provide good habitat for various species of lizards. McCann's skinks were abundant throughout the rock outcrops along the gully edges, whilst common skinks were found in both rocky habitat and grassland. Otago Large geckos were seen at various locations. Otago Large Geckos are "At Risk", with a current ranking of "Declining".

Top Tipperary Tailings Storage Facility

Modified farmland within the site provides habitat for introduced and native passerines, and grazing for several waterfowl species.

In an area largely devoid of indigenous trees the exotic plantations within the TTTSF provide roosting and nesting habitat, mostly for introduced passerines such as house sparrows, goldfinches and chaffinches and also native species such as grey warblers and silvereyes.

Many farm ponds exist within the area and provide waterfowl habitat. Welcome swallows were observed foraging for insects over the ponds.

No sign of Otago or grand skinks was found along the bluffs on the true left of the creek, nor was there any sign found of the more common species of lizards.

Frasers North Waste Rock Stack

A plantation of mature radiate pines provides roosting habitat for a variety of passerines, including goldfinches, greenfinches, chaffinches, blackbirds and the native grey warbler. Paradise shelducks were seen utilising the farm ponds below the plantation. Spur-winged plovers were seen utilising the improved pasture and yellowhammers, redpolls and other introduced passerines were seen foraging in the tussock grassland. Australasian harrier hawks were observed flying over this area.

Within the FNWRS there are two areas of suitable lizard habitat. The first is on the crest of the hill in the northeast section of the FNWRS. McCann's skinks were observed on the rock outcrops. However, the number of lizards that could be supported in this area would be relatively small. The second area is within the tussock grasslands between the lines of exotic plantation. McCann's skinks were also observed basking in this area.

Frasers South Waste Rock Stack

The improved pasture of the FSWRS supports a variety of introduced passerines such as skylarks, yellowhammers, starlings and redpolls. Spur-winged plovers and pied oystercatchers were observed foraging in the improved pasture. New Zealand pipits were observed utilising the scattered tussock areas. A number of ponds are within the FSWRS and two species of duck were observed feeding in them, paradise shelduck and grey duck/mallard duck hybrids. Australasian harrier hawks and Australian magpies were observed flying above the site.

Lizard habitat in the FSWRS footprint is limited due to a lack of rock outcrops. No lizards were encountered during the 2010 survey, although common skinks are likely to occur there within the grassland.

Round Hill Extension

Due to the already modified nature of the Round Hill Extension area, the existing avifaunal values are low. The majority of birds seen were flying over the site, very few individuals were observed utilising the area. Of those that were seen feeding amongst the pasture grasses all were common introduced passerines such as yellowhammers and redpolls.

McCann's skinks were observed in the re-sown pasture grass of the rehabilitated rock stack within the Round Hill Extension. Approximately 16 hectares of such habitat occurs within the Round Hill Extension and McCann's skinks are likely to be present throughout. Common skinks may also be present amongst the re-sown pasture grasses.

Round Hill – Southern Pit Extension

As the Round Hill Southern Pit Extension is situated within a tailing dam the avifaunal values are very low. No birds are seen utilising the area for foraging.

Despite an abundance of rocky retreats in the form of spoil mounds, it is unlikely that lizards are present due to the lack suitable vegetation.

Innes Mills Stage V

The Innes Mills Stage V extension contains only a small amount of habitat suitable for bird life. A white-faced heron (*Ardea novaehollandiae*) was seen feeding amongst tussock. Species observed foraging in the rough pasture included yellowhammer, skylark and starling. Southern black-backed gull, spur-winged plover and an Australasian harrier hawk were all seen flying over the site.

McCann's skinks were seen basking in spoil mounds alongside the haul road margin. Common skinks may also be present amongst the pasture grasses and tussocks.

Frasers Stage VI

The bird communities of Frasers Stage VI pit extension comprise almost entirely of introduced passerines such as skylarks, chaffinches and dunnocks. Only three native species were observed, the Australasian harrier hawk and the southern black-backed gull flying overhead and spur-winged plovers foraging in pasture grasses.

McCann's skinks were seen throughout the site, with most observed basking on the soil mounds along the haul road margins.

4.2.4 Aquatic Values

A detailed study of the aquatic values within the Macraes area was undertaken by Ryder Consulting. The "Oceana Gold and Macraes Gold Project Macraes Phase III – Aquatic Ecology Assessment" is **attached** as Appendix 5.

A review of published and unpublished literature and relevant databases was undertaken to obtain existing information on aquatic communities within the Macraes area. In addition aquatic communities within the Macraes area were surveyed in October 2010. The survey included sites in the Deepdell Creek catchment, Tipperary and McCormicks Creek catchment, the Cranky Jims Creek catchment and in the North Branch of the Waikouaiti

River catchment including tributaries of Murphys Creek. The existing aquatic values are as follows.

Camp Creek

The upper reaches of Camp Creek are contained within a straight channel bordered by open pasture with unrestricted stock access to the creek. Instream habitat is dominated by riffles and runs, with some small pool areas, and bed sustrate is dominated by gravels and cobbles. Large beds of the aquatic plant "*Glyceria fluitans*" are present in the creek channel. *Glyceria fluitans* is on Biosecurity New Zealand's schedule of prohibited plant species. The middle reaches of Camp Creek are located amongst gorse, matagouri and tussocks. Instream habitat is dominated by short runs and riffles, interrupted by large pool sections. The lower reaches have similar aquatic habitats to the middle reaches meandering through a steep gorge with valley sides covered with tussocks, matagouri and grasses. Instream habitat is dominated by riffles and runs with some pool sections where the creek widens. Small beds of the aquatic plant *Glyceria fluitans* are present along the creek edges.

Overall, instream habitat quality is higher in the middle and lower reaches of Camp Creek relative to the section immediately upstream of Horse Flat Road.

Water quality is expected to be moderately degraded due to the effects of unrestricted stock access and the large amount of exposed soft sediment in the channel. Periphyton growth was variable. While indices of benthic macroinvertebrate community health varied and ranged from "fair" to "excellent" all sites surveyed were dominated by *Deleatidium* mayflies.

Healthy flathead galaxiid populations are present in the lower and middle reaches of Camp Creek, with large longfin eels also present. However, only low numbers of galaxiids are present immediately upstream of Horse Flat Road and in Camp Creek tributaries.

Deepdell Creek

The proposed Back Road Waste Rock Stack is located on slopes draining into Deepdell Creek, downstream of the current Macraes mining operation. The proposed BRWRS catchment includes three small tributaries of Deepdell Creek. The catchment is dominated by tussock lands, with scrub and some pasture in the gorges. The middle reaches of one tributary is within a steep gully with matagouri and tussocks over pasture. Another tributary of Deepdell Creek contains ponds, steep gullies with native vegetation bordering the channels, with a very small flow of water under normal conditions. The headwaters of another Deepdell Creek tributary within the proposed site contains a pond with large areas of open water with beds of *Glyceria fluitans*. The upper reaches of the creek are confined by a steep pasture covered gully. Steep cliffs with tussocks, matagouri and spaniards line the banks. Stock have unrestricted access to the creek. Instream habitat is very limited with the majority of the channel containing very little visible water and large areas of soft sediments.

The water quality in the majority of the water courses in the Back Road Waste Rock Stack is moderately degraded due to the effects of stock and the large areas of exposed soft sediment in the channel.

Watercourses in the Back Road Waste Rock Stack area are dominated by soft substrates overgrown with vegetation providing little suitable habitat for significant periphyton growth. The benthic macroinvertebrate communities in tributaries of Deepdell Creek in the proposed Back Road Waste Rock Stack area are of poor quality, characterised by taxa typically found in slow flowing, soft bottomed, wetland type habitats.

Surveys for fish were not undertaken in the headwaters of the Deepdell Creek catchment due to an absence of suitable fish habitat. Very little surface water was present, and generally only wet areas of soft sediment were present, infested with vegetation and having negligible flow. While flathead galaxiids and longfin eels could potentially be present in the lower reaches of some of these streams, limited instream habitat and low river flows will most likely restrict movement of fish into the upper reaches.

Tipperary Creek

The proposed TTTSF is located at the head of Tipperary/McCormick's Creek catchment. The presence of stock water ponds in the Cranky Jims Creek catchment and tributaries draining into Tipperary Creek has modified flows in the channels by reducing the flow of water downstream and creating areas of slow flowing or standing water. Downstream aquatic habitat is dominated by wet areas of soft sediment with pasture grasses and tussock throughout, and a negligible flow. Stock access is unrestricted throughout, except in short sections where the channel is narrow and incised, restricting access.

Headwater tributaries of Tipperary Creek, upstream of the Macraes-Dunback Road, are characterised by gullies with boggy, wetland like habitat at the base draining open pasture areas with open stock access. Water movement is diffuse through low gradient wetland areas containing tussock and pasture grasses and beds of "*Glyceria fluitans*".

The Tipperary Creek channel approximately 300 metres downstream of the Macraes-Dunback Road becomes more defined and has areas of bedrock and gravel/cobble substrate. Large areas of fine sediments are present beneath the gravel substrate and within the Glyceria beds.

Overall, aquatic values are considerably higher at the sites lower downstream in the Tipperary Creek catchment. These higher values are due to increased flow providing habitat more suitable for stream invertebrate and the fish communities relative to the sluggish wetland-like habitat in the headwaters.

Water quality was assessed at four sites in the Tipperary Creek mainstream and in two farm ponds. The water quality varied from poor to high. The most upstream site in Tipperary Creek is located in a wetland-like area with low flowing water. Water quality is poor at this site relative to other sites downstream. In the sections of Tipperary Creek with a defined stream channel and continuous flowing water, water quality was high.

Conditions in the headwaters of the Tipperary Creek provide little suitable habitat for significant periphyton growth. However further downstream periphyton is more common where the creek has a more defined channel and continuous flowing water over a stony bed.

Results from the October 2010 survey and previous sampling in the Tipperary Creek catchment indicate that invertebrate community health is relatively poor in the headwater channel and tributaries, but improves downstream of the Macraes-Dunback Road, where flows increase and habitat suitable for aquatic communities is common. The highest quality invertebrate communities in the catchment have generally been found at the most downstream sites.

Surveys for fish were not undertaken in the headwaters of Tipperary Creek catchment upstream of Macraes-Dunback Road in 2010, due to a lack of suitable habitat. Fish surveys have generally been undertaken in areas well downstream of the proposed TTTFS, where robust flathead galaxiids populations have been found. Fish communities are more diverse further downstream, with galaxiids, eels, bullies and trout having been previously found.

Fish communities in the lower reaches of Tipperary Creek downstream of the Macraes-Dunback Road were surveyed in the 2010 survey. However, no fish were found at the site of the proposed Tipperary Creek silt pond, while further downstream healthy populations of flathead galaxiids were found.

Murphys Creek

The proposed Frasers South Waste Rock Stack is to be located adjacent to the existing Frasers West Waste Rock Stack, in the headwaters of Murphys Creek, a tributary of the North Branch of the Waikouaiti River. Two sites were assessed in the Frasers South West Waste Rock Stack area in October 2010.

The headwater tributaries of Murphys Creek, upstream of existing mine activities, are situated in valleys of open pasture, with wetland like habitat along the valley floor. Further downstream, trickles of flowing water are visible where channels become confined. Fine sediments are evident throughout the channel coupled with large areas of bank erosion. Aquatic values are low.

Ponds are present at the base of the two valleys assessed. One pond retains the appearance of a natural wetland while the other appears to be formed by an existing waste rock stack blocking water movement further downstream. Stock have open access throughout both wetland areas.

Water quality in the headwaters of Murphys Creek is expected to be moderately degraded due to the effects of unrestricted stock access, causing excessive pugging, and the large amount of exposed soft sediment in the channel.

Watercourses in headwaters of Murphys Creek are dominated by soft substrates overgrown with vegetation, providing little suitable habitat for significant periphyton growth.

Benthic invertebrate sampling from a headwater tributary of Murphys Creek, downstream of Golden Bar Road, indicated relatively low taxonomic diversity. All taxa found were typical of slow flowing, soft bottomed, wetland type habitats. These communities were indicative of poor to fair water quality.

A fish survey was not undertaken in the headwaters of the Murphys Creek catchment due to the absence of suitable habitat. Fish surveys have generally been undertaken in areas well downstream of the proposed waste rock stack area, where relatively healthy and diverse fish communities have been found. The only survey that has been undertaken in headwater areas higher in the catchment found low numbers of galaxiids. The isolation of Murphys Creek headwaters from downstream reaches by existing waste rock stacks, and the generally poor habitat for fish in these headwater areas, suggest that the local galaxiid populations will be very small or non existent.

North Branch Waikouaiti River

The proposed Frasers North West Rock Stack is located in the headwaters of the North Branch of the Waikouaiti River catchment. Frasers pit is located directly downstream of the area, and the North Branch is piped around the mine workings.

Tributaries of the North Branch of the Waikouaiti River have channels that consist of occasional boggy sections and no visible flowing water. Stock have open access. Stock water ponds have been created in small streams in the area. The presence of these ponds have modified flows in the channels by reducing the flow of downstream water during dry weather periods and creating areas of slow flowing or standing water. Aquatic habitat

downstream of the two ponds consists of wet areas of soft sediment with pasture grasses and tussock throughout, with negligible surface flows.

Surface water in this area is expected to be moderately degraded due to the effects of unrestricted stock access, the presence of stock water ponds reducing downstream flows, and the large areas of exposed soft sediment in the channels.

There is little habitat suitable for the accrual of periphyton.

Benthic macroinvertebrate communities were indicative of "poor" to "fair" water quality in the lower reaches and "fair" to "good" in the headwaters.

A fish survey was not undertaken due to the lack of suitable habitat. Previous surveys in the headwaters of the North Branch near the Macraes-Dunback Road have found no fish. Fish surveys have been undertaken in areas generally well downstream of the proposed waste rock stack area where healthy and diverse fish communities have been found.

Non Migratory Galaxiids

Non migratory galaxiids have been found throughout the Macraes area, including in tributaries of the Shag River and the North Branch of the Waikouaiti River. Recently, a fish classification process has been applied to New Zealand freshwater fish. The rankings include all described species, and genetically distinct but undescribed taxa.

The Lower Shag galaxiids ("*galaxias sp. E*"), which was included in the 2005 ranking process as "data deficient", has been regarded in the June 2009 ranking as belonging to a more widespread described taxa. Recent genetic analysis suggests that the Lower Shag galaxids, as such no longer exists, with all of this type of non-migratory galaxiids in the Shag River catchment being *G. depressiceps*.

The Department of Conservation ("DoC") are currently managing all non-migratory galaxiids in the Shag river catchment as "*G. depressiceps*". The flathead galaxias, "*Galaxias depressiceps*", is listed as "Not Threatened", with a "conservation dependent" qualifier. Consequently common galaxiids found in the immediate vicinity of the Macraes Mine can be regarded as not threatened.

4.2.5 Regional Geology

The eastern area of Otago is underlain principally by Mesozoic age schist of the Torrlesse Terrane. Weathering and erosion over a long period formed the distinctive low relief of the Otago peneplain. The landscape in the Macraes area comprises widespread outcrops of schist and thin cover soils.

The general landscape in the vicinity of the Macraes Mine is that of rolling hills with moderate relief (generally ranging from 500 to 580 metres elevation). The North Branch Waikouaiti River flows along a broad valley to the west across Macraes Flat before turning south into a deeply incised gorge.

Tributaries of Deepdell Creek and Tipperary Creek flowing to the north and east have steep sided channels incised tens of metres into the schist.

A key feature of the geology in the area of the TTTSF is the Macraes Fault, which strikes east-west and crosses the impoundment. A series of structures parallel to the Macraes Fault, including Taieri Ridge and the Rock and Pillar range, show evidence of late Quaternary tectonic deformation (ie during the last 125,000 years). This deformation

comprises tilting, faulting and folding of late Quaternary deposits over a wide zone rather than along a discreet fault. An assessment of the Macraes Fault undertaken as part of the current investigation found that the Macraes Fault has not ruptured to the ground surface during the last 11,500 years and no evidence of any late Quaternary deformation was present. This is explained in the "Top Tipperary TSF: Preliminary Geotechnical Assessment" **attached** as Appendix 6

The Hyde-Macraes Shear Zone, which is the gold bearing structure mined by OceanaGold, dips gently (-15ºC) to the east and is about 1000 metres below surface in the area of the proposed impoundment.

4.2.6 Topography and Soils

The topography of the Macraes Flat area is that of an ancient erosional surface, or peneplain, which has been bisected by Deepdell Creek, the NBWR, Tipperary Creek and Murphys Creek. Deepdell Creek, which flows toward the northeast, and Tipperary Creek, which flows toward the southeast, both discharge into the Shag River. The NBWR flows toward the southwest past Macraes Flat, then turns to flow toward the southeast. Murphys Creek initially flows toward the southwest then turns toward the south to discharge into the NBWR.

Exploratory and geotechnical drilling and landform comparison indicates that a thin layer of loess covers much of the Macraes Mine area. The loess soils comprise a very stiff, light yellow grey silt, sandy silt or silty fine sand. Subsurface investigations identified a surficial cover of loess, colluviums and topsoil. Geotechnical investigations in the area of the proposed Back Road WRS and the TTTSF typically exposed 0.2m to 0.4m of soil materials, with a maximum identified thickness of 1.8m.

Laboratory tests conducted on samples of loess obtained from the test pits include water content, particle size analysis, Atterberg limits, pinhole dispersion, crumb, compaction and permeability.

Colluvium has accumulated at the base of steep slopes around the Macraes Mine site. Colluvium mainly comprises fine angular schist gravel in a sandy or silty matrix, with the matrix mainly derived from reworked loess.

4.2.7 Schist

The soils are directly underlain by schist comprising well foliated, fine grained pelite to coarser grained psammite. North and south of the impoundment, foliation typically dips at 20º to 40º towards the east which is consistent with the regional foliation pattern. Foliation locally dips towards the southeast as a result drag folding adjacent to the Macraes Fault.

4.2.8 Macraes Fault

Macraes Fault has offset the Hyde-Macraes Shear Zone by about 250 metres in a reverse sense (refer to the "Top Tipperary TSF Active Fault Assessment" (Appendix 7)). This deformation has been accompanied by a number of faults, both parallel to foliation and cutting across foliation.

Trenches were excavated near to the right abutment and along the footprint of the main embankment proposed for the TTTSF exposing a number of faults inferred to have

accommodated deformation association with the Macraes Fault. The trenches suggest a widening zone of deformation approximately 250 metres wide at the right abutment and 70 metres at the main embankment.

The "Top Tipperary TSF Active Fault Assessment" (**attached** as Appendix 7) concluded that the Macraes Fault has not ruptured in the last 11,500 years, and no evidence was found of movement during the last 125,000 years. This assessment was peer reviewed by Geological and Nuclear Science Limited (**attached** as Appendix 38). The peer review concluded the assessment presented a sound documentation of an active fault investigation

4.3 Groundwater, Surface Water and Hydrogeology

4.3.1 Introduction

Golder Associates (NZ) Limited ("Golder") has written a number of technical reports to evaluate aspects of water management and effects of the Macraes Phase III project. The detailed technical assessments produced by Golder on the Macraes Phase III project include:

- "Water Quality Effects Mitigation Options" (Appendix 9)
- "Site Wide Surface Water Model" (Appendix 10)
- "Tipperary Creek Hydrological Monitoring" (Appendix 11)
- "Top Tipperary Tailings Storage Facility Hydrogeological Assessment" (Appendix 12)
- "Tailings Static and Kinetic Geochemical Assessment" (Appendix 13)
- "Groundwater Contaminant Transport Assessment – Deepdell Creek, North Branch Waikouaiti River and Murphys Creek Catchments" (Appendix 14)
- "Environmental Water Quality Data Summary Report" (Appendix 15)
- "Golden Point Pit Lake Seepage Loss Assessment" (Appendix16)
- "Tailings Storage Facility Drainage Rates Following Closure" (Appendix17).

The information presented in these technical reports is summarised and integrated in the "Water Management Summary Report" (Appendix8).

4.3.2 Existing Water Quality, Criteria and Compliance Levels

Surface Water

There are five water courses in the Macraes Mine for which surface water quality data is available. These are:

- Deepdell Creek
- Shag River
- Murphys Creek
- North Branch Waikouaiti River
- Tipperary Creek

There are existing compliance points at each of Deepdell Creek, Shag River, Murphys Creek and the North Branch of the Waikouaiti River.

Current compliance points are set out in Table 1 with an explanation of why particular standard is appropriate at that point.

Table 1: Existing Macraes Mine Water Quality Compliance Points

Location	Standard	Explanation
Deepdell Creek DC07	**Stockwater (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Water take from this point for primary (livestock) use**
Shag at Loop Road	**Drinking (pH, arsenic, cyanide, copper, iron, lead, sulphate)**	**Potable water take at this point**
North Branch Waikouaiti River NBWRRB	**Stockwater (pH, arsenic, copper, iron, lead, zinc)**	**Water take from this point for primary (livestock) use**
North Branch Waikouaiti River NBWRRF (Rossford)	**Stockwater (pH, arsenic, copper, iron, lead and zinc)**	**Water take from this point for primary (livestock) use**
Murphys Creek MC100	**Stockwater (pH, arsenic, copper, iron, lead, zinc)**	**Water take from this point for primary (livestock) use**
Murphys Creek MC01	**Stockwater (pH, copper, iron, lead, zinc, sulphate)** **Drinking (arsenic)**	**Water take from this point for primary (livestock) use**
North Branch Waikouaiti River NB03	**Drinking (pH, arsenic, copper, iron, lead, zinc, sulphate)**	**Potable water take at this point**

Existing Monitoring Data

Deepdell Creek

An evaluation of the water quality data measured at the Deepdell Creek compliance point DC07 (downstream of Golden Point workings) between 1990 and 2010 indicates that:

- Concentrations of chloride, potassium, sodium, CN_{WAD}, copper, iron and lead were comparable to those measured at the upstream control site, while concentrations of calcium, magnesium, sulphate and arsenic were higher.
- Concentrations of copper, lead and CN_{WAD} are typically below the detection limits and no analysis results have exceeded the respective compliance limits.
- OceanaGold achieved a high level of compliance at Deepdell Creek compliance point between 1994 and 2010.
- It is apparent that sulphate concentrations have increased since Macraes Mine operations began in 1990. This increase has been attributed to seepage losses from the waste rock storage areas.
- Since 2006 the sulphate concentrations detected have been typically an order of magnitude higher than those detected both at the same site previously and at upstream sites during the same period. The increased concentrations a combination of tail seepage since 2006 appear to be primarily a result of discharges from the Golden Point underground workings which receive seepage along with water stored within the waste rock in Golden Point pit. The discharges from the Golden Point underground workings increased due to Macraes Mine water management issues that have subsequently been corrected. Sulphate levels have since stabilised at a lower level, within compliance requirements. The concentrations of soluble arsenic and iron have remained stable over the monitored period, as has pH.

Shag River Compliance Point

The Shag River compliance monitoring site is located at Loop Road downstream from the confluence of Deepdell Creek and the Shag River. An evaluation of the data measured at the Shag River compliance site since monitoring commenced in 2006 indicates that:

- With the exception of sulphate, the concentrations of major ions detected at the Shag River water quality compliance monitoring site are similar to those measured in Deepdell Creek upstream of Macraes Mine. The measured pH is also similar to that measured at the upstream control site.
- It is likely the elevated concentrations of sulphate detected at Loop Road monitoring site in 2006 and 2007 were a consequence of the increase in discharges from the Golden Point underground workings. The measured sulphate concentrations have subsequently decreased as the Golden Point discharges have been brought under control.
- The concentrations of CN_{WAD}, arsenic, copper, iron and lead at the Shag River compliance site between 2005 and 2010 were typically below their respective detection limits.
- With the exception of pH, there have been no exceedances of the limits since monitoring began. A pH of 6.9 was recorded on 13 August 2009, which was outside the consented range of 7.0 to 8.5; however, this exceedance is minor and considered to be within the analytical error for pH measurement.

Murphys Creek

The water quality of Murphys Creek is monitored at Site MC100 and MC01, respectively, 100m and 1000m, downstream from Murphys Creek Silt pond. Water quality samples have been collected from site MC100 since June 2004 and from site MC01 since December 2003. The key findings from the data measured are:

- The concentrations measured at site MC100 were generally lower than the concentrations measured a further 900m downstream at site MC01. The pH was unchanged between sites.
- There has been a general increase over time in the concentrations of major ions at both sites. The concentrations of trace elements at both sites have not changed greatly over the monitoring period.
- The compliance limits for pH, arsenic, copper, lead and zinc were not exceeded in any of the samples collected from Site MC01. However, the compliance limit for iron of 1.0g/m^3 was exceeded on two occasions during the monitoring period.

North Branch Waikouaiti River

The water quality of the North Branch Waikouaiti River ("NBWR") is monitored at 3 locations. NBWR Red Bank Road ("NBWRRB"), NBWR Ross Ford ("NBWRRF") and NB03. The NBWRRB site is located to the north-west of Frasers WRS, while the NBWRRF site is some 8 kilometres further downstream. Site NB03 is located a further 8 kilometres downstream of Site NBWRRF, and is downstream of the confluence with Murphys Creek. The evaluation of the data measured at these sites indicates that:

- The concentration at Sites NBWRRB and NBWRRF were, with the exception of sulphate, comparable to one another. Sulphate concentrations were higher at Site NBWRRB comparable to Site NBWRRF.
- Since 2008 there has been an increase in the concentrations of calcium, magnesium, sodium and sulphate at all sites, potassium concentrates have also increased.
- There is no indication of a general increase in the concentrations of copper, iron, lead or zinc overtime. However, arsenic concentrations at site NBWRRB appear to have increased since monitoring began.

Tipperary Creek

Water samples were collected from site TC01 between May 2009 and July 2009 and analysed to assess the current water quality in Tipperary Creek. The results indicate that water quality at Tipperary Creek is similar to the background water quality in Deepdell Creek. The key points are:

- A near neutral to mildly alkaline pH with low concentrations of major ions.
- Soluble arsenic and lead concentrations were less than the respective detection limits in all samples.

Compliance Limits

The compliance limits referred to in the above section are shown on the table below:

Table 2: Consented receiving water quality limits

Parameter	Deepdell Creek	Shag River	Murphys Creek	N. Branch Waikouaiti
Site	**DC07**	**Loop Road**	**MC01**	**NB03**
pH (unitless)	6.0-9.5	7.0-8.5	6.0-9.5	6.0-9.5
Arsenic	0.15	0.01	0.15	0.01
CN_{WAD}	0.10	0.10	-	-
Copper[A]	0.009	0.009	0.009	0.009
Iron	1.0	0.2	1.0	1.0
Lead[A]	0.0025	0.0025	0.0025	0.0025
Zinc[A]	0.12	-	0.12	0.12
Sulphate	1,000	250	-	-

Notes: Units g/m^3 unless otherwise stated, arsenic, copper, iron, lead and zinc are (filtered) concentrations; and [A] compliance limits for copper, lead and zinc are hardness dependent, the limits in this table have been calculated[1] assuming a hardness of 100 g/m^3.

Summary

Only minor exceedances of the existing surface water quality criteria have been recorded. These exceedances are mainly related to dissolved iron. The dissolved iron concentrations detected at some monitoring points are likely to be derived from waste rock stack seepage. At other compliance monitoring sites the concentrations that exceed the compliance criteria may be natural in origin.

Exceedances of the water quality criteria for trace metals tend to be a consequence of the criteria being hardness dependent. Results indicate the exceedances are not related to mining operations and in each case the exceedance was related to changes in water hardness.

Sulphate exceeded the compliance criteria in Deepdell Creek once. This exceedance was a consequence of an oversight in water management at the site leading to mine water discharges from Golden Point Pit through the historical underground workings to Deepdell Creek. These discharges were brought under control once they were identified. Sulphate concentrations in Deepdell Creek have since decreased to levels similar to those recorded prior to the unplanned releases.

Groundwater

The compliance limits that apply to compliance bores down gradient of both the MTI and SPI are as follows:

[1] Copper (g/m^3) = $(0.96\exp^{0.8545[\ln(\text{hardness})]-1.702})$ / 1000
Lead (g/m^3) = $(1.46203 - [\ln(\text{hardness})(0.145712)]\exp^{1.273[\ln(\text{hardness})]-4.705})$ / 1000
Zinc (g/m^3) = $(0.986\exp^{0.8473[\ln(\text{hardness})]+0.884})$ / 1000.

Table 3: Consented ground water quality limits

Parameter	Compliance limit
pH (unitless)	6.0-9.5
CN_{WAD}	0.10
Arsenic	0.15
Copper[A]	0.009
Iron	1.0
Lead[A]	0.0025
Zinc[A]	0.12

Note: Units g/m^3 unless otherwise stated; arsenic, copper, iron, lead and zinc are (filtered) concentrations; and [A] compliance limits for copper, lead and zinc are hardness dependent, the limits in this table have been calculated[2] assuming a hardness of 100 g/m^3.

Background Groundwater Quality

Groundwater samples obtained from GW1, located up gradient of the MTI are considered to be representative of background groundwater quality outside the mineralised zone. However, analysis of groundwater quality at GW1 in February 2010 indicates that mining operations may have affected groundwater quality at this location. A Mann Kendall analysis was undertaken to determine if there are any long-term trends. The following comments are made based on the additional analytical results:

- The pH of the groundwater at GW1 has typically ranged from 7 to 8.
- The concentrations of calcium, sulphate, CN_{WAD}, arsenic, copper, lead and iron have generally been near their respective detection limits.
- Calcium, sulphate, arsenic and iron concentrations have not changed over time.

Mixed Tailings Impoundment Monitoring Wells

Groundwater quality in detection wells down gradient from both the MTI and the silt settling pond in MTG have changed over time, reflecting the movement of tailings seepage water in a plume from the MTI. In summary:

- The pH of the groundwater in each detection well has typically remained between 6.5 and 7.2.
- The concentrations of the conservatively transported major ions, sulphate, calcium and sodium have increased in 4 detection wells since monitoring began.
- Since late 2007, the rate of increase in concentrations of major ions in the detection wells appears to have slowed and in some cases started to decrease. However, this trend is not consistent with all major ions, in particular sulphate concentrations detected in GW46 continue to increase.
- Soluble inorganic nitrogen (SIN) concentrations do not appear to have increased since mid 2005.
- CN_{WAD} concentrations have shown an overall increase in trend with the exception of those measured in GW50, which have remained below 0.2g/m^3.

[2] Copper (g/m^3) = $(0.96\exp^{0.8545[\ln(\text{hardness})]-1.702}) / 1000$
Lead (g/m^3) = $(1.46203 - [\ln(\text{hardness})(0.145712)]\exp^{1.273[\ln(\text{hardness})]-4.705}) / 1000$
Zinc (g/m^3) = $(0.986\exp^{0.8473[\ln(\text{hardness})]+0.884}) / 1000$.

- Lead and copper concentrations have typically remained close to, or below detection limits.
- Iron and arsenic concentrations in each of the detection wells have stabilised or decreased over the monitoring period.

Groundwater quality at compliance wells downstream have also changed over time. Prior to October 2005, there was no evidence that tailings seepage water from the MTI was affecting the groundwater quality at the compliance wells. However, since then concentrations of some species, in particular sulphate and calcium have increased sharply which indicates tailings seepage water from the MTI is present in groundwater within the area. In summary:

- The pH of the groundwater in each compliance well remains relatively stable over the monitoring period and was consistently within the compliance limits of 6 to 9.5.
- Since October 2005, concentrations of sulphate and calcium in all compliance wells have increased. Based on the concentrations measured in the detection wells this trend of increasing concentration for sulphate and calcium is expected to continue.
- Sodium concentrations have remained relatively consistent since the beginning of the monitoring period.
- CN_{WAD} continues to return concentrations well below the consent standard of $0.1g/m^3$ and generally concentrations are close to, or below laboratory detection limits.
- Concentrations of arsenic, copper, lead and zinc have typically below or close to detection limits, which are substantially below compliance limits.
- Soluble iron concentrations remain around the consent compliance standard of $1g/m^3$. Results from the last five monitoring rounds indicate generally increasing concentrations.

Southern Pit Impoundment

The potential effects of SPI derived seepage water on surrounding groundwater are monitored using two sets of monitoring wells. Detection wells are located to the north (down gradient) of the SP11 embankment to provide early warning of changes to groundwater quality. Compliance wells were installed to detect changes in groundwater quality prior to reaching Deepdell Creek.

An evaluation of groundwater quality data measured within detection wells down gradient of the SP11 embankment indicates that:

- The pH of the groundwater is typically circumneutral, and remained relatively stable throughout the monitoring period.
- Sulphate, sodium and calcium concentrations have increased since January 2005. Concentrations of soluble arsenic in both detection wells remain well below $0.15g/m^3$.
- Soluble iron concentrations in wells have regularly exceeded $1g/m^3$ however, concentrations at detection well SPMW4 have decreased since 2005 and are now consistently less than $1g/m^3$.
- Concentrations of lead, copper and CN_{WAD} are typically close to or below their respective laboratory detection limits.

Monitoring wells SPMW5, SPMW6 and SPMW7 are designated "compliance wells". The groundwater quality at the Southern Pit compliance wells is strongly influenced by varying mineralisation associated with the historical underground workings at Golden Point with the

result that water quality differs significantly from one well to the next. The key findings from the data measured in these wells are:

- The pH of groundwater at SPMW7 has varied over the monitoring period between 6.5 and 7.4. Since January 2007, the pH has consistently been between 6.5 and 7.
- The concentrations of both sulphate and calcium at SPMW7 vary inversely with pH.
- Compared to SPMW7, the water quality in both SPMW5 and SPMW6 has remained relatively stable since monitoring began in late 2001. The groundwater at both wells has a pH of between 7 and 7.5. Sulphate concentrations generally range from 100 to 200g/m^3 in SPMW5 and from 10 to 30g/m^3 in SPMW6. The concentrations in both wells do not vary greatly and indicate stable water quality. Soluble iron concentrations in all 3 compliance wells have been below 0.6g/m^3 since monitoring began.
- Arsenic concentrations in SPMW6 are typically below 0.01g/m^3. The concentrations SPMW7 have decreased from approximately 0.2g/m^3 in January 2007 to less than 0.03g/m^3 in early 2010. The most recent data indicates concentrations have increased slightly to 0.01g/m^3. However, this remains below the compliance limit of 0.15g/m^3. In contrast, arsenic concentrations in SPMW5 are consistently above the consent compliance standard of 0.15g/m^3, returning levels of approximately 0.6g/m^3. This reflects the bore's location within historic mine workings in a mineralised zone.
- Soluble lead and copper concentrates in all three monitoring wells have been at or below detection limits since monitoring began. CN_{WAD} concentrations have been consistently close to or below the detection limit in all three compliance wells.

Mixed Tailings Impoundment Western Monitoring Wells

A series of monitoring wells have been installed within the western margin of the MTI. Data from a selection of these wells shows the effects of the MTI on water quality to the west of the TSF. The selected monitoring wells, labelled P1, GW2, GW38 and GW3 are located in a line along the access road around the western margin of the TSF. Monitoring well P1 is located close to GW1 and both are likely to represent background groundwater quality at the site. Monitoring wells GW2 and GW38 are located to the west of a shallow gully to the west of the MTI . Monitoring well GW3 is located further to the northwest to the west of the Lone Pine WSR. An evaluation of the groundwater quality data measured in these wells indicates that:

- The pH of the groundwater in P1 is consistently around 6 while the pH in GW3 is slightly more neutral at 6.4. The pH of groundwater in GW38 is circumneutral, ranging from 6.5 to 7.5. GW2 returns the most consistent pH around 8.
- The concentrations of calcium, sodium and sulphate in the groundwater sampled at GW3 and P1 have been relatively stable over the monitoring period, while the concentrations in GW2 ground water are particularly variable.
- GW38 has returned some highly variable SIN concentrations and this has been repeated in the most recent sampling rounds. Concentrations in the other 3 wells are close to detection limits;
- Iron concentrations in GW2 and P2 are consistently 1g/m^3, while concentrations in GW3 and GW38 are higher, ranging from 1 to 16g/m^3.
- CN_{WAD}, copper, arsenic and zinc concentrations are consistently close to or below detection limits. Lead concentrations have, on occasion, been greater

than 0.0025g/m^3, the compliance limit that applies to the compliance wells down gradient of the MTI and SPI.

Summary

The water quality at the line of compliance wells in MTG, down-gradient from the MTI, has generally been in compliance with the water quality criteria, with the exception of soluble iron. Soluble iron exceeded the compliance limit during the two years following installation of the wells when there was no tail seepage influence. Concentrations may now be starting to exceed the compliance limits as the leachate plume from the MTI has reached the compliance wells.

The groundwater quality in the compliance monitoring wells down-gradient from the SPI is more variable than that in the compliance wells in MTG. The variability of the water quality between SPI compliance wells is primarily due to the relative separation of each well from either the Golden Point Pit or the historic Golden Point underground workings.

Frasers West WRS Monitoring Wells

Monitoring wells around the Frasers West WRS are labelled FDB01 through FDB10. Monitoring has been undertaken since 2001. The key findings on the water quality data measured in these wells are as follows:

- In general, pH of the groundwater in the FDB03, FDB04, FDB05 and FDB10 monitoring wells is between 6 and 9.5. The pH of the groundwater from monitoring wells FDB06 and FDB07 is more acidic, ranging from 5 to 6.5. FDB08 and FDB09 groundwater has a pH of between 6 and 6.5.
- Concentrations for three of the conservatively transported major ions (calcium, sodium and sulphate) appear relatively stable in monitoring wells FDB03, FDB05, FDB07 and FDB10. The water quality in FDB08 appears relatively constant until 2009, when the concentrations of these ions began to increase. The concentrations measured in FDB04 and FDB06 groundwater are showing an upward trend indicative of seepage water reaching these monitoring wells from the Frasers West WRS.
- Soluble iron concentrations are considerably below 1g/m^3 in monitoring wells FDB07, FDB08 and FDB09, and between less than 0.02g/m^3 and 7.2g/m^3 at FDB03 and FDB05. However, it is noted that iron concentrations in these wells now appear to be decreasing. Iron concentrations in monitoring wells FDB04 and FDB10 wells were higher than 1g/m^3 when first sampled, but are now close to, or below detection limits.
- Concentrations of arsenic, copper and lead are typically below detection limits, and in all cases, below the compliance limits of 0.15g/m^3, 0.009g/m^3 and 0.0025g/m^3, respectively, that apply to compliance wells down gradient of the MTI and SPI.

4.4 Human Environment

4.4.1 Community

The Macraes Mine is located within a relatively remote rural part of the Waitaki District. Other than mining, the area supports typical farming activities dominated by sheep and cattle grazing, and some areas of plantation forestry and deer farming. The Macraes Mine is by far the dominant economic activity in the area. The nearby township of Macraes Flat

provides a focal point for the local community, including people associated with the mine who live locally. The township comprises a small number of dwellings, a primary school, church and a hotel and mine visitor centre (both owned by OceanaGold).

The economic and social impacts of the Macraes Mine are discussed in greater detail in Section 4.5.

4.4.2 Heritage Values

The Macraes district consists of a complex and extensive heritage landscape. There are a variety of historic site types, representing farming, alluvial and quartz mining operations. Since the early 1990s a vast amount of archaeological and heritage assessments and inventory work has been undertaken.

Currently OceanaGold uses the OceanaGold Heritage Management Plan to assist it in identifying and protecting significant archaeological sites. The Management Plan was completed in 1998 and updated in 2005. The Management Plan was developed with the objective of ensuring that "*identified heritage sites (including archaeological sites both pre- and post- 1900 in origin) would only be modified or destroyed where no other reasonable options exists*"[3]. Within the Management Plan criteria for the assessment of archaeological and heritage values are outlined.

Opus International Consultants have carried out a thorough archaeological survey of all areas to be affected by works associated with the proposed MPIII expansion. The "Archaeological Survey-Macraes Phase III" is **attached** as Appendix18.

The results of the field survey have been separated into geographic locations, linked with proposed activities associated with the proposed MPIII project. They are as follows:

Camp Creek

A total of ten previously unrecorded archaeological sites were identified along a section of Camp Creek to the east of Horse Flat Road in the general vicinity of the proposed dam and reservoir. These sites are generally located on natural terrace areas immediately adjacent to the creek bed and contain evidence of alluvial mining (water races, sluicing) as well as occupation sites (huts). While these sites are considered to have significant archaeological values, it is not possible to assign a specific date to the occupants without further investigations. Site I42/157 was identified as a good example of an extensive area of alluvial workings and habitation and accordingly the location of the dam embankment was moved to preserve this site. These sites have been formally recorded as archaeological sites in the New Zealand Archaeological Association (NZAA) national database.

Tipperary Creek

Within the area of the proposed TTTSF there are a number of recorded archaeological sites, and several archaeological features. These include trenches and workings associated with the Duke of Edinburgh Mine (I42/78), alluvial workings recorded in Upper Tipperary Creek (I42/90), remains of a 1870s stone house (I42/79), and Tate Mine (I42/91).

The Duke of Edinburgh Mine includes a dam and evidence of workings over a large area. Features associated with the mine include the main area of the mine and battery, the dam

[3] OceanaGold Heritage Management Plan Update 2005 (page 1)

and the adit and shaft in the Upper Tipperary Creek. Prospecting pits, adits and trenches connected with the Duke of Edinburgh reef were also found. These are assumed to be related to the operation of the Duke of Edinburgh Mine between 1866 and 1874. Many of these features have been affected by farming activities since that time.

The remains of a stone house recorded as archaeological site I42/79 are also in the vicinity of the TTTSF. The stone house and associated features appear to have been constructed sometime in the 1870s or 1880s and the site has the potential to contain archaeological evidence associated with its occupation and use.

Evidence of alluvial workings located within the Upper Tipperary catchment includes remains of sluicing water races, the remains of a benched track above the gully and remnant small ponds that are associated with historic dams. Some of these areas have been modified by farming operations.

On the southern side of the Macraes-Dunback Road the main Tipperary Creek gully widens. Approximately 800m down the gully there is evidence of workings, prospecting pits and a possible hut site. Above the workings on the true left of the gully there is a small cave and rock shelter. This was first reported by Petchey in 1996 but had not been formally recorded as an archaeological site. The cave and associated mining workings have now been recorded as archaeological site I42/158.

The Tate Mine main shaft and mullock heap (I42/94) are located within the general area of the TTTSF. However, only trenching outside the main shaft area is within the area of the proposed TTTSF and realigned Macraes-Dunback Road.

Tate Dam and Battery (I42/91) are located alongside the existing Macraes-Dunback Road. The main feature of battery today is the concrete foundation for the diesel engine. Upstream of the battery site are the remains of a large earthen dam, with a concrete abutment at the western end. All features associated with the Tate battery and dam will be located within the footprint of the proposed tailings storage facility.

In 2009 OceanaGold received an authority to modify some sites within this area for construction of a tailings impoundment that was subsequently not constructed. Included within the authority are parts of site I42/91 (Tate Mine), and part of site I42/78 (workings associated with the Duke of Edinburgh Mine).

Back Road Waste Rock Stack

No formally recorded archaeological sites are located within the area of the proposed Back Road Waste Rock Stack. The area does however contain evidence of historic mining workings. The site includes an area assessed by Nichol and Wright as part of a Historic Places Trust Authority application for a proposed tailing storage facility in 2009. Several features identified by Nichol and Wright (including various trenching and depressions associated with early mining activities), are located within the general vicinity of the proposed Back Road Waste Rock Stack. The Waste Rock Stack was redesigned to preserve this feature.

As part of the Historic Places Trust authority granted for the 2009 impoundment, a large trench associated with the Duke of Edinburgh reef was identified as having high significance and was intended for long term protection. This feature is also within the general vicinity of the proposed Waste Rock Stack, but will not be physically impacted by the proposed Waste Rock Stack.

Frasers South and Frasers North Waste Rock Stacks

Within the general area of the proposed Frasers South and Frasers North Waste Rock Stack Extensions there are four recorded archaeological sites identified on the NZAA site database. Two of these sites no longer exist as a result of the expansion of the main Frasers Pit.

The remaining two sites I42/33 and I42/41 are located immediately adjacent to Golden Bar Road. I42/33 is recorded as a prospecting pit. No evidence of this feature was seen in the 2010 survey. Site I42/41 is a historic trig site.

Extension of Frasers Pit

The extension of the Frasers Pit will result in the loss of an old farming homestead known as Robinson Homestead. Robinson Homestead is an example of a later 19th century/early 20th century farm homestead, within the project area, however there are other examples in the district including the historic Deepdell Station homestead, recently acquired by OceanaGold, which provides potential for long term protection.

The historic values of the Robinson Homestead were first formally identified by Petchey in 1996, although Petchey did not formally record this as an archaeological site. As part of the current assessment, the site has been formally recorded and entered into the NZAA site recorded database as site I42/159.

4.4.3 Summary of Tangata Whenua Values

Iwi or Hapu Exercising Mana Whenua over the Area

The First Schedule of the Te Runaka o Ngai Tahu Act 1996 states that: "*The takiwa of Kati Huirapa ki Puketeraki centres on Karitane and extends from Waihemo to Purehurehu and includes an interest in Otepoti and the greater harbour of Otakou. The takiwa extends inland to the Main Divide sharing an interest in the lakes and mountains to Whakatipu with Rünanga to the south"*.

The Macraes Mine is situated within the takiwā of Kāti Hūirapa Runaka Ki Puketeraki.

In recognition of Kāti Hūirapa Runaka's special affinity with the area OceanaGold has entered into a Memorandum of Understanding with Kāti Huirapa Runaka on 6 December 2004. A copy of the Memorandum of Understanding is attached as Appendix 36.

The objective of the Memorandum of Understanding was to establish an effective and efficient working relationship between OceanaGold and Kāti Huirapa Runaka in relation to their specific interests in the area, and in particular to:

- Manage the effects of mining and other related activities so as to take into account and have regard to the spiritual and cultural values and customary rights of mana whenua as they apply to the use and management of natural and physical resources;
- Ensure the effects of mining are remedied, avoided or mitigated as required by the Resource Management Act 1991 and having regard to the interests of Kati Huirapa Rünaka;

- Manage the effects of mining as far as practicable, so as to specifically avoid, remedy or mitigate any adverse effects on waahu tapu, mahika kai and waahi taoka;
- Ensure timely consideration by Kāti Huirapa Rūnaka of any proposals for resource consents made by OceanaGold, and to ensure that wherever possible Kāti Huirapa Runaka provides its written approval to such consent applications;
- Provide necessary and other relevant information to ensure effective and informed consultation as outlined in the terms and reference;
- Develop and maintain an ongoing and meaningful consultative process between mana whenua and OceanaGold; and
- Establish a Trust with mana whenua representation responsible for the future development and monitoring of Macraes Mine beyond mine life.

The KTKO Natural Resource Management Plan ("NRMP") 2005 has been developed to:

- Provide the principal planning document for Kai Tahu ki Otago;
- Provide information, direction and a framework to achieve a greater understanding of the natural resource values, concerns and issues of Kai Tahu ki Otago;
- Provide a basis from which the management of the natural, physical and historic resources of Otago is further developed.
- Provide the basis, but not substitute, for consultation and outline the consultation expectations of Kai Tahu ki Otago.

The sections of the KTKO NRMP relevant to the MPIII address:

- Preventing deterioration of water quality;
- The effect of dams on cultural values;
- Ensuring only the minimum amount of water is abstracted;
- Managing instream works to protect nohoanga, mahika kai, fish passage, habitat values;
- Promotion of Accidental Discovery protocols and other measures to ensure protection of waahi tapu;
- Protection of cultural landscapes.

The relevant provisions from the NRMP are **attached** as Appendix 37.

4.5 Existing Mine Operations – Existing Economic and Social Impacts

A detailed assessment of the economic impacts of the proposed extension of the Macraes Mine life at the national regional and local levels was undertaken by Mike Copeland of Brown Copeland and Co Limited. "Macraes Phase III Project Assessment of Economic Impacts" is **attached** as Appendix 19.

The Macraes Mine currently involves gold production from the Macraes opencast mine and Frasers Underground mine as well as the processing of ore from the Reefton Mine on the West Coast.

In 2010, 268,602 ounces of gold was produced with an estimated value of $423 million, whilst production is estimated to be 270,000 ounces in 2011, with an estimated value of $488.5 million[4].

Employees and contractors engaged at the site in 2010 total 563, with a further 28 engaged in the Dunedin head office. In total the Macraes Mine directly creates 591 jobs for the Otago region. Wage and salary payments for 2010 are estimated at $41.2 million for the Otago region - $2.04 million for Dunedin staff and $39.2 million for those employed at Macraes Flat.

Of OceanaGold's own staff (i.e. excluding contractors engaged on site at Macraes Flat), 32.7% reside in Dunedin, 27.5% reside in Palmerston, 19.4% reside in Waikouaiti, 8.8% reside in Oamaru, 3.1% reside in Waitati and Warrington, 1.7% reside in Dunback and 6.5% reside elsewhere within the Waitaki District and Dunedin City. This indicates that at least 57.4% reside in Waitaki District or Waikouaiti.

The Waitaki District economy is primarily driven by the agricultural sector and agricultural product processing. This is also the case for the north-east Otago area which includes the Waitaki District plus the towns of Waikouaiti, Hyde and Middlemarch and surrounding countryside.

The Macraes Mine provides jobs for 3.6% of Waitaki's workforce. This helps to provide greater diversity and balance to the north-east Otago economy, providing employment opportunities and income less dependant upon returns to the agricultural sector and making the local economy more resilient to agricultural commodity price cycles.

Expenditure in 2010 by the Macraes Mine for goods and services other than labour is estimated to total $153.8 million. Of this other expenditure it is estimated 6% ($9.2 million) is spent in north-east Otago (including Macraes Flat, Oamaru, Dunback and Palmerston) and the northern part of Dunedin City (including Waikouaiti, Hyde and Middlemarch). An estimated 29% ($44.6 million) is spent in Dunedin City itself, and 1% ($1.5 million), in the rest of Otago implying a total of 36% ($55.3 million) for the whole Otago region. The types of industry groups to benefit include those involving lime production; automotive equipment supply, maintenance and repairs; electrical equipment installation, maintenance and repairs, and building contractors.

In addition to these direct economic impacts there are indirect impacts arising from:

[4] Assumes average gold price of US $1,375 per ounce and exchange rate of NZ $1 = US $0.76

- The effects on suppliers of goods and services provided to the Macraes Mine; and
- The supply of goods and services to employees of OceanaGold and its contractors and to those engaged in supplying goods and services to OceanaGold and its contractors. For example, there will be additional jobs and incomes for employees of supermarkets, restaurants and bars as a consequence of the additional expenditure by these employees.

The Waitaki District Council ("WDC") also benefits from the increased rates revenue provided by OceanaGold. Because of economies of scale it is likely that rates paid by the Macraes Mine will be greater than the increase in WDC's costs as a consequence of gold mining operations on the site as compared to pastoral farming. This effect is further enhanced when factors such as OceanaGold's obligation to maintain the running surface of Macraes-Dunback road is taken into account. This broadening of the rating base provides the opportunity for a greater range of council provided services or a reduction in the rates burden for other ratepayers. In the current financial year (2010/2011) OceanaGold will pay rates totalling $345,842 (including GST) to WDC.

The economic assessment contained in Appendix 19 has used accepted district and regional multipliers to gauge the size of these indirect effects. Using the multipliers the assessment concludes the total north-east Otago economic impacts assessment (i.e. direct plus indirect impacts) of the current Macraes Mine are:

- 1,126 additional jobs;
- $58 million per annum in additional wages and salaries; and
- Additional other expenditure of $13.8 million per annum.

This greater diversity is reinforced by the contribution the Macraes Mine makes to tourism in north-east Otago. The Macraes Mine tour is the major reason why tourists visit Macraes Flat. Current (2010) visitor numbers are estimated at 5,000 per annum.

In addition to these financial benefits the Macraes Mine has provided the region with other socioeconomic benefits. It significantly contributes to the "social fabric" of the north-east Otago community via staff, contractors and their families belonging to service clubs, sports clubs and other voluntary organisations. As well as fulfilling leadership roles and making other contributions within the community, the project staff, contractors and their families help provide the critical mass to underpin these organisations, ongoing sustainability.

42 emergency response personnel, who respond to community emergencies as and when required, are located on site. Included in the 42 are 2 qualified ambulance officers, 2 volunteer fire fighters from Palmerston and 2 volunteer fire fighters from Waikouaiti. The emergency response team are also an official co-response unit ("CRU") for St John Ambulance southern region.

Macraes Mine staff and contractors also help to underpin local school rolls. Children of OceanaGold staff and permanent contractors at Macraes Flat make up:

- 39% of pupils at East Otago High School (79 out of 202);
- 43% of pupils at Palmerston Primary School (49 out of 104);
- 48% of pupils at Waikouaiti Primary School (39 out of 82);
- 33% of pupils at Flag Swamp Primary School (4 out of 12);
- 44% of pupils at Karitane Primary School (8 out of 18);
- 80% of pupils at Macraes Primary School (8 out of 10); and
- 28% of children at pre-school institutions in North-East Otago (74 out of 269).

In recognition of the important role that the community plays in helping the Macraes Mine realise its potential, the company provides financial support to a number of initiatives at the community level. Over the past 12 months (November 2009 to October 2010) more than $200,000 has been distributed to community groups including grants to the Bannockburn Respite Home, East Otago High School, Flag Swamp Primary School, Macraes Community Incorporated, Middlemarch Play Centre, Otago Life Education Trust, Otago Medical Research Foundation, Otago Nuggets Basketball Team, Otago Rugby Football Union, Progress of Waikouaiti Area Committee, Waihemo Heritage Group, Waikouaiti Primary School, and the Waikouaiti Volunteer Fire Brigade.

In summary, since 1990 the Macraes Mine has been, and continues to be a significant contributor to levels of employment, incomes and expenditure for the Waitaki District north-east Otago, and the Otago region. The Macraes Mine has also provided the region with a range of significant socioeconomic benefits.

4.6 Reefton

OceanaGold's Reefton Mine on the West Coast uses the Macares Flat processing plant to process the ore concentrate it produces. Without the Macraes Phase III project the Reefton Mine would have to cease operations in 2012.

In 2010 OceanaGold provided 222 on-site jobs for staff and contractors with wages and salaries of $15.5 million. Other expenditure for local businesses on the West Coast by OceanaGold in 2010 is estimated at $11.2 million. The Reefton Mine also has a range of indirect economic and social impacts in the Buller and West Coast Region.

5. Detailed Project Description

5.1 Overview

Mining and processing of Macraes ore commenced in 1990. The current operations comprise the following:

- an open pit mine called Frasers pit;
- the Frasers underground mine which is accessed from part way down the open pit;
- a number of active waste rock stacks (Frasers West, Frasers East);
- two tailings storage facilities (the Mixed Tailings Impoundment and SP11 Impoundment)
- an ore processing plant; and
- associated infrastructure to support ongoing operations in the form of roads, pumps, pipelines, powerlines, workshop facilities, offices and a large water storage dam.

There is also a number of previously worked open pits that are in various stages of rehabilitation or post mining management including pits at Deepdell, Golden Point, Round Hill, Southern, and Innes Mills and Golden Bar.

The main features of the MPIII Project are:

- A new tailings storage facility (called Top Tipperary Tailings Storage Facility (TTTSF)) will be constructed in the upper Tipperary catchment basin. It will result in an increase of 51Mt of total consented tailings storage capacity (from 81Mt currently to 132Mt);
- Reclamation of tailings from within the current SP11 tailings storage facility. The tailings will be relocated to a stack within the footprint of the existing Mixed Tailings Impoundment, called the Reclaimed Tailings Stack ("RTS") with any residual reclaimed tailings being stored within the new Top Tipperary Tailings Storage Facility;
- New rock stacks and extensions to existing rock stacks will be constructed, increasing the total consented tonnage from 850Mt to 1,180Mt. The existing Back Road Rock Stack will be substantially expanded to the east of the Round Hill/Southern Pit locations. Frasers East and Frasers West Rock Stacks will be linked by a new rock stack called Frasers South Rock Stack and an extension added to the north of Frasers East Rock Stack called Frasers North Rock Stack;
- Macraes-Dunback Road will be realigned from near Hocking Road following the legal (but unformed) Macraes Back Road alignment north before turning west to run along the divide between the Deepdell and Tipperary catchments and rejoining the current alignment adjacent to Innes Mills Pit, (near the old Golden Bar haul road traffic lights);
- Golden Bar Road will be realigned for the last 2.5km before rejoining Macraes-Dunback Road;
- Expansion of existing pits to include the following; Frasers Stage VI, Round Hill – Southern Pit Extension, and Innes Mills Stage V;
- Continued down dip (North Easterly) development of Frasers Underground mine;

- A new fresh water storage dam in Camp Creek (a tributary of Deepdell Creek) that will be filled from flood flows. The dam will result in a permanent residual flow in Deepdell Creek during dry periods;
- Surface water on the expanded mining infrastructure will be managed with diversions and new silt control dams;
- The existing processing rate of approximately 6 million tonnes per annum will remain and the intensity of operations on site will remain similar to current levels; and
- Providing this is accepted by the Macraes Community Incorporated as appropriately mitigating the effects of the mine above OceanaGold is proposing a revised closure strategy to replace the Heritage and Art Park which will comprise: two lakes formed from pit excavations; trails and tracks to existing art works; formation of a Community Development Trust; gifting Stanley's Hotel to the Trust and provision of a significant fund to the Trust to support local community initiatives and encourage business development. Such initiatives could include upgrading Stanley's Hotel and upgrading the town water supply, but ultimately that will be at the discretion of the Trust.

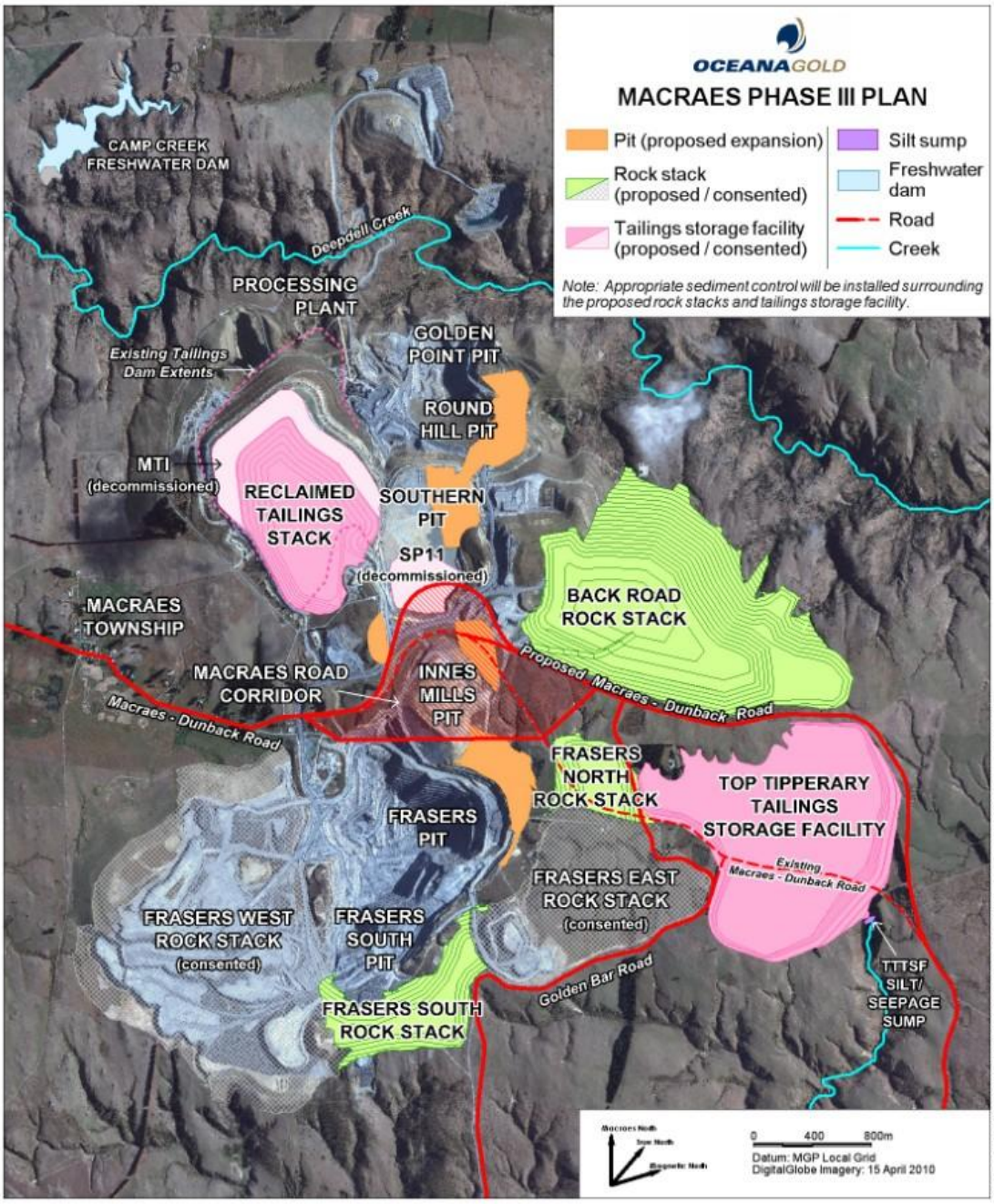
5.1.1 Environmental Issues to be addressed

The principal mining related environmental issues to be addressed are as follows:

- Noise: from works associated with proposed pit expansions, construction of WRSs, TSFs and road realignments.
- Dust: created by earthworks (including stripping of overburden and topsoil, mining, construction of roads and dam structures, formation of WRSs and rehabilitation of the TSF), vehicle movements on unpaved surfaces, loading and unloading of materials, and wind generated dust from dry exposed surfaces such as roads and stockpiles.
- Airblast and Vibration: from the proposed pit expansions on the Macraes Village, the nearest houses to the proposed operation not owned by OceanaGold and the historic buildings in Golden Point Historic Reserve.
- Stability: of the proposed pit expansions; the reclaimed tailings storage facility; the TTTSF embankment; and the structural integrity of the WRSs.
- Archaeology: Archaeological and heritage resources that have been identified within areas proposed for Camp Creek Freshwater Dam; Macraes-Dunback Road realignment; TTTSF; WRSs and Frasers Pit extension.
- Ecology: potential effects (aquatic, avifauna and herpetofauna, and botanical) of WRSs, TTTSF, Camp Creek Freshwater Dam and road realignments on ecological values.
- Water Quality/Quantity: the construction of a new tailings storage facility (TTTSF), additional WRSs, relocation of current TSF and expansion of several existing opencast pits will result in new tailings water seepage and contaminant losses which have the potential to affect water quality and quantity in the wider catchment.
- Landscape and Visual: potential effects from the construction and operation of the proposed mine expansion on landscape and visual effects.
- Cultural Values: the maintenance of natural landscapes, protection of waahi tapu and waahi taonga for taonga species and impacts on the mauri of the land, water and air are all of cultural importance.

These issues are addressed in detail in sections 6 and 7.

Figure 3: Macraes Phase III Plan



5.2 The Mine

The Macraes Mine is centred on the Hyde Macraes Shear Zone ("HMSZ"). Since open pit mining commenced at the Macraes Mine, a series of conventional open pits have been developed along the north-west trending (mine grid north) HMSZ. Gold mineralisation is variably distributed along the hangingwall shear as well as along a number of erratic, concordant shears, located below the hangingwall shear. Zones of sheeted, and variously orientated, quartz veins within the intrashear schist also carry some mineralisation. The footwall schists are typically barren.

The hangingwall shear dips at 15-20° to the east (mine grid east) with a mineralised width of 5-30m. The structure has been mined over a strike length of 6km and, in the Frasers area, is known to be mineralised to depths in excess of 500m.

Mining operations commenced in 1990. Ore mining at Macraes Mine has come from ten pits, comprising, from north to south, Deepdell North, Deepdell South, Northwest Pit, Golden Point, Round Hill, Southern Pit, Innes Mills, Frasers North and South, Golden Ridge and Golden Bar.

All of these pits have been either fully or partially backfilled with mine waste rock apart from Deepdell South and Golden Bar (where lakes have been formed) and Frasers (which is currently being actively mined and also consented to be a lake once complete).

Current operations are in Frasers North Stage 4C (FN4C) and Frasers Stage 5. Round Hill, Southern Pit, Frasers North Stage 6 (FN6) and Innes Mills North are still to be mined and form part of the MPIII application.

The conventional open pit mining operation at Macraes Mine utilises two Montabert drills for ore grade control and blast holes, two Drilltech drills for overburden blast holes and various ancillary units in addition to the four hydraulic excavators and nineteen rear-dump diesel trucks to remove both overburden and ore. Contracts for fuel and other commodities and services support the open pit operations. Blasting requires relatively light powder factors compared with other operations due to the relatively weak and fractured rock mass. Ore is blasted in 7.5m high benches and excavated in three, nominally 2.5m high flitches. Waste is blasted in 15m benches and excavated in four flitches.

The Frasers Underground (FRUG) operation has been operating since 2008 and was up until 1 July 2010 mined under an alliance agreement, with OceanaGold providing management and technical guidance to a mining contractor who performed the physical mining tasks. Since that date, operations have been undertaken by OceanaGold.

The underground retreat long-hole open stope (RLHOS) mining operation utilises electric-hydraulic development jumbos, diesel load-haul-dump units, diesel haul trucks and a production drill rig to extract both waste and ore. The retreat stope voids are not backfilled, instead the mine design utilises yielding pillars between adjacent extracted stopes to gradually deform over a timeframe that permits ore extraction.

The up-dip panel (Panel 1) has had the majority of its ore already mined. The remainder of Panel 1 represents an extension of the Frasers Open Pit Stage 6 mineralization, extending from 300m to a depth of around 320m.

At around 320m, the tenor of mineralization drops, and remains patchy down dip for a distance of approximately 250m. The width, grade and continuity then improve below 370m to at least 650m, forming a second panel (Panel 2) which to date remains open down dip below 650m.

The mineralised zone within Panel 1 averages 15 to 25m thick. Panel 2 intersections are generally thinner.

Exploration drilling success in Panel 2 during 2010 extended the mine life to at least 2014 and a further drilling campaign planned for 2011 should extend the mine life further.

5.2.1 Detailed Description

It is intended that the Macraes Phase III expansion will entail the following pit stages, mined by open pit methods as highlighted in the Figure 4.

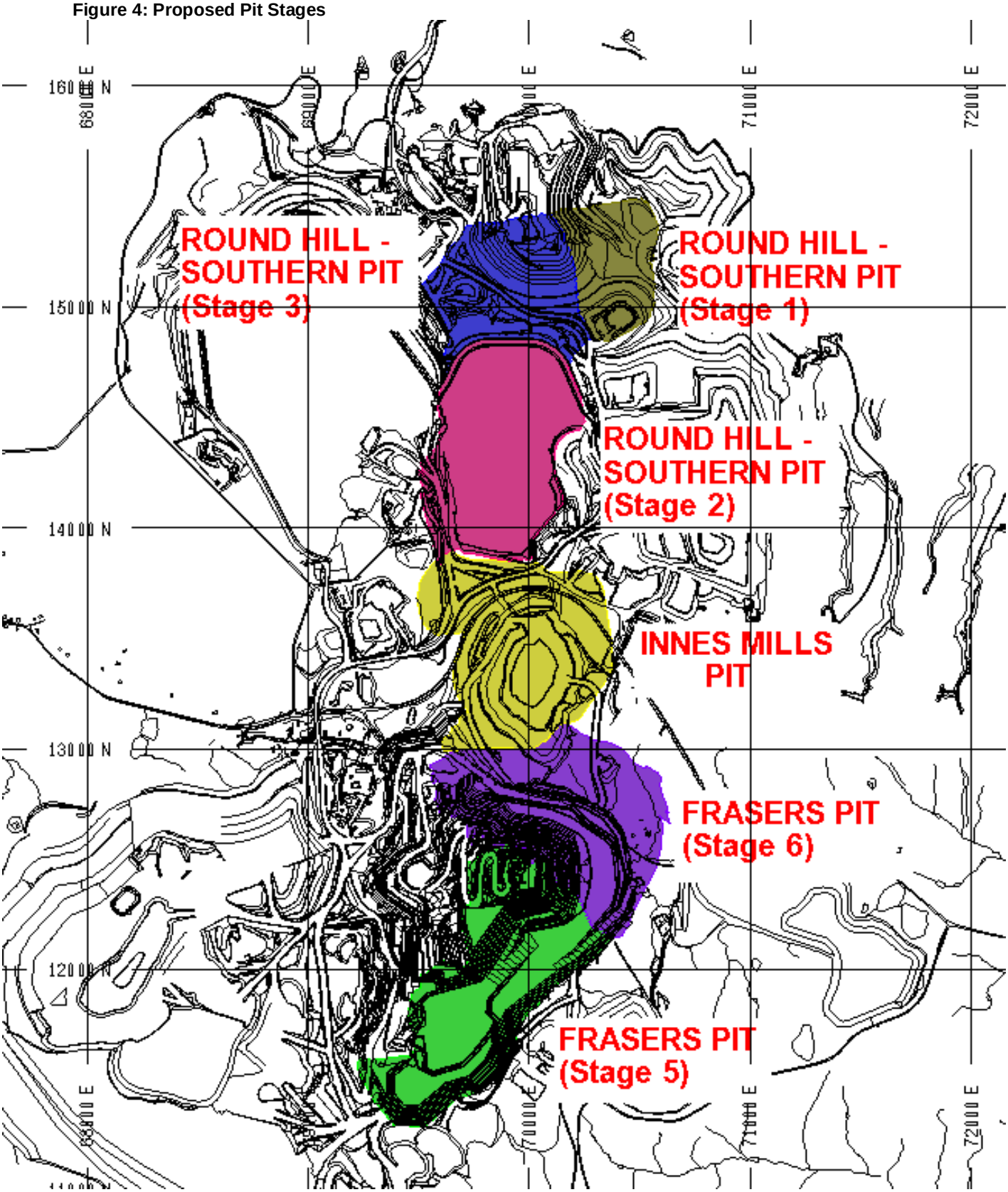
i) Frasers Pit stage 5 (currently being mined and completed late 2012);
ii) Round Hill – Southern Pit stage 2 (tailings removal);
iii) Round Hill – Southern Pit stages 1 and 3;
iv) Frasers Pit stage 6; and
v) Innes Mills Pit.

An alternative sequence has also been considered:

i) Frasers Pit stage 5;
ii) Frasers Pit stage 6;
iii) Round Hill – Southern Pit stage 2 (tailings removal);
iv) Round Hill – Southern Pit stages 1 and 3; and
v) Innes Mills Pit.

These two sequences are only proposed at this stage. In reality sequencing of the mining operations can, and does, change as the needs for operational flexibility change. The primary environmental issues addressed in this AEE are not dependant on a particular sequence. When necessary some assessments such as noise and dust, have made certain assumptions about sequencing.

Figure 4: Proposed Pit Stages



The total tonnage of material to be mined from all open pits from 1 January 2011 is planned to be 490Mt. This volume includes 55Mt of backfill from Round Hill, 64Mt of backfill from Innes Mills and 18Mt of tailings from the outer section of the decommissioned SP11A TSF.

The mining of Round Hill - Southern Pit will involve the removal of old backfill and the SP11A embankment and tailings. The original SP10 wall and tailings within its impoundment will remain in place. Mining will not remove the MTI embankment.

Mining of Round Hill – Southern Pit will be controlled by geotechnical constraints to ensure the integrity of the MTI dam and RTS is maintained and stability of the Processing Plant is not compromised by movement associated with the footwall fault.

The Frasers Underground operation will continue its mining operations in parallel with the open pits until 2018. All waste material from the underground will be placed within the main Frasers Pit itself.

5.2.2 Environmental Engineering and Management Details

Open pit mining will continue using standard blasting and ripping methods used at the Macraes Mine since operations commenced, and will typically be at a rate of 50 to 60 Mt per year using a diesel powered mobile fleet of equipment.

Ore and waste rock will continue to be drilled and blasted in tonnages usually of 100,000 to 1,000,000 tonnes of rock per blast. Blasting will be done on average 3 to 5 times per week during daylight hours. In practice this will represent little change from current operations.

Hydraulic excavators will then load the fleet of dump trucks, which will transport the ore to the run of mine (ROM) stock-piles located at the Macraes processing facility or low grade stockpiles for later re-handling. Waste rock will be hauled to one of the afore-mentioned waste rock stacks for final deposition. A fleet of support equipment such as bulldozers, graders and water carts will assist the main mining fleet.

The rehandling of previously deposited waste rock from Round Hill and Innes Mills will not require drilling and blasting. The SP11A tailings will be re-handled predominantly by a fleet of tractor pulled scrapers.

5.2.3 Post Mining Phase

In-pit backfill options will be evaluated over the life of mine and economic factors and where it is viable will be utilised to reduce the impact of surface waste rock stacks. At closure, pit lakes will naturally form in the Frasers/Innes Mills and Round Hill/Golden Point/Southern Pits.

Waste rock stacks will be constructed in such a manner that should they not be constructed to fully consented limits they can be rehabilitated in accordance with the final design slopes and contours proposed.

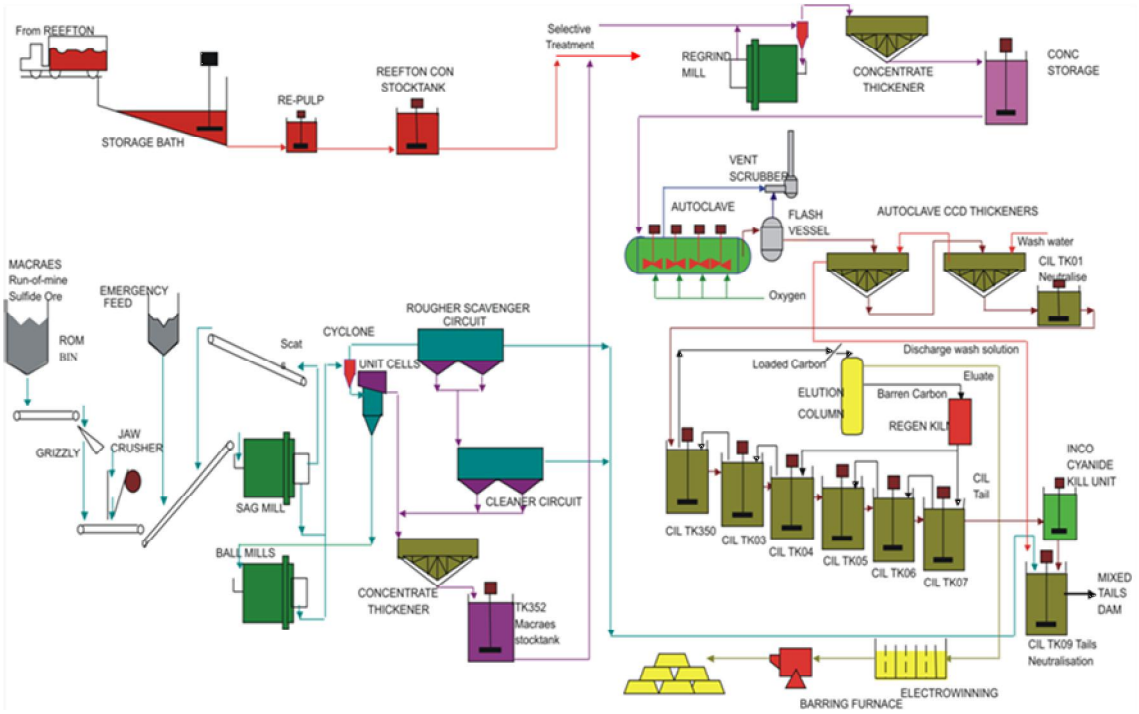
5.2.4 Ore Processing

Ore processing has been undertaken at the same processing facility since inception in 1990. The processing plant capacity has been increased over the years from an original capacity of 1.5 million tonnes per annum to its current processing rate of 6 million tonnes per annum.

A number of processing improvements have occurred throughout the life of the mine including the addition of more milling and flotation capacity. An autoclave was added in 1999 and is used to oxidise under pressure the ore that is concentrated during the flotation process (including Reefton ore concentrate).

The Macraes Process Plant recovers gold by concentrating the metal into a relatively small fraction of flotation concentrate, oxidising the reground concentrate in a pressure oxidation autoclave, washing the oxidised residue and then utilising a carbon-in-leach process to recover gold from the residue. Figure 5 is a schematic diagram of the plant flow sheet.

Figure 5: Schematic Flow Sheet for Macraes Processing Plant



In detail the plant comprises:

- two single stage jaw crushing circuits, which reduce the ore to a top size of approximately 200mm; the products from these two circuits are directly fed to the two SAG mills and an emergency feeder on the conveyor system feeding the higher capacity circuit provides continuity of feed to the grinding circuit if the jaw crusher feed is interrupted;

- a complex grinding circuit to reduce the particle size of the ore to 80% passing 140 µm; the original, higher capacity crushing circuit feeds a 2,300kW SAG mill and the new crushing circuit feeds a 1,500kW SAG mill; discharge from the two SAG mills are directed to two separate cyclone clusters, the underflow from which is fed to the flash flotation section or two parallel ball mills (2,300kW and 2,500kW); ball mill discharge is directed to the larger of the cyclone clusters;

- the flash flotation circuit, comprising both roughing and cleaning, on the circulating load of the grinding circuit, to recover as much of the sulphide minerals, and consequently the gold, at as coarse a size as possible;

- a main primary flotation circuit comprising tank cells and trough-style cells to maximise gold recovery to flotation concentrate; a cleaner flotation circuit controls the sulphur grade of the concentrate to optimise the performance of the following pressure oxidation circuit;

- regrinding of the flotation concentrate in a 900kW ball mill to 80% passing 15 µm improves pressure oxidation kinetics; limestone is added to the regrind circuit feed to control net acid generation in the pressure oxidation circuit;

- washing and thickening of the reground flotation concentrate in a high rate thickener to control the level of chloride ion in the liquor fed to the pressure oxidation circuit;

- repulping and treatment of Reefton concentrate through a 450kW IsaMill, generating an 80% passing 20 µm sized product;

- pressure oxidation (POX) in a 77 m^3 autoclave at 3,150kPa and 225°C to achieve greater than 75% oxidation of the sulphide component of the Macraes concentrate; oxygen is supplied to the autoclave from a cryogenic plant operated by BOC;

- pressure oxidation through the autoclave of Reefton concentrate at the same operating conditions as for Macraes concentrate, targeting greater than 88% oxidation;

- the facility for separate treatment of Macraes and Reefton concentrates excess concentrate from either source results in a proportion of Macraes concentrate being sent to CIL unoxidised as direct leach (due to the higher recoveries achievable on unoxidised Macraes concentrate compared to unoxidised Reefton concentrate);

- washing of the oxidised residue from the pressure oxidation (POX) process to separate the acid liquor generated by the oxidation;

- further neutralisation of the acid liquor using flotation tailings and lime;

- leaching of gold from the POX residue using cyanide in a CIL circuit that uses kerosene and high activated carbon concentrations to control preg-robbing by the carbonaceous component in the ore;

- destruction of the cyanide in the CIL tailings using the INCO process, with sodium metabisulphite as a source of sulphur dioxide (SO2); and

- recovery of gold from the loaded carbon using a normal elution and single pass electrowinning circuit, followed by smelting to produce gold bullion.

The POX plant uses technology that minimises formation of gold chloride complexes in the autoclave. Formation of these soluble complexes in the presence of active carbon can result in preg-robbing prior to contact of the oxidised residue with cyanide. Washing the concentrate with water in a thickener controls chloride levels in the flotation concentrate pulp. The acidity of the autoclave pulp is controlled by the addition of limestone to the regrind.

Commissioning of the POX circuit in 1999 proceeded with minimal disruption to plant operations and the process has been both a technical and economic success, being a large contributor to a significant reduction in cost per ounce of production.

In 2007, OceanaGold replaced the primary flotation columns and the 38m^3 trough-style flotation cells with three 300m^3 tank cells simplifying the rougher/scavenger flotation circuit and enabling the large conventional cells to be used to increase the capacity of the cleaner circuit.

The underground ore is separately crushed and primary milled before being blended with open pit ore during the secondary grinding stage at the Macraes Process Plant.

There are no major expansions planned for the processing plant for the future. The only impact of the expanded operations and life of mine on the processing plant will be in the area of tailings pumping. Pumping to the new TTTSF this new facility will be beyond the duty of the existing tailings pumps therefore the pumps and associated pipeline will need to be upgraded to handle a much higher total pumping head.

5.3 Waste Rock Disposal

5.3.1 Overview

A number of waste rock stacks have been constructed over the mine life to date. The principal rock stacks that have been formed are the Western Rock Stack, Northern Gully Waste Rock Stack, Back Road Waste Rock Stack, Frasers West Waste Rock Stack and Frasers East Waste Rock Stack. There are also formed waste rock stacks associated with the Deepdell and Golden Bar pits.

The Western, Northern Gully and Back Road Waste Rock Stacks were formed from waste rock mined from Golden Point, Round Hill, Southern and Innes Mills pits and have been rehabilitated except for Back Road Waste Rock Stack. Back Road Waste Rock Stack has been partially rehabilitated as it remains incomplete.

Mining of the Frasers pit commenced in the late 90's and the Frasers West Waste Rock Stack was constructed. This stack is still active. As mining of the Frasers open pit progressed down dip to uncover more ore, it became more cost-effective and efficient to stack waste rock to the east of the open pit. A new stack, called Frasers East Waste Rock Stack, was consented in 2005 and construction started in 2009.

The MPIII project will require new rock stacks and extensions to existing rock stacks to be constructed, increasing the total consented tonnage from 850Mt to 1,180Mt. The existing Back Road Waste Rock Stack will be substantially expanded to the east of the Round Hill/Southern Pit locations. Frasers East and Frasers West Rock Stacks will be linked by a new rock stack called Frasers South Rock Stack and an extension added to the north of Frasers East Rock Stack called Frasers North Rock Stack.

Waste rock will also be used for ongoing construction of the tailings storage facility, various haul roads and for sub base material for the Macraes Road realignment.

5.3.2 Description of Stacks

There are currently two main Waste Rock Stacks (WRS) in use at Macraes, the Frasers West WRS and Frasers East WRS.

There currently remains 176Mt of consented capacity in the current WRS's. Macraes Phase III calls for the increased requirement of 304Mt WRS capacity.

In summary the increased WRS are:

i) Back Road 228Mt
ii) Frasers South 50Mt
iii) Frasers North 26Mt

The existing Back Road WRS is located on the eastern edge of Southern and Round Hill Pits. Its expansion will comprise material removed from these two pits along with some material from Innes Mills Pit. The Back Road WRS will be wholly contained within the Deepdell Creek catchment.

The total footprint of this WRS is 234Ha and at the highest reaches 650mRL. This will result in a maximum WRS height of 65m above natural topography.

The Frasers South WRS will be located on the southern edge of Frasers Pit and will connect the consented Frasers East WRS with the Frasers West WRS. It will be located straddling the catchment divide of Murphys Creek and the North Branch of the Waikouaiti River (NBWR). This WRS will be constructed to a maximum height of 590mRL or 45m above natural topography.

The Frasers North WRS is an extension to the northern end of the currently consented Frasers East WRS and along with the TTTSF will necessitate the realignment of a 4.5km stretch of the Macraes-Dunback and Golden Bar Roads.

The geotechnical characteristics of the site are discussed in detail in section 4.2.

5.3.3 Environmental Engineering and Management Details

The construction process for all WRS's will effectively be the same as currently employed and will involve:

i) Involvement of a landscape architect in the design phase;
ii) Fencing and making the area safe;
iii) Topsoil stripping and storage or if available, direct relocation to another rehabilitation ready area;
iv) Construction of a perimeter safety bund, to protect from rolling rocks;
v) Direct mine truck dumping and pushing by dozers in vertical lifts not exceeding 20m.

General ground and surface water management is explained in section 5.7.

The likely deposition sequence is:

i) Within the existing consented WRS footprints until mid to late 2012;
ii) Back Road WRS from early to mid 2012 until 2016; then
iii) Frasers South and North WRS's.

The average yearly rate of deposition will be approximately 55 million tonnes.

See section 7.4 for details on the structural integrity of the WRSs.

Rehabilitation of the WRS's will be undertaken by mining equipment on a progressive basis, meaning that rehabilitation occurs once a section of a WRS is complete rather than waiting until the whole stack is completed.

Once final profiles are achieved in a section of the WRS a 300mm layer of brown rock (highly weathered schist) will be placed over the fresh waste rock and track rolled down with a dozer. A layer of 150mm layer of topsoil will be placed on top of the brown rock layer. Fertilising and seeding of grasses shall then be undertaken to return the ground to agricultural pasture. This is the existing rehabilitation strategy for WRS's.

5.4 Tailings Disposal

5.4.1 Overview

There are currently two active tailings storage facilities (TSFs).These are the Mixed Tailings Impoundment (MTI) and the Southern Pit Option 11A (SP11A) TSF. A previous tailings storage facility, SP10, sits within the footprint of SP11A.

The MTI has been used as the principal TSF since 1990. Since 2002 tailings storage has been shared between the MTI and SP10 and SP11A TSFs. The existing TSFs have a limited remaining life and insufficient remaining storage capacity to impound all of the tailings generated as part of Macraes Phase III. Therefore a new TSF is proposed.

A number of options have been investigated with the selected option being located in the very upper reaches of the Top Tipperary catchment, hence it is called the Top Tipperary Tailings Storage Facility (TTTSF). Capacity is needed to store an additional 44 million tonnes of tailings from mid 2012 through until early 2020 at current processing rates. The final TTTSF footprint, including the embankment forming the impoundment is 184 ha and the tailings storage volume will be approximately 37 million m^3. The crest height will be 560mRL, 70 metres above the ground surface at the highest embankment point.

The TTTSF will sit in the headwaters of Tipperary Creek (Shag River Catchment), outside of the catchment of the NBWR and the Deepdell Creek catchment. The TTTSF will straddle the Macraes-Dunback Road and as such a road diversion will be required prior to commencement of construction of the TTTSF. Macraes-Dunback Road will be realigned over three stages. Resource consent to undertake the earthworks associated with the first realignment was granted to OceanaGold on 25 February 2011. HPT Authority was granted on 1 March 2011. Preparatory works (e.g. fencing) are currently underway.

It is proposed to pump mixed tailings via a pipeline from the processing plant and deposit the tailings sub-aerially by spiggoting from the dam crest of the TTTSF. The pipeline route will be along the western side of the current SP11A TSF and will then follow the Macraes-Dunback road corridor to the upper reaches of the TTTSF.

Additionally, OceanaGold has identified that it is economic to remove the tailings and the embankment from the SP11A TSF and mine deeper in the Southern and Round Hill pits. The removed tailings will be stored on top of the MTI in a Reclaimed Tailings Stack (RTS).

5.4.2 Tailings Disposal - Environmental Issues to be Addressed

There are a number of issues that have required investigation. These include:

- the feasibility of reclaiming the SP11A tailings, and stacking them in the RTS on top of the MTI;
- the stability of the MTI TSF and RTS during and after mining Round Hill – Sothern Pit;
- the stability of the SP10 TSF during and after mining of Round Hill – Southern Pit;
- design of the TTTSF, the dam seepage water chemistry and impact on the surrounding groundwater and surface water;

- landscape, dust, ecological and archaeological impacts; and
- long term closure issues and solutions.

5.4.3 Description

Engineering Geology Ltd (EGL) was contracted by OceanaGold to undertake the design of the TTTSF. The "Oceana Gold (NZ) Ltd, Macraes Gold Project Top Tipperary Tailings Storage Facility Technical Report" (**attached** as Appendix 20) documents the proposed design of the TTTSF and also covers construction, operation and closure.

The feasibility of the proposed Round Hill –Southern Pit design in terms of potential west wall and plant site movement was undertaken by Pells Sullivan Meynink (PSM). The "Oceana Gold (NZ) Ltd, Round Hill East and Southern Pits report PSM71-107R is **attached** as Appendix 25. Appendix 25 has been peer reviewed by Kevin Rosengren and Associates Pty. Limited. The peer review is **attached** as Appendix 26 PSM was also engaged to undertake geotechnical studies in relation to the general stability of waste rock stacks at Macraes Gold Mine. The "Waste Rock Stack General Stability" report is **attached** as Appendix 27.

EGL was also contracted by OceanaGold to assess the feasibility of mining Round Hill – Southern Pit with specific reference to the geotechnical stability and, storm water control of:

- The deconstruction of the SP11 TSF;
- Retaining the Southern Pit Option 10 (SP10) TSF, with re-profiled tailings surface, above the proposed Southern Pit face;
- Retaining the MTI TSF above the western face of the proposed Round Hill – Southern Pit;
- Construction of the reclaimed tailing stack on top of the MTI TSF.

The "OceanaGold (NZ) Ltd Macraes Gold Project Mining of Round Hill – Southern Pit MTI SP10 and SP11 Tailings Storage Facilities and Reclaimed Tailings Stack Technical Report" is **attached** Appendix 21.

Design, construction and sequencing

The design of the embankment for the TTTSF considers local site geology, seismicity, climate and operational conditions as set out in Appendix 20.

The embankment will be built in stages with the initial embankment constructed to RL530. The embankment will be raised as necessary to safely store the anticipated tailings production and normal operating pond water plus runoff from an extreme rainfall event.

The TTTSF incorporates a comprehensive subsurface drainage network to facilitate collection of seepage from the tailings. The seepage is collected in a Seepage Collection Sump located at the downstream toe of the embankment that forms the impoundment, and pumped back into the TTTSF. Water that accumulates on the TTTSF is pumped back to the processing plant for use in processing ore.

The site is located in an area of low historic seismic activity, but there are nearby faults capable of generating strong shaking and these have been considered in deriving loads for seismic design. The proposed TTTSF overlies the Macraes Fault. Extensive studies were undertaken by Golder to assess historic faulting and the potential for further fault movement. The fault is assessed to have a recurrence interval in excess of 10,000 years. Allowance for

movement of the fault has been considered in the design of the embankment forming the TTTSF.

The New Zealand Society on Large Dams (NZSOLD) publication "New Zealand Dam Safety Guidelines" is used as a basis for design, construction, and operation of dams in New Zealand. Requirements for design, construction and operation are related to the Potential Impact Classification (PIC). PIC categories are based on a dam break study which is a theoretical assessment of the incremental losses which a hypothetical failure might give rise to. A dam break study has been undertaken for the TTTSF to enable an assessment of incremental losses which could arise as a result of failure.

The results of the dam break study for the TTTSF assessed the PIC for a hypothetical breach under both sunny day and flood induced conditions to be **medium**. For earthquake design NZSOLD states that medium and high potential impact dams are generally designed for two levels of earthquake, namely the maximum design earthquake (MDE) and operating basis earthquake (OBE). Immediately following an OBE event there should be "either no damage or minor repairable damage". Immediately following an MDE event "some damage", is allowable, but it must not lead to catastrophic failure. This is in accordance with recommendations by the International Commission on Large Dams. For this project the OBE has been taken equal to the 150 year return period earthquake ground motion. In addition, the response of the embankment to the 475 year return period earthquake ground motion has been considered. This is because there is potential risk of liquefaction of the tailings at this high level of ground motion, although the effect on the stability is unlikely to be significant for a downstream construction embankment. The MDE has been taken equal to the 2500 return period earthquake ground motion.

The factors of safety (FOS) for the upstream and downstream slopes of the initial embankment constructed to RL530 prior to receiving tailings are 1.96 and 2.08 respectively, which are greater than the normally accepted minimum FOS of 1.5.

The long term static factor of safety of the downstream shoulder of the final embankment (RL560) is 1.92. The equivalent factor of safety for the upstream shoulder has been analysed with the tailings at RL530 and the factor of safety is 1.87. As the tailings level rises so the factor of safety will increase and therefore the long term factor of safety with the tailings at the maximum storage level will be greater than 1.87. All these factors of safety are greater than the normally accepted minimum factor of safety of 1.5.

Where the embankment overlies the Macraes Fault the in-situ rock will be weaker. However, the embankment height is lower and this will compensate in part for the effect of reduced strength on the factor of safety for shear failure through the in-situ ground. As a check, stability analyses were carried out for a typical embankment section over the Macraes Fault with reduced shear strength parameters for in-situ rock. The stability analysis showed that with the reduced in-situ rock strength the factor of safety is still greater than 1.5.

Pseudostatic analyses during earthquake shaking have been undertaken for the TTTSF embankment to estimate permanent deformations. In all cases it is assumed that the phreatic surface is at the top of the tailings and the tailings liquefy. Earthquake loading was undertaken to represent the 475 year return period and MDE earthquake ground motion shaking. Under the 475 year return period earthquake ground motion some minor permanent displacement is predicted for potential failure surfaces. Larger permanent displacements are predicted for the MDE, but they are still relatively small (less than 100mm).

The permanent deformations predicted for the 475 year return period are insignificant. Permanent deformations for the MDE are small (less than 200mm) and would not result in

release of tailings or liquor and so the performance of the embankment is considered satisfactory.

The tailings construction sequence involves decommissioning of both of the current TSFs by mid 2012 then commencing tailings deposition into a new TSF located at the Top Tipperary site (TTTSF).

It is envisaged there will be one final deposition phase into SP11A in 2011, whilst a final consented upstream lift on the MTI is constructed. Deposition is currently occurring in the MTI and a planned final deposition period will occur from 2011 to 2012.

Following decommissioning a process of closure and rehabilitation will commence on both dams. In the case of SP11A, the outer compartment (north of the internal SP10 wall) will be mechanically re-handled once dry enough and placed as a reclaimed tailings stack (RTS) on top of the MTI. Any residual wet tailings that cannot be mechanically re-handled will be slurried and pumped to the new TTTSF. The tailings stored in SP10 above the level of the SP10 wall will be benched into and battered back to a suitable slope and rehabilitated, so that SP10 is effectively reinstated as an existing, decommissioned TSF.

The MTI and SP10 dam embankments will remain in place. The SP11A embankment will be removed in conjunction with the tailings reclamation.

The reclamation of the SP11A tailings will utilise:

- an excavator and haul trucks;
- a fleet of tractor pulled scrapers; and
- low ground pressure dozers.

The tailings material will be relocated primarily by the tractor pulled scraper fleet. The scraper fleet will operate on the tailings surface and will excavate the tailings from the SP11A impoundment, haul the tailings to the MTI RTS, and deposit the tailings within the RTS footprint.

The excavator and truck fleet will be restricted to working on the dam embankment or rock substrate. They will be used primarily to remove the SP11A embankment material and facilitate tailings drainage through excavating and maintaining a peripheral drain and sump network. Embankment material will be taken to a waste rock stack or if suitable re-used for future dam construction.

A low ground pressure dozer will be used for re-contouring, final contouring of slopes, rehabilitation, and internal ramp construction.

Dust management and stormwater runoff control procedures will be in place for the handling and placement of the tailings. The tailings will be progressively rehabilitated in accordance with standard rehabilitation techniques.

The construction of the TTTSF will be staged. An initial wall will be constructed to hold two to three years capacity of tailings. Subsequent lifts (in a downstream manner) will be made to the main wall, eventually incorporating “wing” walls along the northern and southern flanks. The footprint of the TTTSF will therefore gradually expand, reaching its maximum extent by ~2017.

5.4.4 Environmental Engineering and Management Details

The required steps and sequence of construction will be as follows:

- Macraes-Dunback Road diversion potentially starting from early 2011 with final alignment and public usage by late 2011. A separate consent has been granted to authorise the proposed road earthworks in advance of the balance of the MPIII project. Resource consent to undertake these earthworks was granted to OceanaGold on 25 February 2011. Preparatory work under the earthworks consent has already commenced.

- Top-soil stripping and embankment footprint preparation (late 2011).

- Installation of powerlines and discharge and return water pipelines in parallel with construction (by mid 2012).

- Construction of the main wall (starter wall to hold 3 years tailings), from 2011 to mid 2012.

- Continued construction phases until it reaches the final consented maximum height (560RL).

- The main Golden Bar road realignment will take place in 2014, though a section of the decommissioned Dunback-Macraes Road will be used to link the existing gravel road with the new Macraes-Dunback Road realignment.

- Post closure capping, active seepage water management and finally passive water management.

5.4.5 Post Mining Phase

The rehabilitation plan at closure will be to fully cap the facility with brown rock and topsoil and for pasture to be re-established on the final surface. Post-closure water management is discussed in section 6.2.

5.5 Freshwater Dam

5.5.1 Overview

Modelling of future water quality for several of the nearby creeks has been undertaken to assess the impact of mining-related surface water flows. These studies have shown there is a potential deterioration in some of the water quality for these creeks unless management strategies are put in place.

A number of mitigation options are available for improving water quality including the construction of a freshwater dam to discharge fresh water into the waterways during low flow periods to dilute contaminants. Augmentation of water may be required to ensure water quality standards are met for Deepdell Creek in particular. Therefore the environmental effects of the likely location of a storage dam in the Deepdell catchment, and subsequent changes to the flow regimes have been assessed.

The water quality modelling and proposed management of mitigation measures is discussed in section 6.1.

OceanaGold has determined that the construction of a freshwater dam in Camp Creek is the most appropriate option to supplement low flows in Deepdell Creek to reduce sulphate concentration. Over time the situation may arise where augmentation of flows may also be required to ensure water quality standards are met for Murphys Creek. Again a freshwater dam may be used. However, at this stage OceanaGold is not planning a freshwater dam in Murphys Creek.

5.5.2 Description

Camp Creek is a tributary of Deepdell Creek. Construction of a 29m high Camp Creek Water Storage Dam will provide water storage of approximately 1.4Mm^3. The location of the proposed dam is shown in Figure 6.

A preliminary geotechnical investigation indicates the site is a suitable dam site and that locally derived material should be suitable for constructing the dam.

EGL has assessed the feasibility of the Camp Creek Dam and prepared a Technical Report. The "OceanaGold (NZ) Ltd Macraes Gold Project Camp Creek Water Storage Dam Technical Report" is **attached** as Appendix 23

Design concepts for the proposed dam have been developed. It is recommended that the embankment be a zoned earthfill/rockfill structure with a central earthfill zone, rockfill shoulders with a vertical chimney drain/filter zone. Two spillways (primary and auxiliary) are recommended.

Preliminary stability analyses show that the embankment meets normally accepted standards for both static and seismic conditions, but further analyses is recommended at the final design stage.

Final design of the embankment will be in accordance with the New Zealand Society on Large Dams (NZSOLD) Guidelines and International Commission on Large Dams (ICOLD) recommendations for embankments.

5.5.3 Environmental and Engineering Management Details

The Camp Creek Dam will take between two and eight years to fill and the filling rate is weather dependent. Water quality modelling by Golder has shown that the Camp Creek Dam will store sufficient water to enable Deepdell Creek flow supplementation to ensure water quality standards are met. The exact discharge regime required to achieve this mitigation will be determined through an adaptive management process. Water will be released from the dam when required to ensure compliance with appropriate standards is maintained.

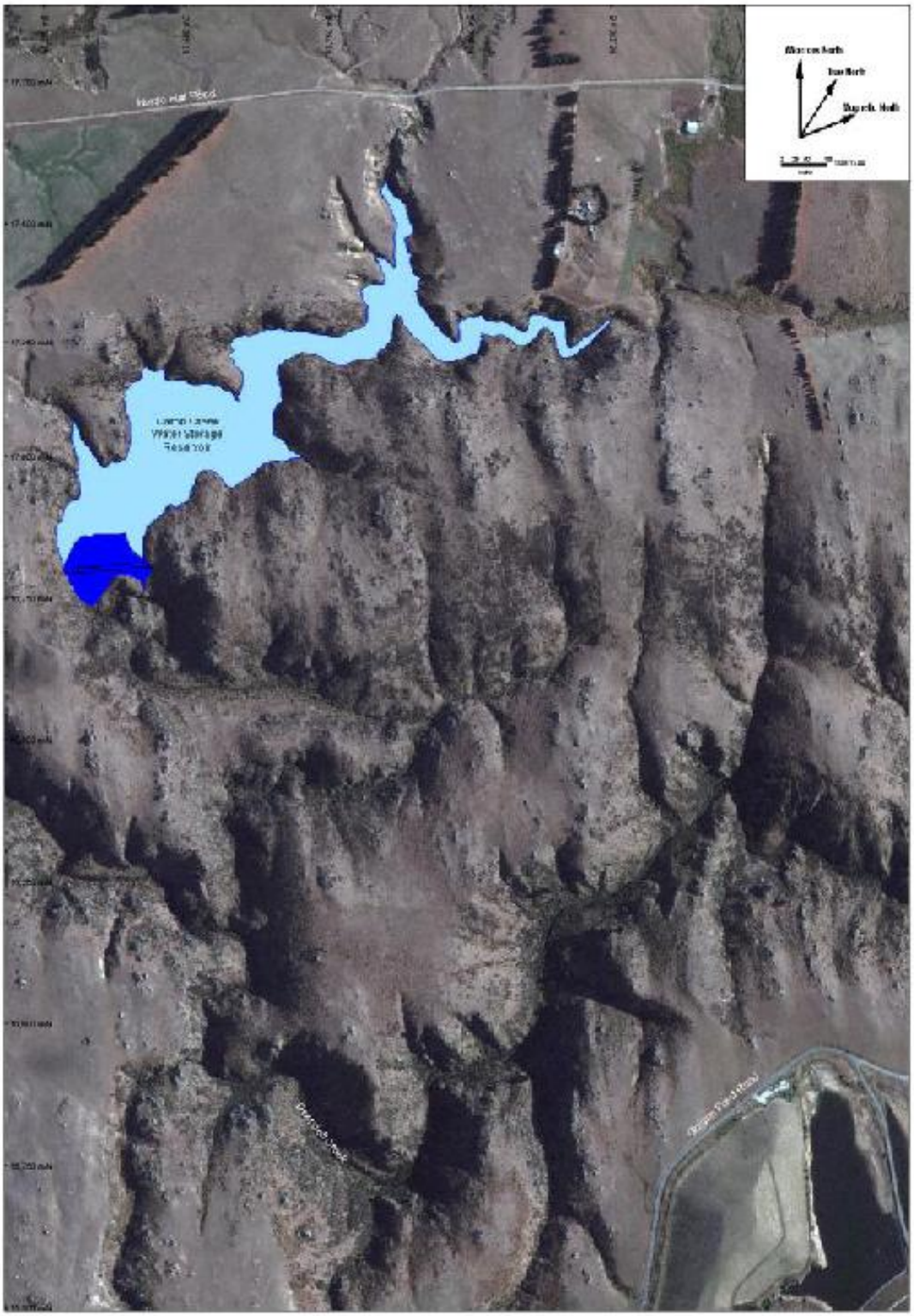
It is proposed to utilise the existing flow monitoring station located in Deepdell Creek (upstream of the Golden Point Historic Reserve) linked to an automated discharge valve on the Camp Creek discharge pipeline. The valve could activate automatically based on the flow measurements in Deepdell Creek and discharge the required amount of water to ensure a minimum flow rate is maintained.

The dam would be located on private land.

5.5.4 Post Mining Phase

The need for the dam to maintain downstream water quality is most likely to arise post closure and the water release system will be designed to be automated and low maintenance.

Figure 6: Location of Proposed Camp Creek Water Storage Dam



5.6 General Ground and Surface Water Management

5.6.1 Overview

Engineering Geology Ltd (EGL) has prepared a report outlining the proposed concepts for erosion and sediment control. The "Oceana Gold (NZ) Ltd, Macraes Gold Project Macraes Phase III Project – Erosion and Sediment Control" report is **attached** as Appendix 22. The report identifies practices and procedures to minimise erosion and sedimentation, and the treatment of runoff prior to discharge into the tributaries of the Tipperary, Deepdell and Cranky Jims Creeks.

Runoff from the pits is captured in the base of the pits and is pumped back for use in the Process Plant so no specific sediment control is required.

5.6.2 Treatment Method Options

The areas of disturbed land associated with the Macraes Phase III project that will require erosion and sediment control are:

- Frasers South WRS
- Frasers North WRS
- Back Road WRS
- TTTSF Embankment
- Camp Creek

Prior to commencement of construction Erosion and Sediment Control Plans will be prepared (ESCP). The ESCP's will detail the design of specific erosion and sediment control devices, responsibilities for implementation, construction details and standards, construction timetable, maintenance, monitoring and reporting procedures, response to storm events and contingency measures. The Plans will incorporate modern erosion and sediment control practices that are documented in the Environment Canterbury Guidelines except that site specific design criteria will be adopted for sizing silt ponds that are based on experience at the site. In general terms the design of erosion and sediment control measures will follow existing practice. Specific erosion and sediment control measures will include:

- cleanwater diversion drains with small dams located in gullies where necessary to divert runoff into the diversion drains. Where necessary (e.g. steeper ground, erosive soils) the drains will be lined (e.g. rockfill, geotextile) and energy dissipation will also be provided at high energy locations
- silt ponds downstream of disturbed areas. Permanent silt ponds will be designed according to existing criteria. The sizing depends on the catchment area and runoff coefficient. Decants similar to those currently on site will be adopted, but will be designed to allow for attachment of floating decants. Service and emergency spillways will be provided and designed to pass the flows from 10year and 100year return period rainfall events
- shoulders of the WRSs and TSF embankments are progressively rehabilitated and will have benches every 20m vertical height to control runoff
- perimeter surface water drains located around the perimeter of WRSs and TSF embankments where appropriate, to ensure runoff is conveyed to the base of gullies without erosion

- progressive stripping of the WRS and TSF footprints, with shaping only undertaken in dry weathers conditions.

The proposed silt ponds will not breach any of the permitted standards in the Regional Plan: Water (Rule 13.2.1.3) and therefore will not required any resource consents.

When mining is completed in the area the existing Frasers West and Murphys Creek silt ponds could be retained as permanent water storage ponds.

5.7 Access, Site Roads, Public Roads and Pipeline Corridor(s)

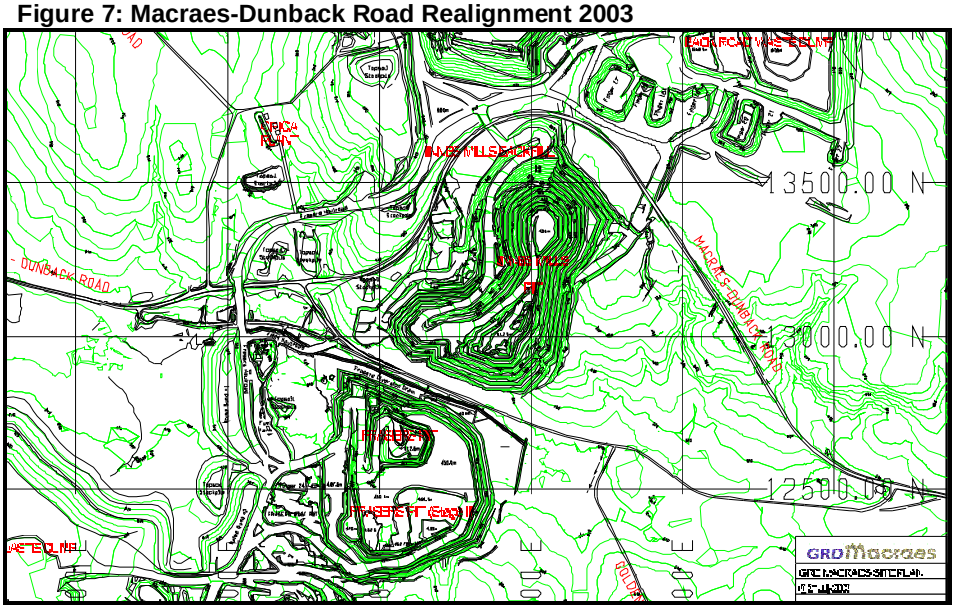
5.7.1 Overview

Access to the Macraes Mine is via the Macraes-Dunback Road. There have been two prior realignments of the Macraes-Dunback Road to allow for ongoing mining activities:

1. In 1997 there was a minor realignment to allow an overbridge/underpass to be constructed. The underpass allows mine traffic to be separate from the public road traffic.

2. In 2003, a major realignment was undertaken (Figure 7) to allow mining of Frasers open pit. The realignment was for a total of 3.15 km and approximately half of the realigned road was constructed atop the backfilled Innes Mills open pit.

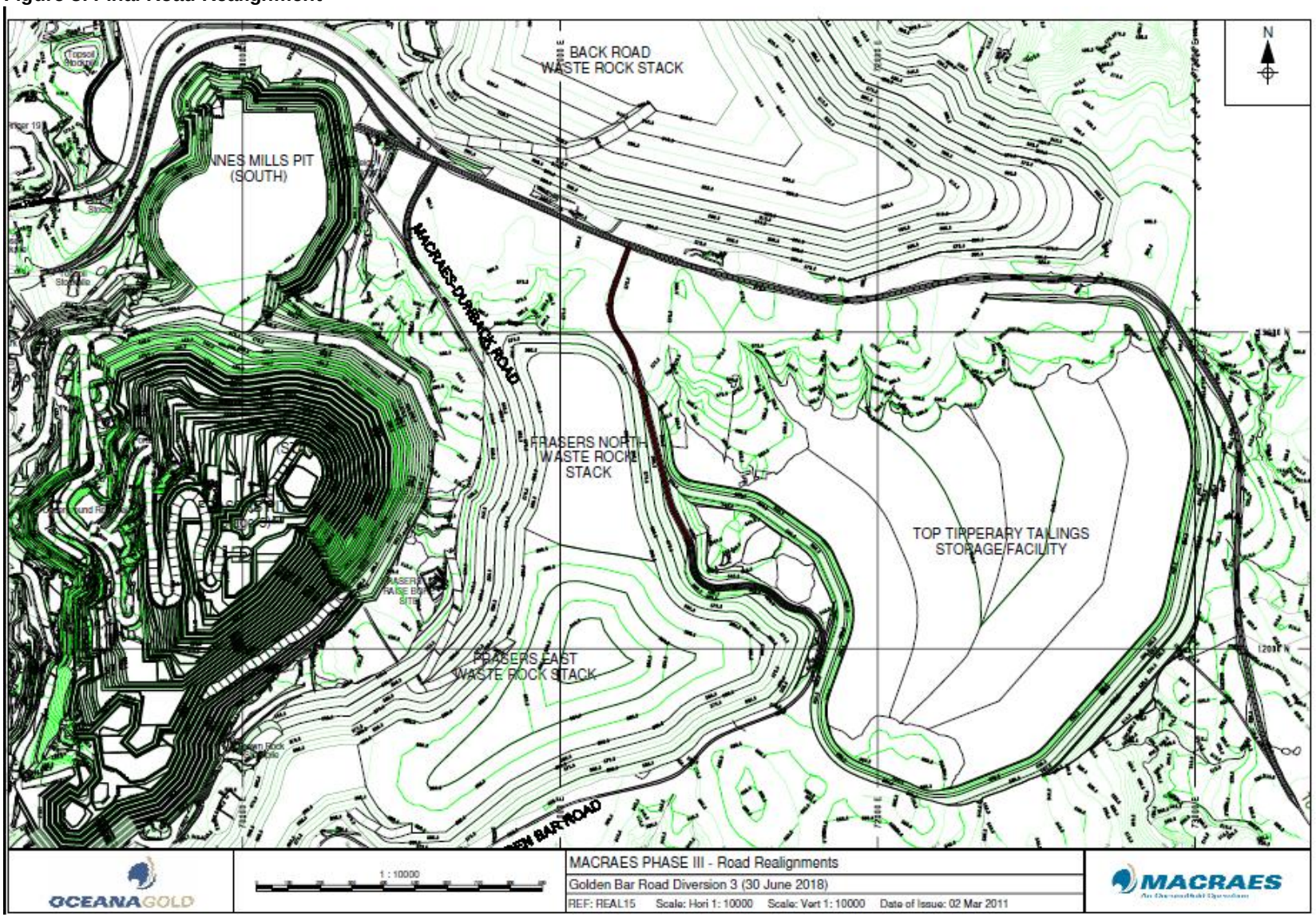
Figure 7: Macraes-Dunback Road Realignment 2003



The Macraes-Dunback Road is the first section of the road that links SH 85 (Pig Route) with SH 87 (near Hyde). The road is a two laned sealed public road that runs between the townships of Dunback and Macraes and falls entirely within the Waitaki District. The Macraes-Dunback Road is the main access road to the Macraes Mine.

OceanaGold is proposing to realign 5.12 km of the existing road to facilitate construction of a new tailings storage facility. The new tailings storage facility (TTTSF) is planned to occupy part of the footprint of the existing Macraes-Dunback Road. The proposed new route will be 5.8km long. The final proposed realignment is shown in Figure 8.

Figure 8: Final Road Realignment



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The proposed realignment will avoid the proposed TTTSF footprint. In order to be able to commence construction of the TTTSF, the earthworks required for the realignment are scheduled to begin in April 2011 and expected to be completed by the end of 2011.

There are two other planned realignments and Golden Bar Road will also need to be realigned as a consequence.

5.7.2 Description

There are three planned realignments of the Macraes-Dunback Road arising as a result of MPIII. Golden Bar Road will also potentially need to be realigned twice.

Macraes-Dunback Road

First Realignment of Macraes-Dunback Road

The first realignment planned is necessitated by the construction of the TTTSF. The location of the TTTSF means that both the embankment structure and the impoundment will cross the existing Macraes-Dunback Road. The realigned road is planned to pass around the eastern and northern sides of the TTTSF.

The planned realignment route will start from near Hocking Road following the legal (but unformed) Macraes Back Road alignment north before turning west to run along the divide between the Deepdell and Tipperary catchments and rejoining the current alignment adjacent to Innes Mills Pit, near the old Golden Bar haul road traffic lights.

The total length of this first realignment is approximately 4.6 km and is planned to commence in early 2011 and be completed by late 2011.

A connector road will have to be established linking the original Macraes-Dunback Road with the new alignment to maintain the connection with Golden Bar road. The proposed alignment is located outside the extent of Innes Mills Pit and is approximately 0.4km long.

Second Realignment of Macraes-Dunback Road

The second realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Prior to removal of this section of the road, a new section of temporary road will be constructed to the south of the existing road. This temporary road is to allow mining of the northern portion of the proposed Innes Mills Pit. The realignment will be formed using mine waste as the base. The second realignment will affect about 0.5km of road and will reduce the road length by a minimal amount (25m). It will be undertaken prior to the removal of the existing road and is provisionally planned for 2016.

Third Realignment of Macraes-Dunback Road

The third and final realignment is to be undertaken where the Macraes-Dunback Road currently traverses the backfilled Innes Mills Pit. Once mining has been completed to the north of the road the pit will be backfilled and the final road realignment will be constructed to allow Innes Mills to be mined to completion. Prior to removal of this section of the road a new section of road will be constructed to the north of the existing road. The realignment will be formed using mine waste as the base. This new realigned section of the Macraes-Dunback

Road will be approximately 1.8km. It will be undertaken prior to the removal of the second realignment road and is provisionally planned for late 2016 early 2017.

Resource consent to undertake the earthworks was granted to OceanaGold on 25 February 2011. HPT Authority was granted on 1 March 2011. Preliminary works for the first realignment are currently underway (e.g. fencing off the area to be realigned and preparatory earthworks). In this current application OceanaGold is applying for the preparatory earthworks associated with the second and third realignments as well as the formation of a road surface and the realignment of the Macraes-Dunback Road (that will result from all three realignment stages).

Macraes-Dunback Road Construction Standards

Realignments of the Macraes-Dunback Road will be constructed to Transit NZ Standards.

Golden Bar Road

The northern section of the existing Golden Bar Road will be within the construction footprint of the TTTSF and subsequently within the construction footprint of the Frasers North WRS and will require realignment. Golden Bar Road will be increased in length from 0.24km to 1.65km.

First Realignment of Golden Bar Road

The first realignment is planned to re-route the road along the northern face of the Frasers East WRS before rejoining with the original Macraes-Dunback Road.

This alignment is planned for 2014.

Second Realignment of Golden Bar Road

The second realignment is required should the Frasers North WRS be constructed to the proposed extent. The realigned section of road would run from the face of the Frasers East WRS up the ridge west of the TTTSF abutment and rejoin the realigned Macraes-Dunback road.

The second realignment is provisionally planned for 2017.

Golden Bar Road Construction Standards

The realignment of Golden Bar Road will be constructed to Transit NZ Standards.

Construction

The estimated time to construct the first realignment of the Macraes-Dunback Road is 6 to 7 months in total, but may occur in two phases. The final alignment of the new road is not expected to require any major sections of cut and fill as the topography is relatively gentle.

The final realignment of Macraes-Dunback Road will require construction of a base on top of the decommissioned SP10 TSF. The base will be constructed using mine waste. The road surface will be constructed using Council approved materials.

The Golden Bar Road is an unsealed road. The realignment of this road is not required until 2014 and its base layer will be constructed from mine waste on the perimeter of Frasers East WRS. It will rejoin Macraes-Dunback Road at the western edge of the TTTSF.

Rehabilitation

The redundant sections of road (following realignment) will either be engulfed by the TTTSF or rehabilitated by removing recoverable gravel and road base material and then covering with topsoil and grass (in the case of the first realignment) or be mined out (in the case of the second realignment).

5.8 Utilities

5.8.1 Electric Power Supply

The construction of the TTTSF will necessitate electric power supply to be constructed to enable water from the TSF to be recycled within the plant and to capture and return water from dam seepage collected in the Top Tipperary silt pond to be located downstream of the TTTSF.

Decant water from tailings deposition and stormwater from rainfall runoff will be collected and pumped back to the processing plant using pontoon mounted pump and HDPE pipeline. A 11 kVA overhead transmission line will be installed to the TTTSF to power these pumps.

5.8.2 Post Mining Phase

Post closure the substation at the processing plant will be removed as will the 11kVA overhead transmission line referred to above.

5.9 Infrastructure and Ancillary Features

5.9.1 Fencing

A number of stock fences will need to be dismantled and re-erected as a result of the rock stack expansions and construction of the TTTSF.

New fencing will be erected along either side of the realigned Macraes Road and along the eastern boundary of the Back Road Waste Rock Stack. Upon mine closure, fencing will be erected around Frasers Pit lake and Round Hill/Golden Pit lake. This is for safety reasons to prevent human and/or stock access to these lakes, and is consistent with OceanaGold's existing closure obligations.

5.9.2 Fuel and Chemicals Storage

There are two main existing fuel facilities:

- The original bunded tank farm for diesel adjacent to the Heavy Vehicle Workshop located to the east of the MTI.

- A 150,000 litre fuel farm adjacent to Frasers Pit to service the mining fleet in the Frasers area. Appropriate consents and licences have been obtained for this.

Fuel for the mining fleet is either delivered from the fuel farms to the mobile equipment in the mine areas by self-contained fuel and service trucks or mining equipment can be refuelled directly from the fuel farms. Fuel for light vehicles is obtained from a dedicated fuel bowser at the Heavy Vehicle Workshop fuel facility.

The underground mine has a separate aboveground diesel tank (10,000l). A fuel bay and servicing area are also present underground.

Explosives are currently supplied by Orica Mining Services. Blast holes are loaded with an emulsion explosive (an emulsified blend of ammonium nitrate, calcium nitrate and fuel oil). The emulsion blend will be slightly altered for dry holes. Some pre-packaged explosive is used.

Initiation of blast holes will be by either electronic or non-electric down hole detonators.

Bulk explosives are transported to the drill holes in explosives trucks (Mobile Mixing Units), and pumped down the drill holes.

The bulk explosives become sensitised within the blast hole using a gassing agent. It usually takes 15 minutes for the explosive to become sensitised in this manner.

The unsensitised emulsion is manufactured and stored at the local batching plant. The batching plant has storage facilities for ammonium nitrate in a prilled form and for ammonium and calcium nitrates in powder form. The emulsion phase imparts waterproofing qualities, which enables the product to be effective in wet blast holes.

Blasting accessories (detonators, primers, detonating cord and surface delays) will be stored in bunded magazines on the top of the Back Road Waste Rock Stack. Accessories for the Frasers In-Pit underground development are stored in a dedicated area within the underground mine.

There are no changes proposed to fuel, chemical or explosives storage for the expansion activities. The handling of explosives and the method of firing is also expected to continue in much the same manner as has been employed at the mine previously.

5.9.3 Post Mining Phase

Post closure all storage facilities will be removed and the land rehabilitated.

5.10 MPIII Construction Phase

A land use consent (LRC11/02) was granted by WDC on 26 February 2011 to undertake earthworks for the construction of the Macraes road realignment. Initial preparatory work for this realignment has commenced and is scheduled to be completed by the end of 2011. The equipment involved will comprise graders, motor scrapers, water trucks and compactors for the road formation and excavators for installation of the culverts.

Commencement of construction of the TTTSF is planned for the 2nd half of 2011. The TTTSF will be constructed in a series of lifts in a campaign fashion similar to the past construction of

MTI and SP11A structures. The initial embankment will be constructed to RL530 and this will provide storage for approximately 13 months of tailings production.

Embankment construction will be undertaken by a Contractor employed by OceanaGold or with OceanaGold's own equipment. Material similar to that used for the construction of the other existing tailings embankments at the Macraes Gold Project will be sourced from within the impoundment area and/or from with mine waste rock as necessary. There is no construction period as such for the other elements of MPIII, being the pit expansion and waste rock stacks, as distinct from the primary activities themselves. The possible mining sequence for the future open pits is described in section 5.2, whilst the possible waste rock stack construction sequence is outlined in section 5.4.

5.11 Workforce

There will be a small increase in OceanaGold's total workforce as a consequence of Macraes Phase III. The main areas of increase involve the construction works comprising the Macraes-Dunback road realignment; and the TTTSF construction and associated infrastructure (power line, pumps and pipelines).

As a consequence of Macraes Phase III employment at the mine site is expected to increase to around 612 jobs over the period 2011-2014 (from 563 jobs in 2010) with a further 28 jobs in Dunedin and then after 2014 (until 2020) fall to around 490 jobs at the mine site and 20 jobs in Dunedin with the closure of the Fraser Underground Mine. Had mining and associated operations such as processing ore ceased in 2012 in accordance with current resource consent consents, staffing levels would begin to taper off in the lead up to that date.

5.12 Rehabilitation

Rehabilitation is an integral part of the mining operation and a key issue considered in all mine planning.

The approach to rehabilitation is largely in accordance with current consents. It includes the following features:

- The surface area disturbed at any one time is the minimum necessary compatible with day to day operations.
- All statutory obligations are met.
- The sites are rehabilitated as soon as possible to a safe and stable condition.
- All contaminants on site are contained and treated in such a manner that they do not pose a long term safety or environmental hazard.
- A suitable sustainable post-mining land use is achieved.

Rehabilitation will be undertaken progressively in order to minimise areas of disturbance. As areas are rehabilitated one of the objectives that must be achieved is that they are left safe and stable. The replanting that will be undertaken will be appropriate to the designated final land use (be it farming, exotic or indigenous planting).

The general approach is to internalise effects on-site where practicable (e.g. re-circulating and treating water before release).

5.13 Mine Closure

5.13.1 Overview

The current mine closure plan for the Macraes Mine includes development of a Heritage and Art Park (HAP).

OceanaGold is currently committed to the staged completion of a defined number of HAP items including art works, park furniture, tracks and roads. These commitments are detailed in LRC01/21 and comprise 3 small, 3 medium and 3 large art works. To date, OceanaGold has constructed 5 of the 9 committed art works. The large art works are to be created on, or to be part of, completed waste rock stacks.

The existing HAP strategy envisaged a mine life until 2012.

The longer mine life means that the large HAP art works will not be able to be completed for some time, and therefore will not be accessible or available to be integrated as part of the wider HAP vision until mining ceases. On this basis, a review of the existing mine closure plan has been undertaken.

The local Macraes community has also indicated that it considers the HAP in its current form is not a sustainable proposition to provide future economic growth and development options for the community, as it was intended. Further, to date the HAP has received little attention from the Waitaki District Council as part of the development of its broader tourism strategy.

A revised strategy, called the Macraes Community Development (MCD) Strategy, has been formulated and will involve redirecting previously committed HAP funds toward funding of a Community Trust instead of completing the remaining art works and maintaining the Park for a period of time. The revised closure strategy will not reduce OceanaGold's current obligations under various consents to protect heritage sites. The general purpose shall be to provide a public benefit to the Macraes community through supporting proposals that will enhance the economic and social wellbeing of the community.

The intent of the MCD Trust is to enhance future growth and development options for the community through:

- Creation of employment opportunities; and/or
- Improvements to community infrastructure; and/or
- Upgrade Stanley's Hotel; and/or
- Enhancement of the economic viability of the Macraes community; and/or
- Promotion of the Macraes community as a desirable location for permanent residency.

The MCD strategy is for the company to inject capital funds into the MCD trust and for Stanleys Hotel and the Manager's House to be vested in the Trust also.

A major benefit of this new MCD strategy is that the committed HAP expenditure can be brought forward and vested in the MCD Trust rather than awaiting the completion of the waste rock stacks (necessary for the completion of the remaining large artworks) at the end of the mine’s life and cessation of mining to allow access.

It is envisaged that the Community Trust will fund and support proposals such as an improved water scheme, upgrading of Stanley's Hotel and the creation of employment

opportunities through tourism or other private enterprises to assist the community achieve economic self-determination post-mining. However ultimately this will be at the discretion of the Trust and the community it serves.

OceanaGold propose consent conditions that stipulate requirements for a Trust Deed will be drafted to ensure there is no alteration or variation of the Community Trust purpose and objectives, and that these objectives are met.

6. Impact Assessment: Natural Environment

6.1 Water Quality

6.1.1 Introduction

As noted previously Golder Associates (NZ) Limited ("Golder") has written a comprehensive suite of technical reports to evaluate aspects of water management and effects of the Macraes Phase III project on water quality within the Mine area, and downstream from the Macraes Mine.

The information presented in these technical reports is summarised and integrated in the "Water Management Summary Report" **attached** as Appendix 8.

6.1.2 Predicted Changes to Water Quality Summary

Golder constructed a mine water management model to simulate dissolved contaminant transport from the Macraes Mine site. The modelling takes account of all activities on the Macraes Mine site including past mining, current mining and mining proposed as part of MPIII. The modelling indicates that without management the proposed water quality limits are likely to be exceeded at most compliance monitoring sites, either during the operational period of the mine or following mine closure. The modelled exceedances are mainly for sulphate, arsenic and iron, although the simulations also indicate cyanide$_{WAD}$ may exceed the compliance limits at individual sites.

The surface water models used for the project incorporate an assumption of conservative contaminant transport within ground and surface water. Experience and empirical data indicate that in reality the modelled arsenic and cyanide$_{WAD}$ exceedances are unlikely to occur. Dissolved iron is also unlikely to present an issue at the compliance points, due to its capacity to rapidly oxidise and subsequently precipitate.

Therefore, the primary water quality issue identified is a need to manage sulphate concentrations in receiving surface water bodies, as sulphate is conservatively transported in water. Mitigation measures are therefore considered to be necessary to ensure appropriate water quality in all of the creeks, with their headwaters intersecting the Macraes Mine sites and in the Shag River. A variety of appropriate management options are available. Golder has recommended a suite of management options from the choices available. Implementation of the recommended suite of management options should be effective to ensure water quality is maintained at appropriate levels in all receiving waters and these are discussed in Section 6.2 below.

6.1.3 Modelling

Groundwater quality

The groundwater model used for this assessment has been based on an existing calibrated model simulating the groundwater system at the site through to 2010. Groundwater quality input parameters are based on the water quality data from the site environmental monitoring program (including leachate water quality representing TSF decant ponds, TSF drain discharges and WRS seepage). Detailed features of the simulated contaminants are set out

in Appendix 14 (Groundwater Contaminant Transport Assessment – Deepdell Creek, North Branch Waikouaiti River and Murphys Creek Catchments). Contaminant transport modelling for each of the simulated contaminants, with the exception of arsenic, has assumed no attenuation prior to entering surface water bodies. This is a conservative assumption, as it is known that many contaminants including arsenic and iron do attenuate or change composition during transport.

The maximum simulated contaminant mass load occurs after processing of ore has ceased with the exception of the tailings storage facility draining systems. A considerable period of time is required for contaminants to be transported through the groundwater system at the site to the receiving water bodies because of the generally low permeability of the intact underlying rock mass. Groundwater discharges rates at the time of maximum discharge mass load are detailed in Appendix 14.

Simulated MTI and SPI drain discharge rates indicate a decrease in flows of approximately 50% within a period of 10 years following closure. It is, however, likely that the simulated rate of decrease in seepage and drain discharges following closure is conservative (i.e. understates the rate at which flows decrease post closure). An assessment of the rates at which MTI and SPI drain discharges have declined during inactive periods in the past, indicates discharges are likely to decline at faster rates of between 50% and 90% within two years following closure.

It is expected that much of the storage tailings mass would become unsaturated during the 20 years following closure of the TSF. There is, however, considerable uncertainty with respect to the length of time required for the overall groundwater system to reach a steady state flow pattern. This uncertainty is partly due to the inherent variability of the hydro geologic characteristics of the tailings mass. In addition, dynamic factors such as the compaction of both the tailings mass and the underlying soils have not been taken into account in this projection.

Once the groundwater systems within the tailings storage facilities have reached a steady state following closure the contaminant loads in water subsequently lost from the tailings would be associated with the residual moisture content and ongoing recharge from rainfall. Further transport of contaminants from the tailings would mainly occur in response to significant rainfall events. These events would lead to pulses of seepage water travelling downward through the unsaturated tailings to the groundwater table. These pulses, averaged on a long term annual basis, are expected to be equivalent to the natural 32mm/year groundwater recharge rate for the region.

Table 4 below shows the maximum discharge mass load and average sulphate and arsenic concentration:

Table 4: Maximum discharge mass load and average sulphate and arsenic concentration

Receiving Water	Groundwater discharge rate (1)	Arsenic (2)	Sulphate (2)
Deepdell Creek upstream from DC07	730	0.03	590
Deepdell Creek between DC07 and DC08	116	0.05	1,050
Murphys Creek upstream from MC100	180	0.03	380
North Branch Waikouaiti River upstream from NBWRRB	100	0.03	1,050

Notes: 1) Post-closure groundwater discharge rate: units of m^3/day.
2) Concentrations in groundwater discharges: units of g/m^3.

Surface Water Quality

The surface water model used for this assessment simulates water flows across the Macraes Mine site and in downstream catchments. Water quality data inputs were based on the site environmental monitoring programme data. From this data representative water quality characteristics for TSF decant water drainage, WRS drainage water and runoff water, rehabilitated surfaces and undisturbed surfaces have been produced. Groundwater seepage quality inputs into the model have been designed as set out in the section above.

The water quality inputs assume the contaminants are conservatively transported in surface waters (even though for a number of simulated parameters such as metals, metalloids and cyanide this is unlikely to be the case).

The model's output is a water balance for the Macraes Mine site, with the predicted mass contaminant load relating to each catchment. It provides conservative projections of water quality at existing and proposed consent compliance points into the future. A detailed description of the model is contained in Appendix 10 "Site Wide Surface Water Model".

The modelling process identifies that without mitigation several parameters may eventually exceed compliance limits at some of the compliance monitoring points. A summary of the unmitigated, unassimilated modelled exceedances of proposed consent water quality limits is set out in table 5 of Appendix 10 "Site Wide Surface Water Model". Of note from this summary is that arsenic, iron and sulphate limits are modelled to be exceeded at most monitoring sites.

However, in reality, once the water management options detailed below are implemented, and the model's conservatism is taken into account, it is predicted the resulting water quality will be acceptable at all sites. The surface water model incorporates an assumption of conservative contaminant transport, therefore the modelled exceedances for arsenic and cyanide are unlikely to occur, as both are subject to geochemical reactions, precipitation, adsorption or breakdown. Dissolved iron is also unlikely to breach appropriate standards at compliance points due to its capacity to rapidly oxidise and subsequently precipitate.

The primary water quality issue to be addressed through mitigation therefore is sulphate. Sulphate does not naturally attenuate except through dilution. Mitigation is therefore proposed to ensure water quality is maintained at appropriate levels. This is set out below.

6.2 Water quality with mitigation

Golder has assessed the efficacy and practicality of a variety of water quality mitigation actions which could be employed to assist OceanaGold to meet proposed water quality limits in receiving water bodies ("Water Quality Effects Mitigation Options Management" Appendix 9 Golder's assessment suggests that several mitigation approaches may prove necessary in combination to resolve all predicted water quality issues in the receiving water bodies around the Macraes Mine.

The most appropriate mitigation measures for managing the water quality at compliance points on the Shag River, Deepdell Creek and Tipperary Creek during mine operations are based primarily on returning all captured discharges from TSF and WRS areas to the mine water management system. This is effectively what is occurring at present and it generally results in very low levels of contaminants (often below detection limits) leaving the site as is demonstrated through results from the site environmental monitoring program. MPIII is not modelled to have an effect on the North Branch Waikouaiti River catchment during operations.

The proposed elements of a site-wide water quality effects mitigation suite following closure of mining operations include;

- Pumping of TSF discharges from SP10/MTI to Frasers Pit or Round Hill following cessation of mine operations for up to 20 years (depending on flow rates from the TSFs), to manage the initial high flow period of TSF discharges.
- Passive treatment of TSF discharges prior to discharge into pits, to remove arsenic and iron, if it is proven necessary for pit lake water quality.
- Ongoing injection of drainage water from the TTTSF to Frasers Underground mine workings. This measure would enable compliance with water quality criteria in Tipperary Creek and assist in compliance with the criteria applicable on the Shag River and McCormicks.
- Supplementation of low flows in Deepdell Creek through the construction of freshwater dam on Camp Creek (a tributary of Deepdell Creek upstream of the Macraes Mine site) and release of water at times of low flow. This measure would enable compliance with the sulphate water quality criteria in Deepdell Creek and the Shag River.
- Installation of drainage systems to return seepage collected from the toe of Frasers West WRS by gravity flow to the mine process water system, or following closure of operations to Frasers Pit.
- Passive treatment (wetlands and waterfalls).

Modelling indicates that application of these mitigation measures will enable OceanaGold to meet appropriate compliance criteria in all receiving water bodies, both during the operating period of the Macraes Mine, and in the post closure phase.

It is proposed that post MPIII the compliance points, and criteria for pH, arsenic, cyanide$_{WAD}$, copper, iron, lead, zinc and sulphate, be in accordance with the know usage background water quality of each site (as shown in Table 5). The suite of mitigation options outlined above is assessed as adequate to ensure compliance with the proposed criteria.

Outside of the pit lakes, a range of suitable compliance limits for sulphate is considered achievable, with mitigation measures in place. Simulated occasional exceedances of the sulphate compliance limits in the Shag River in the post closure phase are considered to be unlikely as both the groundwater and surface water models incorporate a range of

conservative assumptions including the incorporation of high percentile contaminant concentrations as model input concentrations.

This combination of mitigation measures is the not only combination of measures that would enable long term compliance with the proposed water quality limits. It would be possible to use other combinations and measures to meet the proposed downstream water quality compliance criteria and it is recommended in the Golder "Water Management Summary Report" **attached** as Appendix 8 that any consent conditions should only relate to the required water quality outcomes, rather than the methods by which they are achieved. This will enable OceanaGold to use an adaptive management process to most effectively mitigate water quality effects.

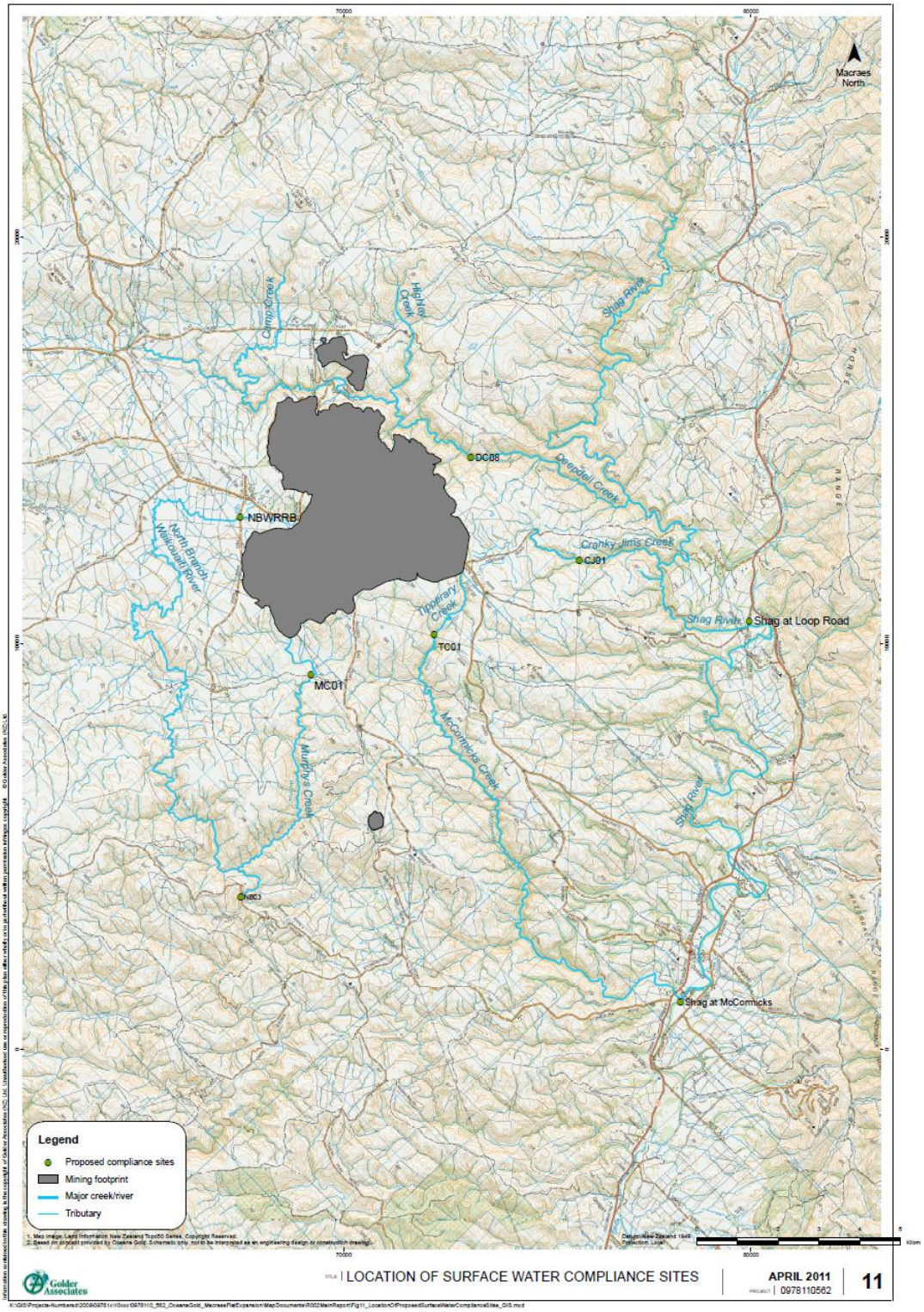
Pit lake quality is addressed in the "Site Wide Surface Water Model" report and in the "Water Management Summary Report". Section 6.4 of the Water Management Summary Report explains that while initial water quality in the pit lakes will be poor, due to pumping of TSF seepage water for 20 years, as the lakes fill and dilution increases both lakes may meet compliance limits for stock water drinking with the exception of sulphate. Given the inaccessibly of the pit lakes, it is not considered necessary to ensure sulphate limits comply with stockwater standards. Sulphate exceedances of this nature will have no greater impact on ecosystem values in the lake compared to those that will develop under stock water limits.

Table 5: Proposed Macraes Mine Water Quality Compliance Points

Location	Standard	Explanation
Deepdell Creek DC08	**Stockwater (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Water take from this point for primary (livestock) use**
Shag River at Loop Road	**Drinking (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Potable water take at this point**
Shag at McCormicks	**Drinking (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Potable water take at this point**
North Branch Waikouaiti River NBWRRF	**Stockwater (pH, arsenic)**	**Water take from this point for primary (livestock) use**
Murphys Creek MC01	**Stockwater (pH, arsenic, copper, iron, lead, zinc, sulphate)**	**Water take from this point for primary (livestock) use**
North Branch Waikouaiti River NB03	**Drinking (pH, arsenic, copper, iron, lead, zinc, sulphate)**	**Potable water take at this point**
Cranky Jim Creek CJ01	**Stockwater (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Water take from this point for primary (livestock) use**
Tipperary Creek TC01	**Stockwater (pH, arsenic, cyanide, copper, iron, lead, zinc, sulphate)**	**Water take from this point for primary (livestock) use**

The proposed surface water compliance sites are shown on Figure 1.

Figure 1: Proposed Surface Water Compliance Sites



6.3 Water Quantity

Effects on changes to water management and catchments are assessed in the "Water Management Summary Report" **attached** as Appendix 8.

The catchment area for the Shag River and McCormicks encompasses an area of 345.3 km^2. At present the water management area of the MGP that has effectively been removed from the Shag River catchment includes the opencast pits, mine site operations and tailings storage facility areas from which runoff has been diverted to the Macraes Mine process plant. The proposed Macraes Phase III Project operations should not increase the mining related catchment area removed from the Shag River catchment.

Downstream Catchment Changes

Following closure and rehabilitation of the Macraes Mine, runoff from the Lone Pine Reservoir and Maori Tommy Gully catchments is to be allowed to flow into Deepdell Creek. Closure and rehabilitation of the Macraes Mine site catchments result in an increase in the effective catchment area of the Shag River from what it currently is by approximately 2.3km^2. This represents a potential increase in flow in the Shag River and McCormicks of approximately 0.7% above what is currently being observed.

The Tipperary catchment, which also discharges to the Shag River upstream from the proposed McCormicks compliance point, is to temporarily lose part of its catchment due to the construction and operation of the TTTSF. This could result in the median flow at TC01 decreasing from 4.4l/s to 2.6l/s. Following site closure and rehabilitation, runoff from this diverted TTTSF catchment area would again be allowed to discharge to Tipperary Creek, leading to practically no change in the catchment area of the Shag River.

The catchment area of the NBWR at NB03 covers an area of 44.9km^2. At present runoff into Frasers Pit and the small area of the NBWR catchment upstream from the pit is diverted around Frasers Pit. This is not planned to change as a consequence of the Macraes Phase III project. As such, the currently observed flows in the NBWR will continue through the operational period of the mine and following closure.

It is possible that mitigation measures introduced to manage water quality in Murphys Creek in the NBWR could lead to runoff from the Frasers South Waste Rock Stack also being diverted to Frasers Pit or the process water system. This diversion may result in as much as an additional 3km^2 of NBWR catchment being diverted to Frasers Pit, equivalent to approximately 7% of the current catchment discharging to the NBWR.

The small currently planned changes in catchment areas, when compared to the large overall catchment, are expected to have no discernable effect on flow rates in either the Shag River or North Branch Waikouaiti River at the compliance points.

The proposed Camp Creek dam will change downstream flows in Camp Creek and to a lesser extent Deepdell Creek during filling, and then during operation. Appendix F to the "Water Quality Effects Mitigation Options" report sets out the changes to receiving waters flow statistics for various scenarios. For DC07 and DC08 the changes to mean, median and mean annual minimum ("MAM (7 day)") will be:

Table 6: DC07 and 08 Flow Changes

	Mean	Median	MAM (7day)
DC07 current	**121.4**	**37.9**	**5**
DC07 (Camp Creek filling with no residual flow)	**90.4**	**28.2**	**3.7**
DC07 with 10L/s discharge	**105.8**	**39.9**	**13.9**
DC08 current	**133.6**	**41.8**	**5.5**
DC08 (Camp Creek filling (with no residual flow)	**102.6**	**32.1**	**4.2**
DC08 with 10l/s constant discharge	**118.0**	**43.8**	**14.4**

The most appropriate discharge regime needed from the dam to dilute sulphate levels will depend on more detailed monitoring therefore the 10L/s constant discharge is provided as an example only. In section 6.4 addressing aquatic ecology, the "Aquatic Ecology Assessment" **attached** as Appendix 5 recommends that a residual flow of 2L/s be retained in Camp Creek during the period the Camp Creek Dam is filled. If this mitigation recommendation is accepted this will alter the statistics slightly.

The effect of these changes on aquatic ecosystems is addressed in the next section. The changed flow regime will not affect downstream water availability.

Pit Lake Water Quantity

Golder has undertaken projections for the filling of Frasers Pit. These projections incorporate the filling of the hydraulically linked Innes Mills Pit Lake and are discussed in the "Site Wide Surface Water Model" **attached** as Appendix 10. These projections indicate that the combined lake would not overflow within the 150 year simulation period of the model. The projection for pit lake volume indicates the rate of filling would decrease over time as the exposed lake surface area increases with a corresponding increase in the amount of evaporation. The rate of rise in the water level in the lake is much more rapid during the first decade following mine closure and during later decades.

Projections for filling of the Round Hill Pit Lake incorporate the filling of the connecting Golden Point Pit. Projections indicate the pit lake would not overflow within the 150 year simulation period of the model. Again projections for pit lake volume indicate the rate of filling will decrease over time as the evaporative area of exposed lake surface increases.

The simulation of water level change in the Round Hill Pit Lake was undertaken on the assumption that there will be no seepage losses in the Pit Lake through historical gold mine adits and underground workings located between Golden Point Pit and Deepdell Creek. If underground workings are not sealed or potential flows through these workings not minimised by some means, the pit lake water level within Round Hill Pit is unlikely to rise much above the level of the lowest workings. Sealing adits should result in the lake surface rising until the late inflows are balanced by evaporation and seepage losses through in the intact rock barrier. Minimising flow through these historical workings is required for water quality purposes, and OceanaGold proposes that this will happen as part of MPIII.

6.4 Aquatic Ecology – Impact and Mitigation

6.4.1 Introduction

The "Oceana Gold Macraes Gold Project Macraes Phase III – Aquatic Ecology Assessment" is **attached** as Appendix 5. The report presents ecological assessments for each aspect of the proposed development. The assessment is based on a review of published and unpublished literature and relevant databases as well as a survey of aquatic communities within the Macraes area undertaken in October 2010.

Overall, the review of existing information, and the October 2010 survey of waterways in the Macraes area indicate that there are very few sites with significant aquatic values likely to be affected by the proposed mine developments.

While some Flathead galaxiid populations could be impacted by the proposed development, the species is not threatened and is widely distributed throughout the Macraes area indicating that the loss of individuals from small isolated areas will not have an impact on the status of the population.

Many areas in the vicinity of the proposed development have been extensively modified by past and existing farming and mining activities. These activities, together with the fact many catchments are small, ephemeral and provide minimal surface water features, contribute to the limited aquatic values present in most of the areas likely to be affected by mine development. However, the middle and lower reaches of the affected catchments have higher quality aquatic values, with healthier invertebrate and fish communities. The use of silt ponds, other sediment control measures and mitigation to ensure compliance with water quality standards, will minimise any effects of the developments on these lower catchment environments.

Camp Creek Freshwater Dam

The conversion of Camp Creek and tributaries from riverine to lake habitat will modify habitat currently utilised by freshwater macroinvertebrates and fish, including Flathead galaxias and longfin eels. The new lake will not provide suitable habitat for galaxiids. However upstream of the lake the populations should be unaffected. As Flathead galaxias are found throughout the Macraes area, any loss of galaxiids due to a dam on Camp Creek is unlikely to affect the overall galaxiids population in the area. The dam will effectively create an upstream fish barrier between Camp Creek and Deepdell Creek, isolating any fish and galaxiids population from the predatory eel and trout present in Deepdell Creek. As Flathead galaxias are non-migratory, and are able to complete their entire life cycle in a short section of stream, this should not adversely affect populations in upper catchments and the dam will, in fact, create a "refuge" for Flathead galaxias.

In contrast longfin eels migrate long distances and require access to the sea to spawn. It is likely that eels present in Camp Creek are occasionally restricted from access to the sea by natural barriers (eg sections of dry river bed) in Deepdell Creek. Longfin eels in New Zealand are classified as "Declining", but only a small number of eels are present in Camp Creek, and its habitat is of limited value for eels, so any loss due to the dam would be less than minor from an overall longfin eel population perspective.

The release of water into Deepdell Creek from the Camp Creek Dam under low flow conditions is a potential benefit to downstream galaxiid and invertebrate populations, as the

frequency and duration of low flow periods would be reduced. Decreases in the Deepdell Creek galaxiid population have been observed following drought conditions. Higher river flows due to release flows from Camp Creek would prevent extreme low flow periods and minimise populations declines.

Overall the effect of the Camp Creek dam and altered flow regimes would be less than minor on instream values.

Back Road Waste Rock Stack

The Back Road Waste Rock Stack will be constructed along the top of a ridge line that contains several very small tributary streams of Deepdell Creek. The waste rock stack will also cover the upper reaches of the streams where they drain the ridge line. These streams are highly ephemeral and contain generally poor quality instream habitat, due to negligible flow down gully-like habitat. Macroinvertebrate communities are of poor quality, probably due to a lack of consistent flowing water, while fish communities are likely restricted to the lower catchment, near the confluence with Deepdell Creek. While the stream habitat will be lost due to the waste rock stack, the loss will result less than minor effects due to the poor quality habitat and poor quality communities.

Top Tipperary Tailings Storage Facility

Aquatic values throughout the proposed TTTSF area are low, due to minimal flow and wetland like habitat. Given the lack of significant aquatic values in the upper catchment the overall effect of the tailings storage facility is no more than minor.

The proposed Tipperary Creek silt control measures and tailings seepage control measures will reduce the risk of contamination of the lower reaches of the catchment from mining activities. Monitoring of creeks downstream of the existing mining activity at Macraes indicates that effects on fish and stream invertebrates are no more than minor. As OceanaGold is not proposing to change the general approach to contaminant management and compliance levels in receiving water bodies, invertebrate and fish communities in the lower reaches of the Tipperary/McCormick's catchment are unlikely to be adversely affected by the tailings storage facility.

Frasers South Waste Rock Stack

The proposed waste rock stack is to be located in an area that has already been extensively modified by mining activity. Aquatic habitat is generally poor, with negligible surface flow through wet, gully-like habitat. The soft bottomed, wet gully habitat supports a relatively poor quality macroinvertebrate community and is not suitable for fish habitat.

Waterways in the immediate area are isolated from the lower catchment by existing mining activities, so any potential effects on aquatic communities would be highly localised.

Frasers North Waste Rock Stack

This area has been extensively modified by farming activities, and existing mining activities prevent continuous surface water flow between the upper and lower catchment. Instream habitat in these headwater areas is generally poor. While supporting a relatively healthy macroinvertebrate community it is not suitable for supporting fish communities.

The existing environment has no sensitive aquatic environment and overall can be regarded as providing poor quality habitat. The loss of headwater streams due to the proposed waste

rock stack is therefore not significant, due to the poor quality of the existing aquatic environment and the modified nature of the waterways.

6.4.2 Mitigation

The use of silt ponds, other sediment control measures and maintenance of water quality standards will minimise any effects of the developments on these lower catchment environments.

The following additional options are proposed for mitigating any potential effects of MPIII in general:

Fish passage

The placement of new culverts can create barriers to fish movement into upstream reaches if installed without considering fish passage requirements. Information on such requirements is readily available and should be consulted to ensure any new or modified culverts provide for passage where suitable fish habitats exist.

Sediment mobilisation and runoff

The likelihood of increased sediment runoff during construction activities is relatively high. However, the risk of sediment losses to streams can be reduced by employing best practice design and mitigation matters through the development of the construction management plan incorporating sediment runoff control measures.

Accidental contaminant spills

The risk of contaminants entering waterways from the presence of construction machinery in, and around, waterways can be appropriately addressed by way of an appropriate on site contaminant management plan, which could form a component of the construction management plan.

Nuisance aquatic weed/algae introduction

To ensure that didymo and nuisance weeds are not introduced or spread by machinery and personnel involved in construction it is recommended that, wherever possible, equipment and other items to be used in or near waterways are first inspected and if necessary cleaned prior to use.

Camp Creek and Deepdell Creek Flows

During the period Camp Creek Dam is filled it is recommended a residual flow of 2L/s, or whatever flow is sufficient to provide a continuous surface flow to the Deepdell confluence be maintained to enable the galaxiid population the opportunity to adjust to the changing flow regime. Once the Camp Creek Dam is discharging flows to augment low flows this is likely to provide a positive effect in addition to simply diluting sulphate contaminants. It will reduce the severity and frequency of drought-like conditions which otherwise occur naturally and adversely affect stream communities.

6.5 Terrestrial Ecology

The impact of the MPIII project on terrestrial ecology was assessed in two separate reports. Botanical values were assessed in the "Oceana Gold (NZ) Ltd Macraes Gold Project Macraes Phase III – Botanical Assessment" **attached** as Appendix 3. Avifauna and herpetofauna values were assessed in the "Oceana Gold (NZ) Ltd Macraes Phase III Avifauna and Herpetofauna Assessments" **attached** as Appendix 4.

6.5.1 Botanical Values

The MPIII project is located within wider the Macraes Ecological District ("ED") area that contains highly variable levels of significance with regard to intact indigenous vegetation. 45 rare plant species are known from the Macraes ED. Of the 45 species, 6 rare plant species were recently found in the proposed mine expansion area along with 2 species classified as locally notable. The plant communities around the active mine areas at Macraes are already highly modified and contain little to no values. Relatively intact areas, including the Back Road Waste Rock Stack, Top Tipperary Tailings Storage Facility and Camp Creek, retain higher indigenous diversity, including rare plant species. Notwithstanding, all areas impacted by the MPIII footprint are already subject to extensive modification, mostly for farming purposes. MPIII will have more than minor adverse effects on several rare or threatened species of plant communities if not mitigated. These effects include flooding habitat of gullies, infill from waste rocks of indigenous vegetation and removal of specimens of several threatened plant species.

The proposed pit expansions including Round Hill Pit, Southern Pit, Innes Mills 5, Frasers/Stage 5 Pit and Frasers Stage 6 Pit, occur on already highly modified pasture land, the removal of which will not negatively impact Macraes ED.

6.5.2 Botanical Mitigation

As avoidance has already been incorporated into the design and remediation is generally not feasible for the bulk of the area affected, mitigation is considered appropriate to reduce the residual adverse effects of the project. Recommended mitigation includes restoration of tussock grass land, fencing of populations of threatened species and artificial enhancement (propagation) of threatened species.

If the mitigation detailed below is carried out successfully it will reduce the effects of the project from more than minor adverse effects to no more than minor adverse effects.

Tussock Grassland

Historically, the Macraes ED was dominated by tussock grassland with areas of hardwood forest. However this ED has been severely modified by fire and farming purposes. Remaining pockets of tussock grassland are therefore of higher endemic value due to their largely depleted distributions. The assessment recommends the removal of healthy expanses of tussock grassland from BRWRS, TTTSF, Frasers Stage 6 and Camp Creek should be mitigated by retiring an expanse of tussock grassland. The preferred option is to select a site outside the mining footprint based on three criteria; that it contains a pre existing representative native tussock grassland; that is unlikely to be encroached upon by future mining activities; and it is feasible to fence the areas off from stock. This option is preferred because it may be possible to combine the mitigation suggested for other threatened

species which are also adversely affected by this development (e.g. the site may also include Hookers Mountain Daisy).

Wetlands

The ephemeral wetlands and ridge top swamps around the district and along the proposed Macraes-Dunback Road realignment, and the proposed Back Road Waste Rock Stack, are recognised as having plant communities of higher biological value because of the limited extent of these wetland habitat type throughout Macraes ED. A small number of wetland areas will be either removed completely or be partially disturbed. If wetlands cannot be avoided, it is recommended that selected wetlands in the area that are not designated for development should be protected and enhanced by fencing off from stock and planting with locally sourced vegetation.

Scrubland

The indigenous scrubland in the BRWRS also has higher ecological value, with the locally notable board leaf (*Grisilenia littoralis*) and koha (*sophora microphylla*). The scrubland in the TTTSF is of a lower standard due to the intensive farming of this site. It is recommended that the loss of indigenous scrub be mitigated by protecting and enhancing an area of indigenous scrub outside of the proposed development area.

Rocky Habitats

Rocky cliff, bluffs and outcrops also have higher ecological values as they provide protection from browsing and have the potential to provide habitat for rare and/or uncommon species. These habitat types are not rare in the Macraes ED and were found in BRWRS, TTTSF, FNWRS, FSW and Camp Creek. It is recommended that during construction care be taken to avoid the introduction of new weed species into areas of higher value through the introduction of soil or some machinery.

Threatened Species

The "At Risk – Declining" Aciphylla subflabellata was found at the BRWRS and the TTTSF. To mitigate the loss of Aciphylla subflabellata, it is recommended that areas outside of the proposed TTTSF an area is fenced off from stock and that consideration be given to the artificial enhancement of Aciphylla subflabellata.

The "At Risk – Declining" coral broom (Carmichaelia crassicaulis) was found in the BRWRS and at Camp Creek. Suggested mitigation measures for coral broom include protecting some populations outside of the intended mine expansion from stock and long term protection of coral broom by implementing a coral broom enhancement programme. The "At Risk – Naturally Uncommon" Hookers Mountain Daisy was found in Camp Creek, Frasers Stage 6, FSWRS, TTTFS, FNWRS and BRWRS. As a number of populations occur within the proposed development areas mitigation for this "Naturally Uncommon" species is recommended. It is suggested that some of the larger populations of Hookers Mountain Daisy outside of the proposed mine expansion areas are fenced off from stock.

Potential sites to give effect to these recommended mitigation measures have been investigated and are detailed in section 15.8 of the Botanical Assessment **attached** as Appendix 3. Areas have been identified in Cranky Jims Creek and Highlay Creek that give effect to the mitigation recommended involving protection of specied habitat types. OceanaGold proposes to continue discussions with DoC and the Waitaki District Council to

confirm the sites necessary for protection in order to achieve an appropriate level of mitigation.

With the recommended mitigation effects on the botanical values will be no more than minor.

6.5.3 Avifauna and Herpetofauna

The wider Macraes ED, contains high reptile diversity and is a stronghold for the "threatened – nationally vulnerable" New Zealand Falcon. As the largest lizard assemblages in Otago occur in the Macraes Flat area this is a significant area for lizard conservation. Three species of lizards are confirmed from within the development areas, including the "At Risk – Declining" Otago Large gecko. Two more species possibly occur within the development areas, the "At Risk – Declining" green skink and the cryptic skink. The presence of the "Threatened – Nationally Critical" Otago skink and grand skink is unlikely within the development areas. Loss of habitat for Otago skink and grand skink has been avoided wherever possible and otherwise minimised. However, some residual habitat which will be lost. Effects include flooding, or infill, from waste rock of the habitat of threatened lizards, flooding of hunting grounds of the New Zealand Falcon, removal of mature trees resulting in loss of nesting and roosting habitat and removal of tussock grassland pipit habitat.

Mitigation is considered appropriate to reduce the adverse effects of this project as avoidance is not feasible for the majority of the affected area. Mitigation includes restoration of habitat (tussock grassland and wetlands (in accordance with the recommendations in the preceding section on botanical values)), replanting of trees and, potentially, translocation of lizards.

If the following mitigation is carried out successfully it will reduce the effects of the project to no more than minor.

6.5.4 Avifauna and Herpetofauna Mitigation

Unmitigated effects of habitat removal would be most significant for terrestrial fauna as one of the key threats to indigenous terrestrial species is insufficient and fragmented habitat.

In respect of bird species, removal of habitat will mostly impact introduced bird species such as finches, starlings, blackbirds and magpies. As these bird species are likely to disperse into surrounding farmland the disruption should be temporary and less than minor. Native species such as paradise shelducks and South Island pied oystercatchers will likely disperse to adjoining farmland to forage. However, there are pockets of high value land located throughout the proposed development areas.

To compensate for the loss of lizard habitat and the loss of lizard individuals mitigation is discussed below.

Tussock grass land

The loss of tussock grassland as detailed in the botanical section will reduce the quality of fauna habitats in the vicinity for the majority of terrestrial fauna and will have a particular impact on the threatened New Zealand pipit. The assessment recommends as mitigation for this loss that an area of land to be retired from grazing and restored as tussock grassland habitat for New Zealand pipit. The assessment recommends selecting a site from outside the mining footprint to be fenced off to allow protection from stock trampling and grazing, and control of weed species controlled within the site.

Wetlands

A small number of wetland areas will be either removed completely or have the potential to be disturbed by the Macraes Phase III project. Wetlands support the greatest concentrations of bird life of any habitat in New Zealand and are of particular importance in the Macraes area due to the relative scarcity of standing water. The assessment recommends that some wetlands outside of the development area are protected and enhanced. A number of potential wetlands are identified in the assessment as being appropriate for such protection. Wetlands would be fenced off to exclude stock and limit disturbance from vehicles.

Planting of trees

The construction TTTSF and FNWRS will result in the loss of approximately 17 hectares of mature stands of trees. These stands of trees are in the form of shelter belts, small exotic pine plantations and homestead plantings. The large trees are important for providing resting and nesting habitat and also acting as ecological corridors. It is recommended that trees are planted outside of the mining footprint as mitigation for this loss of habitat.

Translocation of lizards

Lizard habitat from within the development area of the Macraes Phase III project will be removed. While there is potential for lizards to move out of the development areas of their own accord many individuals from within the resident lizard populations will be killed during the construction phase if they are not removed prior to works beginning. It is recommended that an experienced herpetologist search the development area for resident lizards. The search should focus on finding green skink and Otago large gecko, but other common lizard species should also be relocated. These would then be translocated to a suitable new location identified in consultation with the Department of Conservation.

Camp Creek

The Camp Creek Dam will inundate a significant hunting ground for the endangered falcon. This loss can be mitigated by enhancement of the lake shore as detailed in section 6.4.1 of the Avifauna and Herpetofauna report.

As noted in the botanical section potential sites for mitigation involving the protection of specific habitats has been investigated and is feasible and realistic. Final details of the mitigation will be discussed further with DoC and Waitaki District Council.

In summary, with mitigation, the effects on avifauna and herptofauna will be less than minor.

7. Impact Assessment: Human Environment

7.1 Economic Impacts of Proposed Mine Expansion

Workforce Requirements

The vast majority of workforce requirements will be the same as currently existing. The net additional jobs largely result from the retention of employment over the extended life of the mine rather than the creation of new employment opportunities. Rather than most of the 563 jobs associated with the Macraes Mine ending by 2012, they will now continue to 2020 or thereabouts. Likewise, as noted previously due to the Reefton Gold Project's absolute dependency on mining and processing continuing at Macraes Mine the 222 jobs at Reefton will be enabled to continue beyond 2012. There will be a small increase in the total workforce required for Macraes Phase III, the main area for the increase will be in connection with the construction of the Macraes-Dunback Road realignment; and the TTTSF construction and associated infrastructure (powerline, pumps and pipelines).

Economics and the Resource Management Act

The purpose of the RMA is "sustainable management". "Sustainable management" includes enabling "people and communities to provide for their …economic…well being". Therefore, economic effects are an important consideration when assessing the sustainable management of natural and physical resources under the RMA.

Section 5(2) also refers to "people and communities" which highlights that it is the impacts of a proposal, both good and bad, on the community and not just the applicant or particular individuals or organisations that must be considered.

Section 7(b) of the RMA states that in achieving the sustainable management purpose of the Act, all people "shall have particular regard to… the efficient use and development of natural and physical resources". This includes economic efficiency which can be considered in terms of:

- Maximising the value of outputs divided by the cost of inputs;
- Maximising the value of outputs for a given cost of inputs;
- Minimising the cost on inputs for a given value of outputs;
- Improving the utilisation of existing assets; and
- Minimising waste.

For the proposed MPIII Project it is appropriate to consider the East Otago economic impacts given the likely impacts on local residents and businesses where East Otago is defined to include the Waitaki District (including Macraes Flat, Oamaru, Dunback and Palmerston) and the northern part of Dunedin City (including Waikouaiti, Hyde and Middlemarch). It is also appropriate to consider wider Otago regional and national level economic impacts. These impacts have been assessed in "Assessment of Economic Impacts" **attached** as Appendix 19.

Direct and Indirect Employment and Income Effects

Without MPIII, gold production will reduce by 25% in 2011 from the 2010 level, by 37% in 2012 and then cease altogether. The Reefton Mine on the West Coast would also have to cease operation. There would be commensurate restrictions in employment, wage and salary payments and other expenditure in East Otago and the Otago region (and in Reefton and on the West Coast).

With the MPIII Project gold production is forecast to be around 270,000 ounces in 2011, around 273,000 ounces in 2012 and 2013, and then an average production level of around 195,000 ounces per annum over the period 2014 to 2018. After 2018 gold production will reduce again in 2019 and 2020 if it is decided to close the mine in 2020.

As a consequence of an extension to the mine life beyond 2012, the employment at the mine site is expected to increase to around 612 jobs over the period 2011-2014 (from 563 Jobs in 2010) with the retention of a further 28 jobs in Dunedin and then after 2014 fall to around 490 jobs at the mine site and 20 jobs in Dunedin with the closure of the Frasers Underground mine.

This will result in net additional jobs at the mine site of 126 in 2011, 247 in 2012, 613 in 2013 and 2014 and an increase of 485 net additional jobs from 2015 onwards. This is the number of additional jobs created by MPIII extending the life of the Macraes Mine beyond 2012. Without MPIII employment at Macraes Mine would drop to very low levels after 2012, hence the large increase in additional new jobs from 2013 onwards.

The net additional jobs in Dunedin will be 2 in 2011, 10 in 2012, 28 in 2013 and 2014 and 20 from 2015 onwards. The net additional jobs for the Otago region as a whole are 128 in 2011, 257 in 2012, 641 in 2013 and 2014 and 505 from 2015 onwards.

The net additional wages and salaries paid to employees and contractors for the Otago region as a whole (Macraes Flat site and Dunedin office) will be $8.9 million in 2011, $17-7 million in 2012, $43.6 million in 2013, $40.3 million in 2014 and will average $28.9 million from 2015 onwards.

The net additional expenditure other than wages and salaries in north-east Otago is estimated to be $2.1 million in 2011, $4.1 million in 2012, $8.4 million in 2013, $8.1 million in 2014 and will average $7.9 million from 2015 onwards. For the Otago region as a whole net additional expenditure other than wages and salaries is estimated to be $14 million in 2011, $27.3 million in 2012, $56.8 million in 2013, $54.5 million in 2014 and will average $53.2 million from 2015 onwards.

Using the same district and regional multipliers as mentioned above, the total direct plus indirect economic impacts of the Macraes Phase III Project are estimated to be as follows:

Table 7: Direct and Indirect Economic Impacts

	2011	2012	2013	2014	2015	Onwards
Otago						
Employment (jobs)		**314**	**630**	**1,570**	**1,568**	**1,237**
Wages and salaries ($m)		**24.1**	**48.0**	**118.2**	**109.2**	**78.3**
Other expenditure ($m)	**31.4**	**61.2**	**127.2**	**122.1**	**119.2**	

MPIII will enable the Macraes Mine to continue to be a significant contributor to local and regional levels of employment and income beyond 2012. As shown by the above figures this will result in significant direct and indirect economic benefits for the north-east Otago and Otago region.

Other Economic Benefits

By extending operations beyond 2012, the MPIII Project will enable the current benefits associated with the Macraes Mine, discussed above to continue until at least 2020. These include:

- Diversity of the East Otago and Otago regional economies;
- Employment and wages and salaries in East Otago;
- Increase in rating base of the Waitaki District Council; and
- A wide range of community initiatives and socioeconomic benefits in East Otago and the Otago region generally.

The MPIII Project will also have benefit at the national level. Additional royalty payments to Government are estimated at $1.4 million in 2011, $2.6 million in 2012, $6.1 million 2013, $5.1 million in 2014 and will average $4 million annually from 2015 onwards.

The MPIII Project will also extend the Macraes Flat mining operation's significant contributions to New Zealand's total value of output, GDP and exports. For example, the additional total expenditure in New Zealand as a consequence of the MPIII Project over the period 2011 to 2018 inclusive is estimated at $1.6 billion, or more than 3 times the $0.5 billion[5] estimated expenditure to result from the filming of the two Hobbit movies in New Zealand.

If the Macraes Mine is extended through to 2020, OceanaGold's Reefton operations will extend through to at least 2015. If exploration work indicates extending the mine's life is

[5] See Reuters Entertainment; October 21, 2010

economic and required consents are granted it is likely Reefton will operate beyond 2015. However, if the Reefton Mine is forced to close at the end of 2012 it will result in a significant reduction in employment, wages and salaries and other expenditure on the West Coast.

The Macraes Mine will commence winding down from 2018 onwards. However even after 2020, when gold production is currently intended to cease, the Project will continue to contribute to economic activity in the East Otago economy. Rehabilitation and ongoing monitoring of the site will be required. This will involve:

- Finishing waste rock stacks, capping the tailings dams with top soil, removing the over-bridge and rehabilitating haul roads. This is estimated to require a staff of between 15 and 20 employees for up to 18 months.
- Dismantling the process plant which will take up to 6 months and require between 20 and 30 employees.
- Removal of buildings which will take around 3 months and require 10 to 20 employees.
- Ongoing monitoring of the site, which would continue for perhaps 10 years after mine closure and require 2 fulltime staff reducing to 1 part time staff after 5 years.

Therefore ongoing employment will be generated by the mine even after the cessation of gold production.

Summary

The MPIII Project will be a significant contributor to levels of employment, income and expenditure for East Otago and the Otago region. It will make a considerable contribution at a national level to Government revenue, GDP and exports. The proposed MPIII Project will enable these economic impacts to continue out beyond 2012.

Overall, the economic wellbeing of the East Otago and Otago (as well as the Reefton and West Coast) communities will be enhanced by the MPIII Project. Benefits include:

a. Maintaining significant levels of local and regional employment, incomes and expenditure beyond 2012;
b. Maintaining population levels in north-east Otago, thereby maintaining the quality of some central government provided services;
c. Providing the local economy with greater diversity and resilience;
d. Providing greater employment choice for local residents;
e. Contributing to local community activities and socioeconomic benefits.

Community and Closure Strategy

After extensive consultation with the Macraes Community it has become clear that the Heritage and Art Park is no longer an appropriate closure strategy to assist the community to transition to a sustainable post mining status. Instead it is proposed to establish a Community Development Trust with a discretionary fund to be spent on projects the community deem most appropriate to secure the future of Macraes.

7.2 Effects on Tangata Whenua Values

The maintenance of natural landscapes, protection of waahi tapu and waahi taonga, for taonga species and impacts on the mauri of the land, water and air are all of cultural importance. A comprehensive Cultural Impact Assessment is being undertaken by Kai Tahu Ki Otakau and OceanaGold has volunteered a review condition to take into account the findings of that CIA.

Culturally Important Landscape Features

Previous consultation and assessments undertaken in the vicinity of the Macraes Mine have not identified any culturally important landscape features. Some aspects of the MPIII Project will have a moderate impact on skylines and ridgelines. OceanaGold will be undertaking mitigation to minimise any potential effects. It is unlikely there will be adverse effects on culturally important landscape features

Taonga Species

Taonga species are native birds, plants and animals of special significance and importance to iwi and it is important that these resources are treated with care.

Various ecology assessments have been undertaken in the area by Ryder Consulting **attached** as Appendices 3, 4 and 5. Several areas of significant indigenous vegetation and significant habitats of indigenous fauna were identified as potentially being impacted by MPIII. OceanaGold will undertake appropriate mitigation to minimise any effects on these areas (as set out in the Ryder assessments). This is addressed in detail in sections 6.5.1 and 6.5.2 of this AEE. In summary any effects on indigenous ecosystems, will be minor.

Sites of Significance, Waahi Tapu and Waahi Taonga

OceanaGold has commissioned extensive archaeological surveys of its entire project area since commencement of exploration and mining in the area. While it is acknowledged that early Maori could have occupied the area no evidence of areas of significant interest was found within the area of the proposal. A copy of the survey done by B J Allingham 1992 is **attached** as Appendix 34.

It is therefore unlikely the project will impact on any site of significance. However, it is possible that an unrecorded or unknown site may exist within the area and to that end OceanaGold has an established procedure (**attached** in Appendix 35) communicated to all staff on dealing with such accidental discoveries.

Water

The protection and enhancement of the mauri of water is a primary natural resource management principle. Diversion, mixing of waters from different catchments and contamination are activities that negatively impact on the mauri of some waterways.

Mitigation will be undertaken by OceanaGold to ensure that Macraes Mine operates through to the end of mine life, and in post closure phase, within the proposed compliance criteria for Deepdell Creek and the Shag River that have been previously accepted by iwi.

MPIII is not expected to have any discernable effect on flow rates in the Shag River or the Waikouaiti River.

Air

Dust effects will continue to be regulated by OceanaGold's discharge to air consent requirements, with standard dust suppression requirements. Therefore it is envisaged that MPIII will not have any adverse air quality effects that are more than minor.

Conclusion

While this application is processed and decided upon a Cultural Impact Assessment will be undertaken by Kai Tahu Ki Otakau. In order to take into account the findings of this formal CIA OceanaGold offers the following review condition to ensure the Council can initiate a review of the mitigation conditions based on the findings of the final CIA:

> *"The Council may, within 6 months of receipt of the Cultural Impact Assessment prepared by Kāti Huirapa ki Puketeraki; serve notice of its intention to review the conditions of this consent for the purpose of amending or adding conditions to address mitigation of the effect of Macraes Phase III on cultural values and associations".*

If the CIA concludes there are adverse effects of the MPIII project on ancestral landscapes, awa (rivers), taonga, indigenous vegetation and habitats of indigenous fauna that have not been mitigated, they can be mitigated through the process of reviewing the consent conditions, if it is appropriate to do so, in order to ensure the MPIII Project promotes sustainable management. The review process would be at the consent holder's expense.

7.3 Amenity Effects

7.3.1 Introduction

OceanaGold has undertaken assessments on the landscape and visual effects, noise and blasting effects and traffic effects of MPIII. The results of the assessments are set out in the next section.

7.3.2 Landscape and Visual Assessment

As noted in section 4.1 above Macraes Flat sits within a rural upland landscape of fluvially dissected rolling hills of moderate relief. The presence of the relatively large scale Macraes Gold Project, and its effect relative to landscape change is now a major feature contributing to the local landscape context.

The landscape assessment (**attached** as Appendix 2) describes, with photo-simulations, a number of salient and common public viewpoints. The assessment related to the various 'viewpoints' focuses on an objective description of the degree of change to the status quo that a viewer will experience from each particular photo point rather than whether the change represents an adverse or a positive effect. The fact that the MPIII proposal will be visible and will change aspects of the character of the existing landscape does not necessarily mean that its effects will be adverse, inappropriate or unacceptable. Visual sensitivity is a measure of how visibility changes to a landscape will be regarded and depends upon a

range of viewer and view characteristics. The assessment recommends that a viewing facility be allowed for along the Macraes-Dunback Road for road users that wish to stop and view the mining related operations and the broader landscape context. The Traffic Design Report (**attached** as Appendix 28) addressed in detail below recommends appropriate parameters for such a lay by (see section 6 of the report).

The assessment concludes that the level of potential effect of the MPIII proposal on these viewpoints would be nil through to moderate.

Once the final shaping and revegetation of the TTTSF has been undertaken, and the expanded waste rock stacks completed, the shape, slopes and colour of the new earthworks will be in sympathy with the natural slopes of the areas. Based on the photo points considered the assessment concludes that overall the potential landscape and visual effect does not exceed what is considered to be a moderate effect.

The assessment also considered views to several lesser components of the MPIII proposal namely the Reclaimed Tailings Stack, Camp Creek Freshwater Dam and the two freshwater pit lakes formed as part of the revised closure.

Additionally, any adverse visual effects associated within the construction process of the formation of the proposed tailings storage facility and waste rock stacks will be of short duration and will cease upon completion of the proposal.

The new mining activity associated with the MPIII proposal is an extension of previously consented activity is not unexpected and will be seen in this landscape context as a continuation of the existing mining operation. With the mitigation proposed, the potential adverse landscape and visual effects will be less than minor.

7.3.3 Traffic

Traffic Design Group Limited has undertaken an assessment of the effects upon road users of the proposed realignments of Macraes Road and Golden Bar Road in the vicinity of the Macraes Mine. The assessment uses procedures set out in the NZTA Economic Evaluation Manual to assess the effects on road users and therefore assess traffic effects in ultimately economic terms. The realignment of the Macraes-Dunback Road is an improvement in the sense it will enable vehicles to travel at faster speeds, safely (95km/h instead of 86km/h). The same applies to the realigned Golden Bar Road (90km/h instead of 55km/h). There will also be reductions in accidents for the new alignments compared to the existing alignments.

The "OceanaGold (New Zealand) Limited – Economic Assessment Report" (is **attached** as Appendix 28)

The economic analysis shows a very slight disbenefit. For the Macraes-Dunback realignment this is 2 cents per vehicle per journey in terms of the annual travel time costs, and 6 cents per vehicle per journey in terms of vehicle operating costs. For the Golden Bar realignment, while the travel time increases, vehicle operating costs will decrease. It is therefore considered extremely unlikely that these dis-benefits will be perceived by drivers. In particular the vehicle operating costs associated with the realignment increase because drivers are able to travel more quickly on the road as a result of an improved realignment. Thus drivers will have an improved (but unquantified) quality of journey. In terms of the journey time dis-benefit, this arises from taking an extra 3 seconds for the Macraes-Dunback Road. It is considered that this will not be perceptible to drivers. Further, the realignment leads to a slightly improved accident rate. It also needs to be borne in mind that for the period to 2020, the vast majority of road traffic affected by the realignments will be Macraes

Mine traffic. Accordingly, a portion of the assessed economic cost of the realignments is effectively being internalised and should be discounted from the assessed cost.

Overall, it is concluded that while there is an extremely slight economic dis-benefit to undertaking the road realignment scheme, any effects upon drivers using the road will be negligible and imperceptible.

7.3.4 Noise

Hegley Acoustic Consultants have prepared a detailed assessment of the noise effects of the Macraes Phase III Project. The "Macraes Phase III Proposed Mine Development Assessment of Noise Effects" is **attached** as Appendix 29.

Noise from the proposed Macraes Phase III extension has been predicted based on field measurements of the plant that is to be used during the proposed work.

The assessment adopts the current consent conditions for the mine (under resource consent LRC96/98), and the relevant noise rules in the Waitaki District Plan, as reasonable levels against which to assess future activities.

There is a slight difference between the consent conditions and the District Plan requirements as the District Plan requirements adopt the Macraes Mining Zone as the relevant boundary while the consent conditions adopt the boundary of the Township Zone of Macraes, or the notional boundary of any dwelling in the Rural Scenic Zone. The District Plan criteria is slightly more stringent than the consent conditions.

The assessment demonstrates that even during busy mining periods, the noise level at all the houses in close proximity to the mine will remain well within the mine consent conditions by a minimum of 5dBA L_{10} at the following points (5dBAL_{10} is a clearly noticeable difference in noise level):

- At night time at the boundary of the Township Zone of Macraes; and
- At the notional boundary of any dwelling in the Rural Scenic Zone where no written consent has been given.

When predicted against the District Plan requirements, the noise limits at the boundary of the Macraes Mining Mineral zone will be complied with by a minimum of 7dBA.

Based on these predictions, noise effects of the proposed mine extension will be no more than minor.

7.3.5 Blasting

Orica Mining Services has undertaken a study of the blasting related environmental effects of the proposed Macraes Phase III Project on the Macraes village, the nearest houses to the proposed operation not owned by OceanaGold and the historic buildings in Golden Point Reserve. The study is **attached** as Appendix 30.

Predictive models for ground vibration and air blast over-pressure effects from blasting have been established based on historic blast monitoring data and the monitoring results from six test holes fired in November 2010.

Current consent conditions limit vibration (measured as peak particle velocity) to 5mm/sec at the frequency range of 3-12Hz. This allows for 5% of the total number of blasts over 12 months being up to but not exceeding 10mm/s. A level of 10mm/s is widely accepted as being well below the threshold of structural damage to houses (see Australian Standard as 2187.2-2006). The predictive model showed that it is extremely unlikely that a ground vibration of 10mm/s will ever be exceeded at the consent monitoring points using the current blasting methods. As long as peak particle velocity is less than 10mm/s, adverse effects from ground vibration will be minor.

The closest distance for blasting near the historic buildings within the Golden Point Historic Reserve is proposed to be 750m. Using a typical maximum mass instantaneous explosives change weight (MIC) of 630kg, the predicted ground vibration is less than 5mm/s.

The nearest occupied non-company owned building is in the Macraes village and is approximately 1,200m from the nearest open pit. Again, at a typical MIC of 1,600kg, the predicted ground vibration is expected to be less than 5mm/s.

Air blast from blasting is difficult to predict as it is affected by a number of factors including the MIC, distance from the monitoring point, temperature, cloud over, humidity, shielding effects of the open pit walls, stemming depth and quality, presence of groundwater and the nature of the intervening topography. Provided these factors are appropriately provided for in all blast designs then air blast overpressure of less than 120dBL is expected. Effects from air blast overpressure less than 120dBL are expected to be minor.

As an overall conclusion, the study finds that provided blasting operations continue in a controlled manner similar to the current fashion, adverse effects from ground vibration and air blast are expected to be no more than minor.

7.3.6 Dust

A detailed assessment of the effects of air discharges has been undertaken by Beca Infrastructure Limited. The "OceanaGold (NZ) Ltd Phase III Development Assessment of Environmental Effects of Air Discharges" is **attached** as Appendix 31.

OceanaGold currently holds two resource consents for the discharges to air from the Macraes Mine (96785_v4 and 2006.689). While the new activities are of the same nature as those currently authorised, they will be outside the footprint of the existing resource consents.

The quantity and frequency of dust discharges from the site are directly related to the amount of material that is moved and processed, the area of open ground and local weather conditions. The effects of the discharges are also directly proportional to the quantity of the dust emissions.

The proposed development will not change the nature of the activities carried out but the scale of the activity is expected to increase. As the MTI is rehabilitated and the new TTTSF and WRSs are developed, the focus of the activity at the mine will move further towards the east and away from the Macraes Flat Village. Therefore, the source of the majority of the dust emissions will move which means that the areas potentially affected by mine activities are also likely to move further towards the eastern side of the mine.

The residences in the Macraes Flat Village are potentially most affected by the construction of the RTS on the MTI and the re-handling of material in SP11,, as these activities will take place closest to the village. The village is located approximately 1km from the MTI. As the

tailings related activities will consist of the same type and scale of activity as has occurred during previous operations of the TSFs, the effects are also expected to be similar to current effects. Provided that dust mitigation measures are put in place, there is not expected to be any noticeable increase in dust levels in the surrounding area.

The TTTSF and the extended WRSs will be located on the eastern side of the mine, approximately 2.5km from Macraes Flat Village. As the village is sheltered by the terrain between the planned locations of the TTTSF and WRSs, it is considered unlikely the village will be adversely affected by the construction of the TTTSF and extended WRS.

The mining of Round Hill, Southern and Innes Mills Pits and the continuation of mining at Frasers Pit is not expected to have any significant effects that are greater than the existing effects of the mine. The planned activities are the same as the current activities taking place at the mine.

Any effects from the road realignment construction are not expected to be noticeable as the earthworks will be relatively small scale in comparison to other earthwork activities undertaken at the mine on a daily basis.

The results of monitoring, complaints and audit records demonstrate that the existing effects of the mine are no more than minor and within the limits set by the current resource consents. OceanaGold intends to continue to operate within the current consent limits and continue to use the dust mitigation techniques that have been used successfully to date. A draft Dust Management Plan is appended to the Air Discharges report to illustrate the variety of measures available to avoid adverse dust effects. Provided that care is taken within the remediation of the TSFs and the construction of the extended WRSs and the TTTSF, the effects of the proposed Macraes Phase III project should not be more than the current consented effects and should not result in any adverse effects downwind of the site that are more than minor.

7.3.7 Shading

Shading, attributable to MPIII, on the nearest affected neighbours and the proposed realignment of the Macraes-Dunabck Road has been evaluated by Martin John Hughes, Senior Mine Engineer at OceanaGold's Macraes Flat mine site.

In terms of the shading on the nearest affected neighbours MPIII has no significant impact (1 – 5 minutes of shading at discrete time periods). This minimal shading is due to distance from features; intervening topography existing consented features, and the seasonal trace of the sun.

The location of the BRWRS and TTTSF embankment will result in additional shading of the proposed Macraes-Dunback Road realignment, relative to that which is currently experienced on the existing Macraes-Dunback Road. The majority of the additional shading occurs in terms of Local Sun Set time (i.e. sunset occurs earlier). The maximum additional shading increase at any point calculated in terms of LSST was 56 minutes.

While this has the potential to make parts of the proposed road susceptible to freeze earlier at night, compared to the existing road, the improved aspects of the proposed road means in most cases Local Sun Rise time (LSRT) will occur 10-15 minutes earlier than on the existing road alignment. This would result in increased thaw efficiency in the morning should any freezing occur overnight.

In summary, effects of shading caused by MPIII will be minor.

7.4 Seismic/Stability

7.4.1 TTTSF

Stability analyses **attached** as Appendix 20 ("OceanaGold (NZ) Ltd, Macraes Gold Project: Top Tipperary Tailings Storage Facility Technical Report") shows that the proposed TTTSF embankment design meets normally accepted standards for both static and seismic conditions. By constructing the embankment and operating the impoundment in accordance with the design recommendations, (including monitoring and surveillance in accordance with recommendations), the TTTSF will provide stable secure tailings storage.

7.4.2 Mining of Round Hill – Southern Pit MTI, SP10 and SP11 tailings storage facilities and reclaimed tailings stack

The "Round Hill East – Southern Pits" report by Pells Sullivan Meynick ("PSM") **attached** as Appendix 25 presents the results of geotechnical studies assessing the likely movement of the west wall due to mining the proposed Round Hill – Southern Pit. The likely impact on the Macraes Mine plant site and the MTI are the key reasons why understanding the predicted movement of the west wall is important. The anticipated mechanism causing movement is consistent with that previously experienced and successfully managed during earlier mining at Round Hill and Golden Point. The movement is caused by mining and recedes to background levels when mining ceases.

Previous observations of mining in Southern Pit suggest that the magnitude of displacement is quickly diminished with distance north (or south) from the actively mined area. In other words, the bulk of movement occurs immediately adjacent to the active pit. The results of an analyses suggest that mining the proposed Round Hill – Southern Pit down to 350 mRL will not adversely affect the plant site. However, mining below 350 mRL is expected to reinitiate movement beneath the plant site and at levels greater than that observed in the past. Predicted displacements are in the order of 10 metres at the MTI, and up to 2.5 metres at the plant site. Movement has been successfully managed in the past.

3D analysis predicts displacements in the order of the few hundred millimeters as a result of mining up to the end 2014. From 2015, the expected response is one of increasing movement although the west wall is predicted to remain relatively stable. The bulk of the movement is predicted to occur over a two year period up to 2017.

The maximum displacements at the MTI embankment are predicted to be approximately 4 metres.

The proposed mining plans incorporate strategies based on these analyses to limit the impact on the west wall, such as mining south of approximately 15250mN and maintaining a minimum 25m offset between the Footwall Fault ("FF") and the pits. The conclusion is that the proposed Round Hill – Southern pit expansion can be appropriately planned and scheduled to limit the impact of reactivating the west wall movement. Displacements of similar magnitudes to those previously experienced are predicted to occur as a result of the new phase of mining. These will have to be managed to limit the effect on the processing plant site.

The risk with Round Hill – Southern Pit is that the west wall movement goes from a regressive to a progressive mode. The initial "stop mining" triggers recommended by consulting geotechnical engineers PSM are similar to those successfully adopted in the past and include:

- Generally 50mm/day, limit to 10mm/day at the plant site
- Doubling of the daily rate
- Batter failures or floor heave noticeable during a mining shift
- Distress within the plant site
- Change in direction of displacement vectors of 20º or more

PSM recommends monitoring and management to mitigate against large uncontrolled displacements. Should the behaviour of the west wall change, such that failure is predicted, PSM advise it will be necessary to modify the pit plan. This is likely to entail dividing the pit into either north-south and/or east-west sections; and/or increasing the offsets so that the toe of the west wall is further from the FF.

The PSM assessment was peer reviewed by Kevin Rosengren and Associates Pty Ltd (**attached** as Appendix 26) and URS Corporation (**attached** as Appendix 39). The Rosengren peer review relied more upon the extensive body of experience at the mine rather than the various modeling techniques used in the PSM assessment. The peer review concludes it is in general agreement with the content and conclusions of the PSM assessment. It agrees that the proposal to limit the northern extent of mining to protect the plant site is a sound approach and that stop/start mining can appropriately manage the expected movement.

The URS peer review made a number of recommendations in relation to the adequacy of the current modelling with respect to achieving the design excavation. It is OceanaGold's intention to review these recommendations, in conjunction with PSM, and where it is demonstrated as being beneficial to achieving the design excavation implement prior to undertaking mining.

EGL's "Oceana Gold (NZ) Ltd Macraes Gold Project Mining of Round Hill – Southern Pit MTI, SP10 and SP11 Tailings Storage Facilities and Reclaimed Tailings Stack Technical Report" attached as Appendix 21 subsequently assesses the feasibility of the mining of Round Hill – Southern Pit with regards to the geotechnical stability, and stormwater control of the SP10, MTI and RTS. The EGL report in part relies on the "Round Hill – Southern Pit" PSM report (**attached as** Appendix 25) and its findings in respect of the likely movement of the west wall due to mining. The EGL report has also been peer reviewed by Richard Davidson and Don MacFarlane (Senior Principals of URS Corporation).

Mining of Round Hill – Southern Pit will require the deconstruction of the existing SP11 TSF and re-profiling of the tailings surface on SP10 TSF which is to remain. The excavated tailings from SP11 TSF will be placed in the tailings storage located on the MTI TSF. The mining of Round Hill – Southern Pit will result in the re-initiation of ground movement on the Footwall Fault. This will in turn result in some deformation of the MTI embankment and tailings on the eastern side of the TSF. Movement on the FF occurred during earlier phases of mining of Round Hill and a management regime developed in conjunction with the ORC was implemented. Mining was successfully undertaken. A similar movement management regime will be implemented during this expansion.

The preliminary design of the proposed modifications to the MTI and SP10 TSF embankments, including the proposed RTS, incorporates the safety guidelines of the New

Zealand Society of Large Dams (NZSOLD). The potential impact classification of the MTI, SP11 and SP10 TSF is assessed to be medium.

Preliminary stability analyses show that the existing SP10 TSF and proposed RTS on the MTI TSF, meet normally accepted standards for both static and seismic conditions, even with the re-initiation of mining of Round Hill – Southern Pit. However the preliminary analyses for the MTI TSF show that the stability on the FF is marginal and further work is required to confirm the mechanism of deformation and applicable shear strength parameters at the release surface within Round Hill – Southern Pit.

The Report concludes that it may be possible to mine Round Hill – Southern Pit, deconstruct SP11A TSF, re-profile SP10 TSFs and build a new RTS on the MTI TSF. However, the feasibility of mining the pit, and associated work, will require further detailed investigation and analysis with close consultation between the designers of the pit and TSFs. The final design for the deconstruction of SP11A and geotechnical assessment of the MTI TSF, SP10 TSF and RTS on the MTI TSF will be carried out following Resource Consent approval. A design report will be prepared that documents the detailed design to support the required Building Consent application. The mechanisms controlling the movement of the FF, and the consequences thereof will be investigated and stabilising options developed to control movement for the various eventualities that could occur during mining.

Existing Building Consent requirements will remain in place and it is expected that similar requirements will be imposed upon future activities.

The mining of Round Hill – Southern Pit will also have to be subject to rigorous real time monitoring with a comprehensive management plan that includes a set of conditions to control mining determined by the designers of the pit and TSFs. The MTI SP10 and SP11A TSFs are currently extensively monitored using piezometers installed in the embankments and tailings, and measurements of seepage flows, together with cone penetration tests in the tailings and deformation monitoring stations. The EGL report recommends that in addition to current monitoring further monitoring is implemented during, and after the mining of Round Hill – Southern Pit.

There will also have to be the ability to adjust the sequence and extent of mining, depending on the movement of the Footwall Fault and observations and performance of the adjacent facilities. Comprehensive ongoing active dewatering is proposed to reduce the water pressure along the Footwall Fault so as to reduce deformation due to the mining.

In summary mining induced movement is expected but likely to be manageable after further detailed analyses have been undertaken. OceanaGold has experience in successfully mining in this environment, and by using conservative mining techniques and frequent detailed monitoring, it is expected that the anticipated volumes can be safely extracted from the pits. The tailings embankments are designed such that anticipated levels of deformation associated with this movement can be safely accommodated with no increased risk of contaminant loss.

7.4.3 Waste rock stack stability

The "Waste Rock Stack General Stability" report undertaken by PSM is **attached** as Appendix 27. The report presents results of geotechnical analysis in relation to the general stability of the proposed waste rock stacks at the Macraes Mine. It concludes that the factor of safety ranges between 1.2 and 3.3 depending on overall height and assumed ground water levels. These results indicate that waste rock stability has a factor of safety greater than the accepted 1.2 for a wide range of conditions.

7.5 Heritage features

7.5.1 Introduction

The effects on heritage features are detailed in **attached** as Appendix 18 "Archaeological Survey – Macraes Phase III".

Camp Creek

Six of the ten recently recorded historic sites in the Camp Creek catchment are identified as being potentially impacted by the MPIII expansion. Individually these sites are considered to have variable archaeological values. Several are single prospecting pits or isolated workings, and on their own have limited archaeological values. Sites I42/155 and I42/156 are a mix of workings and either contain clearly defined hut sites, or are likely to contain hut sites dating back to the early 1860s. Each of these sites are considered to be of high historic and archaeological significance and an authority to modify the sites is be required from the Historic Places Trust for any activity that will impact on the sites.

The survey indicated that site I42/157 represents a good example, in good condition, of an extensive area of alluvial workings and habitation. Based on this finding OceanaGold have ensured that a dam site upstream of the location of site I42/157 was identified so that the site is unaffected.

As a group the sites within the Camp Creek gully are considered to represent a significant remnant historic landscape. It is recommended that the connection and link between sites within this landscape is therefore recorded and interpreted in detail.

Where it is not possible to avoid these sites it is recommended that features are recorded in detail and investigated in accordance with accepted archaeological best practice and in line with any conditions that are imposed in any authorities that may be granted by the Historic Places Trust.

In summary by ensuring the dam and lake footprint avoid I42/157 and requiring detailed best practice investigations and recording of the features that will be inundated, the effects on heritage values in the Camp Creek area will be mitigated.

Tipperary Creek

The proposed TTTSF will result in impacts on the remains of the Duke of Edinburgh Mine (shaft, battery site, workings, dam), and alluvial workings in the Tipperary Gully. Trenching outside the main shaft area of Tate Mine will also be impacted. However, the Tate Mine main shaft and Mullock heap (I42/94) will not be affected by either the proposed tailings storage facility or the realignment of the Macraes-Dunback Road.

As the Duke of Edinburgh Mine, Tate (Galli) Mine and the Tipperary Gully include evidence of both early quartz and alluvial mining operations it is recommended that further research is carried out on these sites in order to identify and record details of the operations.

A stone house, and associated features, which appear to have been constructed sometime in the 1870s or 1880s will also be affected by the TTTSF. An authority to modify these sites will be required from the Historic Places Trust.

It is recommended that the stone house site be subjected to a detailed archaeological investigation, including recording, sampling and analysis in accordance with accepted archaeological best practice.

The small cave and rock shelter first reported by Petchey in 1996 will not be affected by the construction of the proposed tailing storage facility. The area of workings on the flat below the cave, which are probably linked with the use of the cave as accommodation, were originally considered as the location of a silt pond. However, the MPIII plans have been amended so that this silt pond is no longer required. Therefore, there should be no physical impact on the cave or workings.

The operations associated with the Tate Mine post date 1900 and are not covered by the provisions of the Historic Places Act 1993. Instead it is recommended features impacted by the proposed TTTSF are recorded in accordance with accepted best archaeological practice in order to mitigate effects.

Back Road Waste Rock Stack

The key archaeological feature originally located within the area of the proposed site for the Back Road Waste Rock Stack is a large trench associated with the workings of the Duke of Edinburgh reef. The feature is a good example of the remnants of mining associated with the Duke of Edinburgh Mine. The trench is over 200m long and is considered to be in good condition. Early survey work revealed that this important feature was located immediately adjacent to the area of the proposed Back Road Waste Rock Stack. Once OceanaGold was made aware of this it took immediate steps to amend the design of the proposed Waste Rock Stack. The amended Waste Rock Stack will now avoid any physical impact on this section the Duke of Edinburgh Mine.

Many of the remaining features in this area (primarily identified by Nichol and Wright 2009) are of limited archaeological value on their own as they represent isolated prospecting pits or small areas of working. Any work that will impact on these features will require an authority to modify archaeological sites under the provisions of the Historic Places Act 1993. Therefore, now that effects on the large trench have been avoided, the effects of BRWRS are less than minor.

Frasers South and Frasers North Waste Rock Stack

No sites identified in the survey within this area will be affected by the proposed work. The historic survey trig site (I42/41) located adjacent Golden Bar Road should not be affected by the physical works associated with the proposed extensions.

Frasers Pit Extension

The key site that will be affected by the proposal to extend Frasers Pit is the Robinson Homestead. The pit has advanced so that it is now within 20m of the site. The long term survival of this feature has been effectively compromised.

As the site cannot be avoided as part of the Frasers Pit extension it will be necessary to apply to the Historic Places Trust for an authority to modify the site. It is recommended that prior to undertaking further work that may impact on the site a detailed photographic record and record of all structures is complied by a suitably qualified building archaeologist.

There is also potential for subsurface deposits associated with the use of the buildings to exist in the area. An authority to modify the archaeological site will be required from the Historic Places Trust. It is recommended that in association with the development of mining operations in this area, discussions are held with an appropriately qualified archaeologist and representatives of the Historic Places Trust in order to determine an appropriate manner of identifying, investigating and recording any such deposits.

7.5.2 General Heritage Mitigation Recommendations

As discussed previously in section 4.4 OceanaGold has developed a Heritage Management Plan to guide the management of historic resources on land OceanaGold manages. The archaeological survey recommends that this plan be updated to include policies identifying the need for appropriate long term management for sites identified for long term protection. This would ensure that sites of high priority or heritage values are excluded from any areas of proposed mine development, preventing the progressive loss of historic sites in the Macraes area over time as well as being appropriately managed. It is proposed that this be undertaken in consultation with the New Zealand Historic Places Trust.

Summary

The proposed MPIII expansion will affect some historic features in the area. These features have varying archaeological value. OceanaGold has already taken steps to avoid impacting some important features (site I42/157 and trenching associated with the Duke of Edinburgh reef) by amending some design aspects of the project. OceanaGold will continue to avoid significant historic features where possible. In situations where effects on these features can not be avoided OceanaGold will take appropriate steps to mitigate any effect. Mitigation will include recording, sampling and analysing features in accordance with accepted archaeological best practice. Where appropriate, representative examples of the features will be preserved. Sites that are subject to destruction will be surveyed and investigated in detail in accordance with any Authority that may be issued by NZHPT.

7.6 Greenhouse Gas Emissions Impacts

There are no mandatory regulatory or statutory requirements to specifically consider the impacts of the mine's energy consumption upon the release of GHG emissions and the subsequent contribution that those emissions have upon climate change.

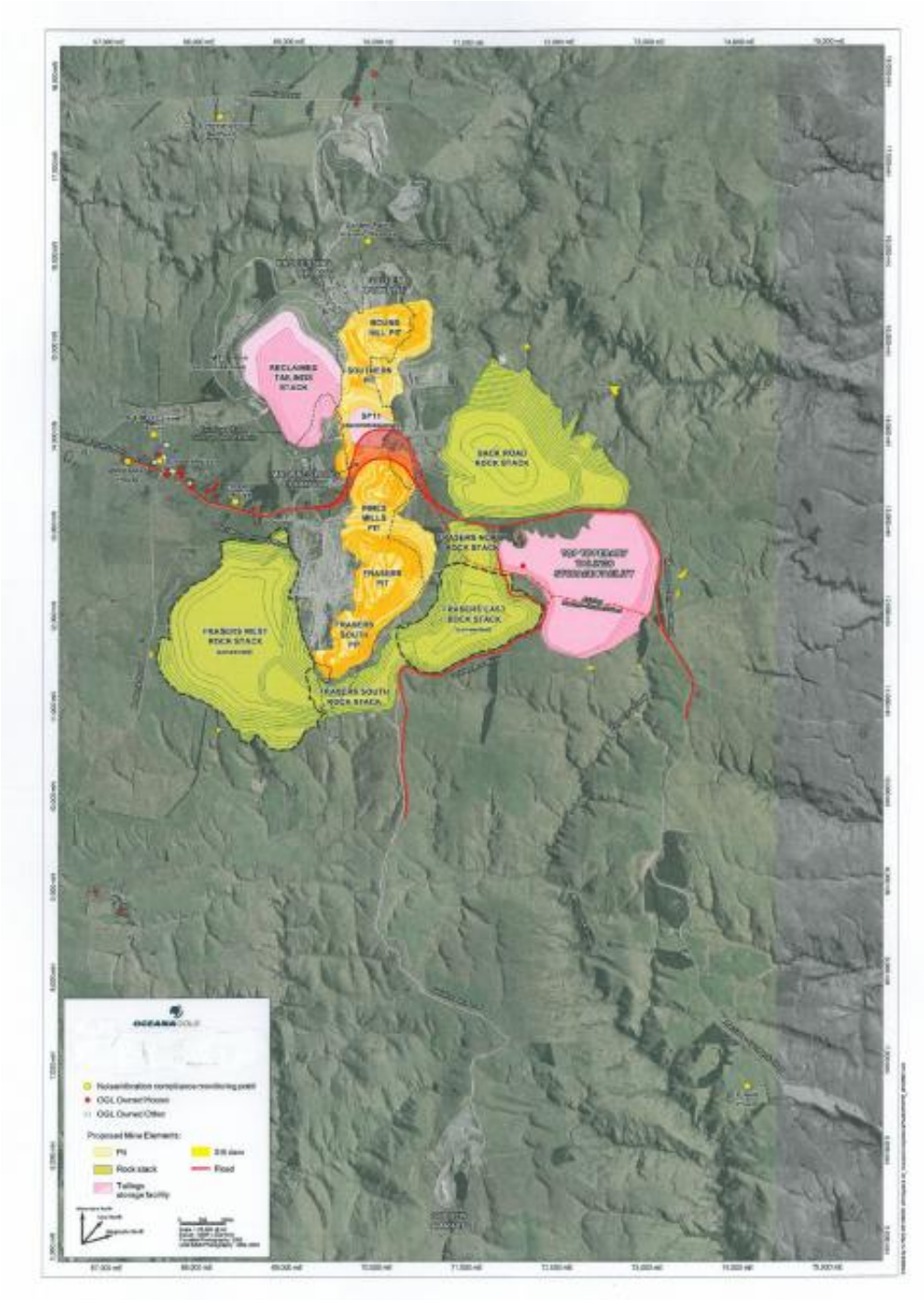
However, OceanaGold has assessed the implications of the Macraes Phase III project on energy consumption and the consequent emission of GHGs (see "Oceana Gold, Macraes Gold Project Emissions Estimation- Macraes Phase III Mine Development" report attached as Appendix 32). The various haul route options for the Macraes Phase III project have been modelled to determine the fuel burn rates and consequent GHG emissions for each haul route option. The results of this modelling indicate that the GHG emissions associated with re-haulage of materials from the deconstruction of the SP11 Wall (Qtr 1 2012 to Qtr 3 2014) and tailings removal in conjunction with development of the Round Hill Pit will be the most efficient in terms of fuel burn and therefore GHG emissions. The waste rock sourced from each pit is being transported to waste rock stacks that require the least fuel burn and therefore the lower GHG emissions compared with other alternate options.

8. Affected Person/Consultation

8.1 Affected Residences

Houses that are owned by OceanaGold and therefore are not affected are shown on Map 2.

Figure 9: Oceana owned houses



Non OG owned residences in the immediate vicinity of the mine includes:

- Howard house situated on Macraes-Dunback Road (mine side of the village)
- School House – situated opposite the Macraes School
- Beekeeper House – situated on the Hyde side of the Macraes village
- R and M O'Connell House – situated at the end of the road past the school (past the village)
- C and E Howard – Bellfield – Horse Flat Road
- P Neill – situated near the corner of Ritchie Road and Macraes-Dunback Road – to the south of the mine

This assessment has taken into account the effects of MPIII on these residences.

8.2 Consultation Undertaken

OceanaGold has identified the following parties as potentially being affected by the proposed MPIII expansion. OceanaGold have consulted with these parties during the course of its evaluation of options and alternatives. OceanaGold has met with these parties and supplied them with the relevant information to enable them to understand how they are impacted by the MPIII project.

The Howard family

The proposed Camp Creek Reservoir is located on land owned by the Howard Family. OceanaGold have met with Colin Howard, on several occasions (23 September 2010, October 2010, 19 January 2011, 7 February 2011, 2 March 2011, 4 April and 20 April 2011) to discuss the MPIII proposal. The parties have reached an in principle agreement to allow construction of this reservoir that will be finalised within the next month.

Sid and Glenda Heckler

Mr and Mrs Heckler own property downstream of the proposed TTTSF. OceanaGold have briefed Mr and Mrs Heckler on the MPIII project. The downstream water quality aspects of the TTTSF, as outlined in the Golders report, were discussed at the briefing. Discussions about appropriate mitigation for water quality effects are ongoing.

Ray and Mary O'Connell

Mr and Mrs O'Connell own land to the west of the Macraes Village. The house on this property looks directly towards the MTI. OceanaGold met with Mr O'Connell on 29 September and 31 March 2011 to discuss the proposed MPIII project.

NZ Historic Places Trust (NZHPT)

OceanaGold met with Matt Schmidt from NZHPT on 1 October 2010 to brief NZHPT on the MPIII project. No major archaeological issues were raised at that meeting. OceanaGold again met with NZHPT on 10 March 2011 to review the "Archaeological Summary – Macraes Phase III". The report writer Cathryn Barr was also in attendance (via telephone). NZHPT indicated that in general it was happy with the assessment. Options for the long term protection of sites was also discussed and further meetings have been arranged between HPT and OceanaGold to address this. NZHPT met again with Cathryn Barr and OceanaGold on site on 5 April to inspect heritage sites potentially effected, or that could be

protected in perpetuity as part of the wider mitigation strategy related to the Heritage Management Plan.

Within 6 months of receiving consents OceanaGold will provide a revised Heritage Management Plan.

Consultation with NZHPT on appropriate heritage sites to protect will continue post lodgement.

Department of Conservation (DoC)

OceanaGold met with Robin Thomas from DoC on 27th September 2010 to provide a general overview of MPIII. The only potential issues he could identify were the impact of the completed freshwater dam on Gallaxias in Deepdell Creek and any potential impact on Tipperary Gallaxias. The impact on Gallaxids is discussed in the "Oceana Gold Macraes Gold Phase III Project – Aquatic Ecology Assessment" **attached** as Appendix 5. The report concludes that MPIII will not have significant adverse effects of the Gallaxids population.

On the 25 February DoC were sent the draft ecology reports (Terrestrial fauna, Botanical and Aquatic Values). OceanaGold met with Cornelias Kater, Murray Neilson, Shar Briden, Bruce Hill and Andy Hutcheon from DoC on 10 March 2011 to provide greater detail on the project and to discuss the draft ecology reports, DoC provided its comments prior to the lodging of this application which were incorporated to the final drafts to the extent practicable.

Post lodgement consultation with DoC will be undertaken to identify appropriate areas to protect as part of OceanaGold's ecological mitigation.

Macraes Community Incorporated (MCI)

OceanaGold has met with the wider Macraes Community and their representatives, Macraes Community Incorporated (MCI), on a number of occasions to discuss the MPIII project and a revised mine closure strategy (the Macraes Community Development (MCD) Strategy).

Consultation with the wider Macraes Community commenced on 22 September 2010 with an open forum discussion around community tourism and sustainability ideas with Jimmy Young from Tourism Resource Consultants Limited (TRC Ltd).

OceanaGold then held a public meeting with the wider Macraes Community on 24 September 2010 to present a summary of the proposed MPIII project. At this meeting the community expressed their desire to discuss the project at their own meeting, before meeting with OceanaGold to discuss further.

A further public meeting was held on 19 November 2010 between OceanaGold and the wider Macraes Community, to discuss ideas for an alternative strategy to replace the Heritage and Art Park (HAP) strategy. OceanaGold agreed at this meeting to prepare a formal strategy for community consultation.

At a meeting on 9 February 2011, OceanaGold tabled the revised mine closure strategy (the MCD Strategy) with MCI. Further meetings were held on 4 March, 8 and 20 April 2011 and OceanaGold has now gained in principle agreement from MCI on the main elements of the MCD Strategy.

Waihemo Community Board

OceanaGold attended a meeting on 18 April 2011 to brief Board members about the project.

8.3 Kati Huirapa ki Puketeraki

8.3.1 Past Consultation

The Runaka have been consulted on all of OceanaGold's previous major developments at the MGP (including 1993 – Macraes Extension; 1996 – Macraes Gold Project Expansion; 2001 – Heritage and Art Park; 2002 – Golden Bar Pit Development; 2005 – Frasers East WRS and others). In the past the Runaka has acknowledged that the MGP does not give rise to significant cultural issues and does not directly affect the Runaga's interests.

In 2003 Te Runaka o Otakou submitted in opposition to OceanaGold's application to increase the footprint and height of the Frasers West Waste Rock Stack. It requested that a Cultural Impact Assessment ("CIA") be undertaken by OceanaGold. In response OceanaGold prepared a cultural assessment to provide the ORC with an understanding of the cultural effects of the proposed FWWRS consents. The assessment concluded that the proposed variation would not impact on tangata whenua's cultural, spiritual or historical association with the land and water. This assessment was accepted by the ORC.

8.3.2 MPIII Consultations

OceanaGold has meet with Runaka representatives on several occasions to brief them on the MPIII project. The initial MPIII project briefing occurred on 5 October 2010 with a follow up meeting on 1st February 2011 to update the Runaka on MPIII's progress. Although the Runaka initially indicated to OceanaGold a CIA would not be necessary, relatively recently the Runaka changed its position and requested a new CIA.

The Runaka indicated that it wanted to prepare a CIA. The time period required to complete a CIA would mean a significant delay in OceanaGold lodging this application.

In response OceanaGold proposed to prepare an interim summary of anticipated cultural issues related to MPIII and the Runaka could then undertake a formal CIA while MPIII was being processed. In order to take into account the findings of the formal CIA OceanaGold offered the following review condition, to be undertaken at the consent holder's cost, to ensure the Council can initiate a review of the mitigation conditions based on the findings of the final CIA:

> *'The Council may, within 6 months of receipt of the Cultural Impact Assessment prepared by Kāti Huirapa ki Puketeraki; serve notice of its intention to review the conditions of this consent for the purpose of amending or adding conditions to address mitigation of the effect of Macraes Phase III on cultural values and associations".*

If the CIA concludes there are adverse effects of the MPIII Project on ancestral landscapes, awa (rivers), taonga, indigenous vegetation and habitats of indigenous fauna that have not been mitigated, they can be mitigated through the process of reviewing the consent conditions, if it is appropriate to do so in order to ensure the MPIII Project promotes sustainable management.

The Runaka considered OceanaGold's proposal. By letter dated 8 April **attached** as Appendix 33 the Runaka accept OceanaGold's suggested way forward.

9. Monitoring and Mitigation

9.1 Existing Monitoring

OceanaGold has an extensive environmental monitoring programme which includes compliance monitoring as required by resource consents and additional in-house monitoring. The monitoring undertaken by OceanaGold has resulted in an enormous amount of environmental data which has informed the technical assessments supporting these applications. This same information is also reported to the consent authorities as required by existing resource consents. In some cases records extend over 20 years. Over this period OceanaGold has reported a small number of exceedences. These have generally been of a minor nature or related to a technical non-compliance. Examples of this are where duplicate compliance limits exist for the same site or where compliance limits have been set for sites that have historically been above the limit for certain parameters. No enforcement or abatement action has ever been taken in relation to the Macraes Mine. There has been no material offsite environmental impact.

9.2 Proposed Monitoring

Monitoring proposed as part of MPIII is consistent with monitoring already undertaken at the mine.

There are a number of inconsistencies and inaccuracies in some of the existing monitoring conditions and the opportunity will be taken to standardise and update these as part of the MPIII application process.

9.2.1 Water

Water

The progressive development of the MGP has resulted in a range of compliance points related to different sections of the mine. In some cases these compliance points are now unnecessary or will become unnecessary if the proposed compliance monitoring regime recommended by Golder in the "Water Management Summary Report" (**attached** as Appendix 8) is approved. The proposed compliance monitoring regime includes:

- New compliance monitoring points downstream of the BRWRS and the TTTSF.
- Removal of unnecessary compliance monitoring points on Deepdell Creek and the NBWR.
- Shifting of one compliance monitoring point in Murphys Creek.

The proposed surface water quality compliance points are outlined in Table 17 of the "Water Management Summary Report" **attached** in Appendix 8

Table 17: MGP surface water quality compliance criteria.

Compliance Point	Potential usage	pH (unitless)		Arsenic		Cyanide WAD		Copper [6]		Iron		Lead[6]		Zinc[6]		Sulphate	
		current	proposed	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed	current	proposed
Deepdell Creek DC07 [1]	Stock watering	6 – 9.5	-	0.15	-	0.1	-	0.009	-	1	-	0.0025	-	0.12	-	1000	-
Deepdell Creek DC08 [1]	Stock watering	-	6 – 9.5	-	0.15	-	0.1	-	0.009	-	1	-	0.0025	-	0.12	-	1000
Shag River at Loop Rd [1]	Drinking	7 – 8 .5	7 – 8 .5	0.01	0.01	0.1	0.1	0.009	0.009	0.2	0.2	0.0025	0.0025	-	0.12	250	250
Shag River at McCormicks	Drinking	-	7 – 8 .5	-	0.01	-	0.1	-	0.009	-	0.2	-	0.0025	-	0.12	-	250
North Branch Waikouaiti River NBWRRB [2]	Stock watering	6 – 9.5	6 – 9.5	0.15	0.15	-	0.1	0.009	0.009	1	1	0.0025	0.0025	0.12	0.12	-	1000
North Branch Waikouaiti River NBWRRF [2, 3]	Stock watering	6 – 9.5	-	0.15	-	-	-	0.009	-	1	-	0.0025	-	0.12	-	-	-
Murphys Creek MC100 [2, 4] (upstream)	Stock watering	6 – 9.5	-	0.15	-	-	-	0.009	-	1	-	0.0025	-	0.12	-	-	-
Murphys Creek MC01 [2, 4] (downstream)	Stock watering	6 – 9.5	6 – 9.5	0.01	0.15	-	-	0.0014	0.009	1	1	0.0025	0.0025	0.12	0.12	-	1000
North Branch Waikouaiti River NB03 [5]	Drinking	6 – 9.5	6 – 9.5	0.01	0.01	-	-	0.009	0.009	1	1	0.0025	0.0025	0.12	0.12	-	250
Cranky Jim Creek CJ01	Stock watering	-	6 – 9.5	-	0.15	-	0.1	-	0.009	1	1	-	0.0025	-	0.12	-	1000
Tipperary Creek TC01	Stock watering	-	6 – 9.5	-	0.15	-	0.1	-	0.009	1	1	-	0.0025	-	0.12	-	1000
Current Guidelines and Standards																	
ANZECC (2000) stock water	Guideline			0.5		NA		0.5	sheep	NA		0.1		20		1000	
NZDWS (2008)	Guideline or Standard	7 – 8.5	(GV)	0.01	(MAV)	0.08	(MAV total)	2	(MAV)	0.2	(GV)	0.01				250	

Notes: All units g/m^3 unless otherwise stated.

1) Current compliance standards from ORC Resource Consents 2006.304, 2006.305, 2006.307, 2006.308.
2) Current compliance standards from ORC Resource Consents 2006.635, 2003.636, 2003.637, 2003.638, 2004.362, 2005.208, 2005.209, 2005.210, 2007.583.
3) Ross Ford NBWRRF compliance point proposed to revert to monitoring only, in favour of downstream compliance point NB03.
4) MC100 compliance point proposed to revert to monitoring only. Compliance limits currently applicable to MC100 to be applied at MC01.
5) Current compliance standards from ORC Resource Consents 2002.491, 2002.759, 2002.763. NB03 becomes final downstream compliance point on the NBWR for all MGP operations.
6) Metal limits hardness adjusted as per equations 1 to 3 below.

ANZECC (2000) drinking water quality guidelines for livestock.
NZDWS (2008) drinking water standards for human consumption
MoH (2008) drinking water limit equivalent to the maximum acceptable value (MAV) given in MoH (2008); MAV for total cyanide, short term.

Trace metal compliance criteria hardness corrections.

1) Copper (g/m^3) = $(0.96\exp^{0.8545[\ln(\text{hardness})] - 1.702}) / 1000$

2) Lead (g/m^3) = $(1.46203 - [\ln(\text{hardness})(0.145712)]\exp^{1.273[\ln(\text{hardness})] - 4.705}) / 1000$

3) Zinc (g/m^3) = $(0.986\exp^{0.8473[\ln(\text{hardness})] + 0.884}) / 1000$.

The water quality compliance limits are proposed to be standardised across the sites. No water quality parameters have been removed from the list of parameters to be measured, however at some sites new parameters have been added as part of the standardisation.

It is expected that monitoring will be required around the TTTSF for groundwater sampling purposes. Compliance wells may be installed close to the receiving water bodies to confirm that contaminant losses to creeks are within acceptable limits.

In terms of the primary contaminant discharge routes it is proposed to install detection wells in Tipperary Creek upstream of the proposed Tipperary sump. Compliance wells are proposed to be installed downstream from the Tipperary sump to verify that contaminant losses from the TTTSF are being collected in the sump. Detection and compliance wells may also be installed downgradient from the TTTSF embankment where it overlooks the western tributary of Tipperary Creek and Cranky Jim's Creek. These wells would be used to verify the nature of the contaminant flows in each of these directions.

Monitoring of groundwater pressures along the catchment divide between Tipperary and Deepdell Creeks may be undertaken to monitor the positioning of the hydraulic catchment divide during and immediately following the operational period of the TTTSF. This monitoring would provide data to verify that contaminants from the TTTSF are not transported in the direction of Deepdell Creek.

9.2.2 Biological

OceanaGold propose to continue the aquatic biology monitoring programme that has been undertaken to date. Quarterly monitoring of macro-invertebrates and periphyton, along with a summer electric fishing survey at a series of control and impact sites has been completed since 1990. The results of each years monitoring are compiled into an annual report.

As a result of the MPIII project and the recommendations of Ryder Consulting Ltd the following aquatic biology monitoring programme is proposed;

Existing Sites

- Deepdell Creek at DC01 (TC), upstream of the mine area,
- Deepdell Creek at DC03 (Site E), downstream of the confluence with Maori Tommy Gully,
- Deepdell Creek at DC 07 (Site L), downstream of the confluence with Northern Gully,
- Northern Gully at NG01, close to confluence with Deepdell Creek,
- Tipperary Creek at TC01, downstream of the Top Tipperary Tailings Storage Facility (I42:147332),
- Murphys Creek at MC100 (MC1), approximately 100 metres downstream of mining activities,
- Murphys Creek at MC01 (MC2), at Murphys tailings ford (I42:129312),
- North Branch of the Waikouaiti River at NBWRRF, at Ross Ford (I42:109289),
- North Branch of the Waikouaiti River at NB03 downstream of the confluence with Golden Bar Creek.

Additional Sites

§ Deepdell Creek at DC00, upstream of the confluence with Camp Creek,
§ Deepdell Creek at DC 08 (Site M), downstream of DC 07,
§ Tipperary Creek at TC01, downstream of the Top Tipperary Tailings Storage Facility (I42:147332),
§ McCormicks Creek at TC02, downstream of TC01 (I42:182324),
§ Cranky Jims at CJ01, at Hocking Road stone culvert (NZTM E1404263 N4976044),

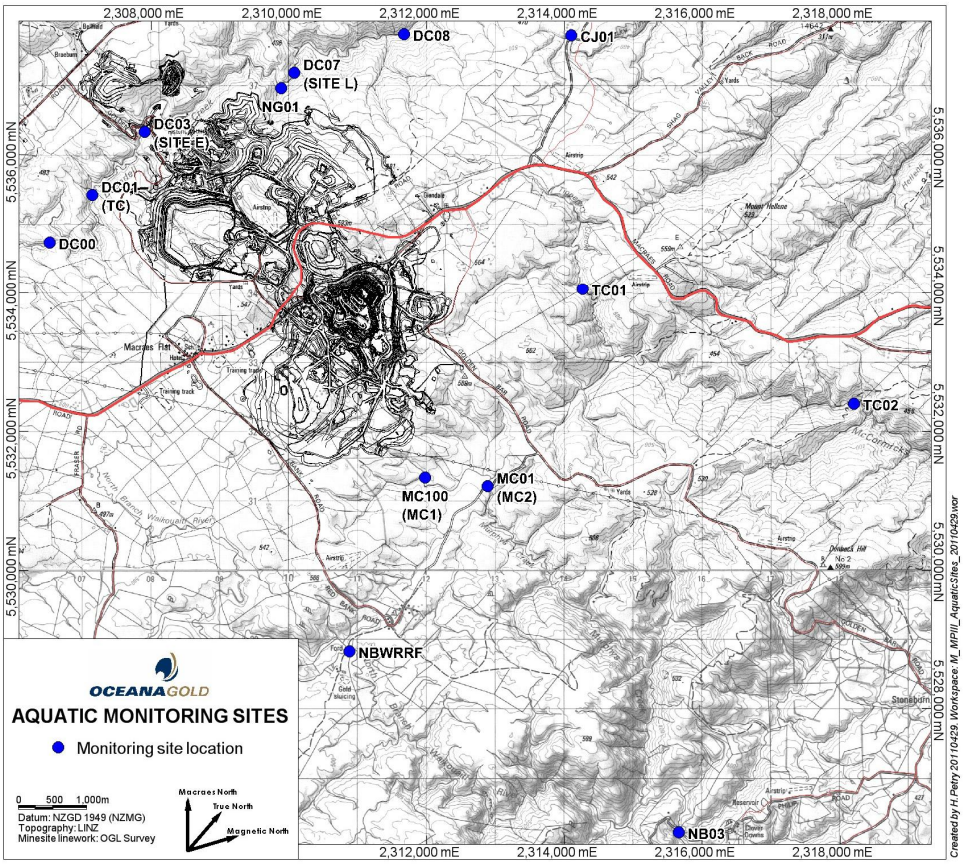
Ryder Consulting Ltd have recommended the following sites be removed from the monitoring programme, mainly due to unsuitability of the site or due to a new site being proposed that better reflects the water body and potential impacts;

- North Branch of the Waikouaiti River at NBWRRB, at Red Bank Road
- Unnamed Creek, whose confluence with Deepdell Creek is located at Map Reference NZMS 260 I42:073 350
- Deepdell Creek, upstream of the mine area at C2 (just downstream of DC01 (TC)
- Battery Creek, close to confluence with Deepdell Creek

No monitoring of the Shag River at Loop Road or McCormacks Creek confluence is proposed as it is considered that monitoring of Deepdell Creek and McCormacks Creek further upstream would intercept any impacts long before they would be detectable in the Shag River.

The proposed monitoring sites are shown on Figure 9.

Figure 10: Proposed Aquatic Monitoring Sites



9.2.3 Air

OceanaGold proposes to continue to use similar monitoring methods to those that are currently employed, but with some improvements as discussed below. OceanaGold also proposes some changes to the locations of the monitoring sites as some monitoring sites (5 and 14) will need to be removed when the Back Road WRS and TTTSF are constructed and others are no longer relevant.

TSP Monitoring

Since the first consent was granted to OceanaGold commercially realistic monitoring methods for TSP have improved and there are now cost effective continuous monitors available which have significant advantages over High Volume Samplers. Real time dust monitors combined with wind sensors provide instantaneous measurements of dust concentrations and the direction from which the dust is coming. Continuous dust monitors can also be used by plant operators to modify operations if dust levels are high and to trigger the operation of dust mitigation systems.

OceanaGold proposes to remove all three High Volume Samplers from use and install a continuous TSP sampler at site 15 in Macraes Flat Village. OceanaGold has not finalised an instrument but it is likely to be a nephelometer. Nephelometers are able to provide instantaneous real time measurements of particulates, but they do have some limitations. The main limitation is that the instrument response depends on both the particle size distribution and the number of particles, rather than the total mass of airborne particulate. Hence they cannot be used for measuring ambient concentrations of PM_{10} for comparison with the NES. For this application the measurements of TSP will not need to be compared to a national standard so this should not be a problem.

Nephelometers are available that include their own filter sampling system to enable periodic gravimetric measurements to be made. The filter samples taken can be used to provide a correlation between the continuous instrumental results and the total mass of particulate collected by the filter paper. The particulate collected on the filter paper can also be used for analysis if required. If OceanaGold does install a nephelometer at site 15 OceanaGold will operate the new instrument adjacent to the existing High Volume Sampler for a period of twelve months so that a correlation can be developed between the new instrument's readings and the existing High Volume Sampler readings.

It is proposed that at site 15 in Macraes Flat Village instruments are installed to replace the High Volume sampler that can measure and calculate the following statistics:

- Hourly average TSP concentrations;
- 24 hour average TSP concentrations;
- Meteorological data (wind speed, wind direction and rainfall); and
- Results of correlations between continuous measurements and nephelometer gravimetric filter samples, if a nephelometer is used to measure TSP.

The TSP High Volume sampler at Howards has recorded consistently low TSP concentrations with the exception of one occasion when unusually high results were recorded in January 2005. This reading was significantly higher than all other 24-hour averages and may have been due to dust sources other than the mine. The site is located more than 1km northwest of active mining areas and winds from the southeast, which would carry dust from the mine to this site, are infrequent. Furthermore the new mining activities proposed in this application will move active mine areas further from the Howards site. It is therefore considered appropriate to cease monitoring TSP at this site.

The TSP monitoring site located at Suttons will be engulfed by the new mining activities and will need to be removed. OceanaGold has considered establishing a new TSP monitoring site to the southeast of the new mining activities. However, the nearest house will be approximately 6.8km from the eastern-most extent of the new works and unlikely to be affected by dust from the mine. Consequently it is considered unnecessary to monitor for TSP to the southeast of the mine.

Deposited Dust Monitoring

The areas of active mining have changed since the original air discharge consent was granted and if this proposal is approved the active mining areas will move more towards the east. Consequently some monitoring sites are no longer relevant and some new sites may be required. As noted earlier, sites 5 and 14 will be engulfed by the new works if they are approved.

It is proposed to retain the monitoring sites that are located in close proximity to Macraes Flat Village (sites 2, 11 and 15). These gauges are located in the area that is most sensitive to dust emissions.

Sites 17, 7 and 6 are located to the northwest of the active mining area. Low dust levels have been recorded at these sites and mining activities will move further to the east if this proposal proceeds. It is recommended that the number of sites in this area is reduced to two. It is recommended that site 17 is retained as it provides information regarding dustfall in the vicinity of residential premises and provides a good measure of background dust levels. It is also recommended that Site 7 is retained. It is located in close proximity to the proposed Camp Creek reservoir. Site 7 will provide a measure of the effects that may arise during construction of the reservoir.

Site 12 is located adjacent to Golden Bar Road and it is most likely that vehicle movements on this road impact on the dustfall recorded at this site. It is recommended therefore that site 12 is disestablished.

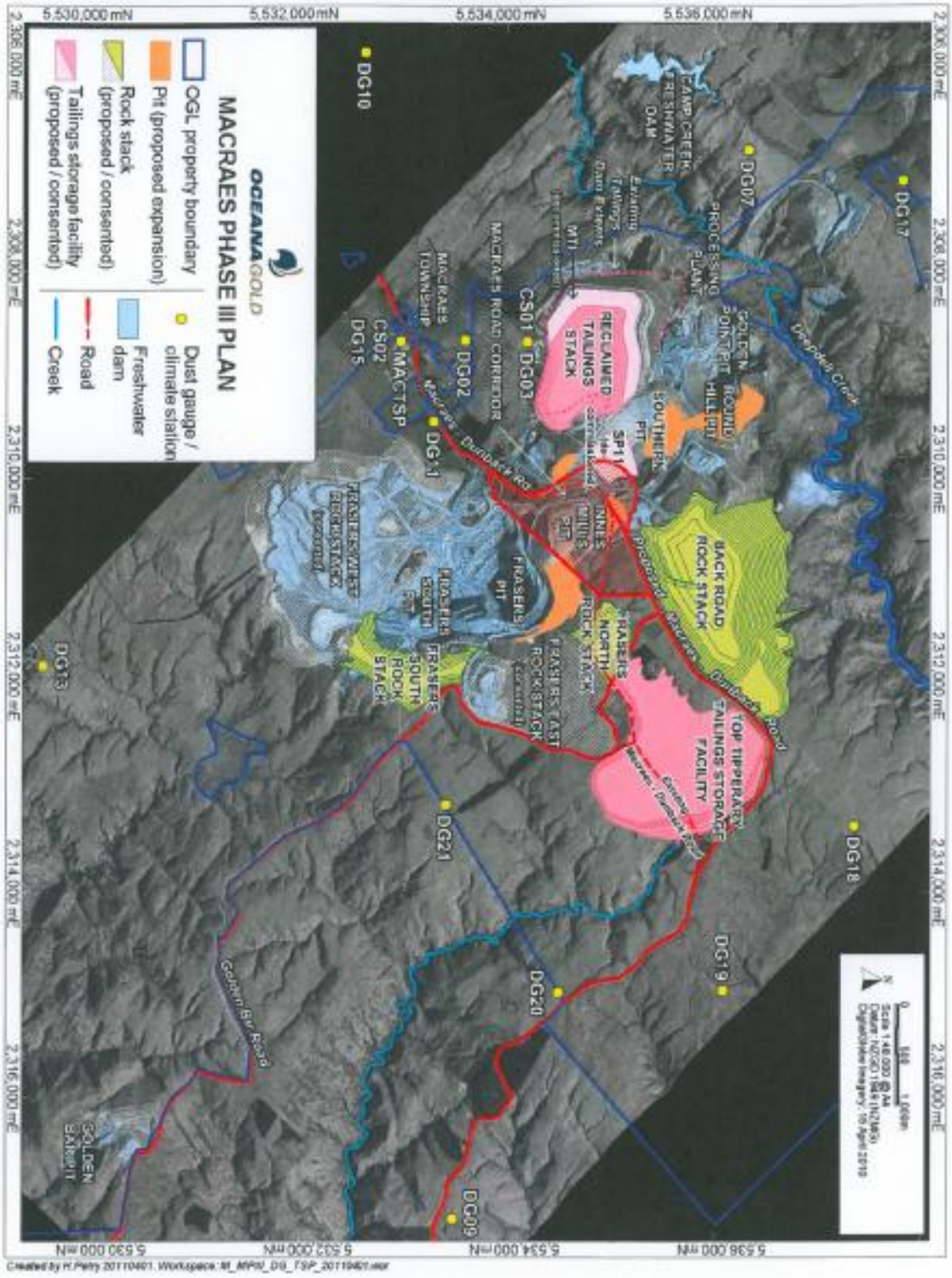
Site 13 is located to the south of Frasers West WRS. It is recommended that this site remain as a measure of dustfall to the south of the mine. This site has at times been used by OceanaGold to calculate background concentrations when data from sites 9 and 10 were not available. As this site is approximately 500m from active mining areas this is not recommended.

OceanaGold proposes to install four new dust gauge sites to the east, south and northeast of the Back Road WRS and the TTTSF. They will be numbers 18, 19, 20 and 21.

It is recommended that background concentrations should be determined by calculating the mean dustfall at sites 9, 10 and 17. Where one of these sites is unavailable (as a result of contamination) the mean background dust concentration should be calculated from the remaining available background sites.

A map showing the location of the modified monitoring site locations is shown in Figure 10.

Figure 11: Proposed Dust Monitoring Site Locations



9.3 Meteorological Monitoring

OceanaGold intends to continue to monitor meteorological conditions at the climate station located on Golden Point Road. In addition OceanaGold will establish a climate station in association with the continuous TSP monitor proposed for site 15.

The Golden Point Road climate station measures wind speed, wind direction, temperature, rainfall and solar radiation. The climate station proposed for site 15 will measure wind speed, wind direction, temperature and rainfall.

9.4 Noise

Monitoring of noise impacts arising from the MPIII Project is proposed to be consistent with current consent conditions for the Macraes Gold Project.

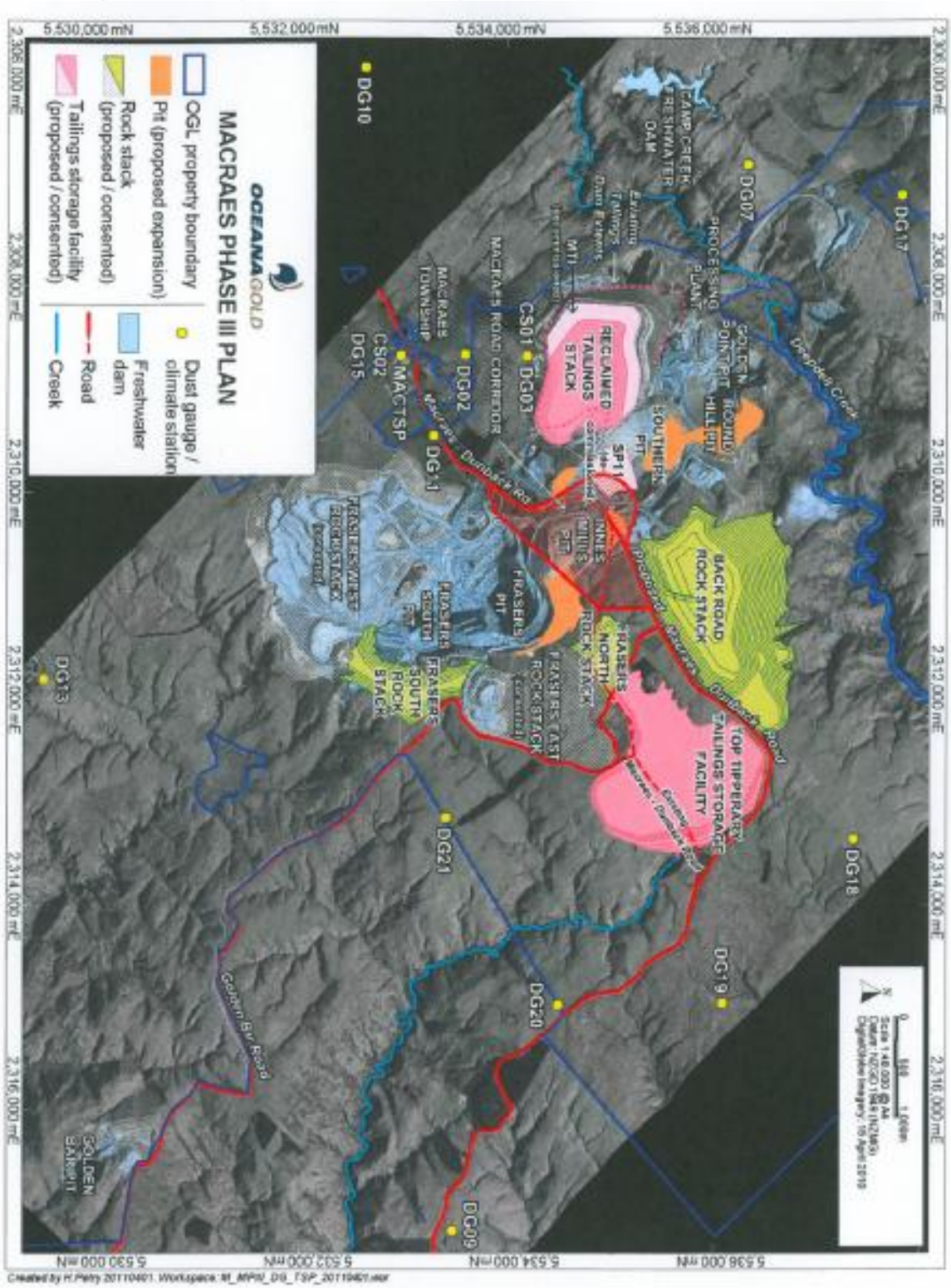
Noise will be measured at any point within the boundary of the Township Zone of Macraes; or at, the notional boundary of any dwelling in the Rural Scenic Zone. The notional boundary is defined as a line 20 metres from the exterior wall of any rural dwelling or the legal boundary where this is closer to the dwelling. Noise monitoring will be undertaken monthly and will focus on the non OceanaGold residences shown on Figure 11.

Noise limits will be as follows:

- On any day between 7 am to 9 pm (daytime): 50 dBA L_{10};
- On any day between 9.00 pm to 7.00am the following day (night-time): 40 DBA L_{10}; and/or 70 dBA L_{max}.

Where relevant, sound levels will be measured and assessed in accordance with the provisions of NZS 6801:2008 Acoustics - *Measurement of Environmental Sound* and NZS 6802:2008 Acoustics – Environmental Noise.

Figure 12: Proposed Blasting and Noise Monitoring Point Plan



9.5 Blasting

Vibration and airblast overpressure monitoring will be conducted at the monitoring locations shown on Figure 11. These are residences that are not owned by OceanaGold and are located outside of the Macraes Mining Mineral Zone. Monitoring will be conducted on a monthly basis and due to an extensive history of low blast monitoring results, will mainly target larger blasts.

Blasting shall be restricted to within the following hours:

- Monday-Friday 9am to 5.30pm
- Saturday and Sunday 10am to 4.30pm

Details of blasting method, strength of the blast and time of blast shall be entered into a record book kept for that purpose and shall be available to the Council on request.

Vibration due to blasting or any other activity associated with the mining operation, when measured at any point within the notional boundary of any dwelling, school or church outside the Macraes Mining Project Mineral Zone as defined by the Waitaki District Council's District Plan shall not exceed a peak particle velocity measured in the frequency range 3-12 Hz of 5 mm/sec provided this level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level shall not exceed 10 mm/sec at any time.

Airblast overpressure from blasting associated with the mining operation, when measured at any point within the notional boundary of any dwelling, school or church outside the Macraes Mining Project Mineral Zone as defined by the Waitaki District Council's District Plan, shall not exceed a peak non-frequency-weighted (Linear or flat) level of 115 decibels (dB), provided this level may be exceeded on up to 5% of the total number of blasts over a period of 12 months. The level shall not exceed 120 dB (Linear peak) at any time. For the purpose of this consent, C-frequency-weighting may be considered equivalent to the Linear or Flat-frequency-weighting.

The notional boundary is defined as a line 20 metres from the exterior wall of any rural dwelling or the legal boundary where this is closer to the dwelling.

9.6 Seismic/stability

The mining of Round Hill – Southern Pit will be subject to rigorous real time monitoring and a comprehensive management plan that includes a set of conditions to control mining of the pit.

An Operational, Maintenance and Surveillance Manual will be prepared to cover the existing and future monitoring requirements.

During and after the mining of Round Hill - Southern Pit the following additional monitoring is recommended:

- Monitoring of seepage rates from relief wells and pumpwells;
- Additional deformation monitoring at critical locations, including real time monitoring, and in the area of the Footwall Fault on and downstream of the MTI embankment;
- Additional piezometers installed within the tailings over the area underlain by the Footwall Fault and downstream of the MTI embankment crest;

- Ongoing geological mapping of the pit faces below the MTI and SP10 TSF

Additional monitoring required for the RTS on the MTI includes:

- Additional piezometers within the tailings
- Additional deformation monitoring stations on the crests of the RL 545 and RL539 upstream embankments

Further details of the above recommended monitoring can be found in the "Mining of Round Hill – Southern Pit, MTI, SP10,and SP11A Tailings Storage Facilities and Reclaimed Tailings Stack Technical report" (**attached** as Appendix 21).

Tailings Storage Facilities

The MTI, SP10 and SP11A TSFs have been extensively monitored using piezometers installed in the embankments and tailings, deformation prisms and measurement of seepage drain flows. In addition to this visual observations, tailings testing and decant pond water level monitoring is undertaken.

Details of the monitoring requirements are included in the respective Operations, Maintenance and Surveillance Manual's for each TSF. The manuals include specific monitoring required by consent conditions and specify trigger and alert levels for key instrumentation, provided by the Design Engineer.

A similar monitoring regime is proposed for the TTTSF and details of this will be finalised following preparation of a detailed design report for the TTTSF and subsequent preparation of an Operations, Maintenance and Surveillance Manual.

The geotechnical monitoring programme attached as Schedule II, Appendix 2 to the current resource consents for the MTI and SPI's has been reviewed and revised as part of the MPIII process and the requirements for the TTTSF have been added. Monitoring includes inclinometers, deformations, peizometers, visual inspections, seepage drain flows, decant pond levels, and tailings testing.

Monitoring data is currently summarised in a detailed Quarterly Geotechnical Monitoring Report however it is proposed to change this to an Annual Geotechnical Monitoring Review Report and to submit Quarterly Geotechnical Summary Reports. The quarterly reports will summarise data and provide confirmation that monitoring has been completed and checked against relevant trigger and alert levels with any variances or issues highlighted.

The following revisions are proposed to clarify and remove inconsistencies with the current monitoring programme:

- Removal of references to settlement markers. This is because the prisms that are required as part of the deformation monitoring are measured in three dimensions and therefore act as settlement markers;
- Revision of the timeframe for measuring key prisms after a significant rainfall event. Currently key prisms are required to be measured within 24 hours of a rainfall event in excess of 35mm in a 24 hour period (taken at 9am). It is proposed to change the timeframe to 48 hours on the basis that the impoundments will be visually checked as part of the visual inspection regime, that any response to a rainfall event is generally outside of the 24 hour period and that 48 hours gives a chance for the weather to clear for readings to be taken;

- Clarification of visual inspections; both the tailings and decant pipelines to be inspected once every 12 hour shift, and seepage outlets, sumps and valves to be inspected daily;
- Revision of drain flow monitoring to allow for monthly analysis of drains for conductivity and total suspended solids;
- Removal of the tailings surface survey requirement. This has been an ongoing issue due to the reliability of survey data of the surface being dubious and safety issues for personnel conducting the surveys.

9.7 Restoration/Rehabilitation

Existing consents require three yearly rehabilitation reviews to be completed which include ground cover, species components, plant nutrition status, soil organic matter and concentrations of exchangeable nutrients in the soil at pre-selected sites.

It is proposed to continue this monitoring for the life of the MPIII project.

10. Glossary

Annual Work and Rehabilitation Programme (AWRP)	The annual report prepared by OceanaGold for the WDC and ORC. The AWRP is provided to compliance authorities as a tool for ensuring a 'no-surprises' approach in relation to Oceana's forward work plan, environmental compliance, and rehabilitation. It contains the planned rehabilitation works to be carried out in the following calendar year including: an explanation of any departures from planned mining activities during the previous year; description of operations over the next year including detailed plans of proposed operations; description of any adverse effect that has arisen over the past year; description and evaluation of mitigation measures; a report of rehabilitation during the exercise of the consent and results; rehabilitation plan for the next year; plans for the next year showing actual contours at 5m intervals; calculation of costs to deal with any adverse affects on the environment; detailed calculation of costs of complying with all rehabilitation conditions of the consent; monitoring data; and bonding assessment and costs for rehabilitation and monitoring
Back Road Waste Rock Stack	An existing waste rock stack which will be expanded as part of Macraes Phase III. It has merged with the original Northern Gully (South) Rock Stack and it is proposed to hold approximately 230 Mt of additional waste rock as part of Macraes Phase III. Construction is scheduled to begin in the latter half of 2011.
Backfill	The waste material used to fill the void created by mining an ore body.
Camp Creek Freshwater Dam	Proposed freshwater storage dam on Camp Creek to store water for mining operations.
Concentrate	The dense product produced by milling, floating and thickening ore containing the valuable ore mineral, from which most of the waste material has been eliminated.
Decline	A sloping underground ramp providing access for underground mining operations from level to level or from the surface.
Exploration drilling	Drilling done in search of new mineral deposits, or extensions of known ore deposits, or at the location of a discovery up to the time when the company decides that sufficient ore reserves are present to justify commercial exploitation.
Frasers East Waste Rock Stack	A consented waste rock stack currently under construction, designed to contain approximately 92Mt of waste rock. Proposed for expansion as part of Macraes Phase III to contain approximately an additional 30 Mt of waste rock to the North and additional 50 Mt of waste rock to the South West.
Frasers North Waste Rock Stack	Proposed expansion of Frasers East Waste Rock Stack.
Frasers South Waste Rock Stack	Proposed expansion of Frasers East Waste Rock Stack linking with Frasers West Waste Rock Stack.

Frasers West Waste Rock Stack	A consented waste rock stack currently under construction, designed to contain approximately 250Mt of waste rock. Proposed as part of Macraes Phase III to contain an additional 30 Mt of waste rock within the existing consent footprint and maximum RL.
Grade	The mineral content of ore, expressed as grams per tonne for gold or percent sulphur
Hangingwall Shear	The boundary between mineralised HMSZ schist (Intrashear Schist) and unmineralised lower greenschist facies schist.
Haulage road	A road constructed for the primary purpose of transporting ore or waste rock with dump trucks or other large earth moving equipment.
Heritage and Art Park	Part of the consented closure plan for the mine area is the formation of a large park which will incorporate a range of small, medium and large artworks, historic sites, tracks, walkways and associated infrastructure, ecological features and items of interest from modern mining. The concept of the Park is to provide a visitor destination and aid community sustainability post mining. The closure plan for the mine including the Heritage and Art Park is proposed to be revised as part of Macraes Phase III.
Heritage Management Plan (HMP)	The plan prepared by OceanaGold for NZHPT with the objective of ensuring that identified heritage sites would only be modified or destroyed where no other reasonable means exists. The initial HMP was prepared in 1998 and has been periodically updated. The most recent update occurred in 2005.
High grade	Ore containing a high proportion of metal, relative to the rest of the deposit. The best ore in a deposit.
Hyde Macraes Shear Zone (HMSZ)	A major, low-angle (~15-20°) geological structure that contains the [main] Macraes [line-of-strike] gold deposits.
Indicated Mineral Resource	An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed.
Inferred Mineral Resource	An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes.
Locality	Defined area of low or nil population.

Macraes Phase III	The whole of the mining operations to be undertaken at Macraes, for which resource consents are sought in the current round of applications.
Measured Mineral Resource	A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity.
Mineral Reserve	A Mineral Reserve is the economically mineable part of a Measured or Indicated Mineral Resource demonstrated by at least a Preliminary Feasibility Study. This Study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A Mineral Reserve includes diluting materials and allowances for losses that may occur when the material is mined.
Mineral Resource	A Mineral Resource is a concentration or occurrence of natural solid inorganic or fossilized organic material in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge.
Mixed Tailings Impoundment	One of the two existing TSFs at Macraes, which contains a mixture of sulphide and oxide tailings.
Open pit	A mine that is entirely surface-based. Also referred to as open-cut or open-cast mine.
Ore	A mixture of ore minerals and rock or other material from which metal can be extracted at a profit.
Ore reserves	The calculated tonnage and grade of mineralization which can be extracted profitably; classified as possible, probable and proven according to the level of confidence that can be placed in the data.
Orebody	A natural concentration of valuable material that can be extracted and sold at a profit.
Oxide tailings	The tailings stream produced from processing oxidised ore sources, which generally contain few sulphide minerals due to the natural weathering of near surface rock.
Portal	The surface entrance to an underground mine.
Pressure oxidation (POX)	Treatment of re-ground concentrate in the autoclave, which was commissioned at Macraes in 1999. POX uses oxygen supplied by an adjacent cryogenic plant, to oxidise the sulphide component of the concentrate prior to leaching and

	recovery of the metal.
Probable reserves	Valuable mineralization not sampled enough to accurately estimate the terms of tonnage and grade.
Proven reserves	Reserves that have been sampled extensively by closely spaced diamond drill holes and developed by underground workings in sufficient detail to render an accurate estimation of grade and tonnage.
Reclaimed Tailings Stack (RTS)	A stack formed from dry tailings reclaimed from a tailings impoundment. As part of Macraes Phase III it is proposed to have two reclaimed tailings stacks – one within the boundary of the proposed Top Tipperary Tailings Storage Facility and the other on top of the existing Mixed Tailings Impoundment.
Recovery	The percentage of valuable metal in the ore that is recovered by metallurgical treatment.
Silt Pond	An impoundment formed for collecting sediment run-off from disturbed areas of the minesite. There are currently the Deepdell North, Deepdell South, Battery Creek, Northern Gully, Maori Tommy Gully, Frasers West, Murphys Creek and Clydesdale Creek silt ponds. Additional silt ponds, including the Tipperary Silt Pond are proposed as part of Macraes Phase III.
Southern Pit 11 (SP11) Tailings Impoundment	One of the two existing TSFs at Macraes, which contains only sulphide tailings.
Sulphide	A compound of sulphur and some other metallic element.
Sulphide tailings	The tailings stream produced from processing ore, containing sulphide minerals, recovered from below the oxide ore cap. The sulphide minerals are separated from the rock via the froth flotation process to produce a concentrate to be further treated to extract contained metals.
Tailings	The material that remains after all metals considered economic have been removed from ore during milling and subsequent processing.
Tipperary Silt Pond	A silt pond proposed as part of Macraes Phase III located downstream of the TTTSF.
Tailings Storage Facility (TSF)	A contained area, generally constructed using existing topography, designated for the purpose of depositing Tailings. At Macraes the existing TSFs are the Mixed Tailings Impoundment and Southern Pit 11 (SP11) Tailings Impoundment. Macraes Phase III will include a new TSF known as Top Tipperary Tailings Storage Facility (TTTSF).
Top Tipperary Tailings Storage Facility (TTTSF)	The new TSF proposed as part of Macraes Phase III
Waste	Non-mineralised rock, or mineralised rock that is not economically feasible to mine.

Waste Rock Stack	A rock stack, constructed according to an engineered design and designated for the purpose of depositing waste rock produced by mining. At Macraes the existing waste rock stacks are Deepdell, Northern Gully South, Northern Gully North, Back Road, Frasers West, Frasers East and Golden Bar Rock Stacks. Macraes Phase III will include the expansion of the Back Road Waste Rock Stack, Frasers East Waste Rock Stack and Frasers West Waste Rock Stack.

Abbreviations	
>	greater than
<	less than
=	Equal
%	Percent
±	plus or minus
‘	Feet
$	New Zealand dollars
º	Degrees
ºC	degrees Celsius
Ωm	ohm metres
3D	three dimensional
As	Arsenic
Au	Gold
AusIMM	Australasian Institute of Mining and Metallurgy
AWRP	Annual Work and Rehabilitation Programme
CIL	carbon-in-leach
CMA	Crown Minerals Act
DD	diamond drilling
DDH	diamond drill hole
Decline	an inclined tunnel that permits vehicular access to the economic portion/s of an underground mineral resource
DoC	Department of Conservation
DOSLI	Department of Survey and Land Information
Drive	an underground mine general term for a tunnel
E	East
ea	Each
EMS	Environment Management Strategy
EP	Exploration Permit
FBT	fringe benefit tax

FRUG	Frasers Underground
GCMP	Ground Control Management Plan
gcm^{-3}	grams per cubic centimetre
g/t	grams per tonne
GPS	global positioning system
GRD	Gold and Resource Developments Limited
HMSZ	Hyde Macraes Shear Zone
HNZEL	Homestake New Zealand Exploration Limited
HW	Hangingwall
Hz	Hertz
IGNS	Institute of Geological and Nuclear Sciences
km	Kilometre
km^2	square kilometre
koz	thousand ounces
kPa	Kilopascal
kt	Thousand tonnes
kW	Kilowatt
l	Litre
LHD	Load-Haul-Dump, specialised underground front end loader
LOM	Life of Mine
LOMP[08, 09, 10, etc]	Life of Mine Plan completed in late [2008, 2009, 2010 etc] relating to following years
ls	lode schist
m	Metre
m^3	cubic metre
M	Million
Ma	million years
MED	Ministry of Economic Development
MFZ	Macraes Fault Zone
ML	Mining Lease
MLOS	Macraes Line of Strike
mm	Millimetre
µm	micron / micrometre
MMCL	Macraes Mining Company Limited
Moz	million ounces

MP	Mining Permit
mE	metres East
mN	metres North
mRL	metres Relative Level
Mt	million tonnes
Mtpa	million tonnes per annum
N	North
NZ	New Zealand
NZHPT	New Zealand Historic Places Trust
NZMG	New Zealand Map Grid
NZSOLD	New Zealand Society on Large Dam
OceanaGold	Oceana Gold (New Zealand) Limited
OGC	OceanaGold Corporation
ORC	Otago Regional Council
oz	Ounce
ppb	parts per billion
ppm	parts per million
POX	pressure oxidation
QAQC	quality assurance, quality control
RC	reverse circulation
RCD	diamond drill hole with percussion pre-collar
RL	relative or reduced level
RLHOS	retreat long hole open stope
RMA	Resource Management Act 1991
ROM	run of mine
RQD	rock quality designation
SAG	semi-autogenous grinding
S	Sulphur
S^{2-}	sulphide sulphur
SO_2	sulphur dioxide
t	tonnes
TSF	tailings storage facility
TSP	total suspended particulate
TSFF	total sediment fine fraction
US	United States of America

US$	United States of America dollar
UHW	upper hangingwall
W	Tungsten
WO_3	tungsten oxide
WDC	Waitaki District Council