Summary of Operations and Expenditure.

General field reconnaissance/site visits  
Geologist/field assistant                   $3,200  
Sample analysis (grab samples)             1,250  
Consumables                                200   
Computer mapping                           2,200  
Office and Administration                   1,800  

Total                                      $8,650

Only minimal exploration was carried out in the previous year, consisting of field reconnaissance and random grab sampling, computer digitised mapping of the tenement in preparation for bulk sampling in 1978, and sample analysis.

Year two committed expenditure for Exploration Licence 9558

Field reconnaissance:

Geologist                                   $9,500  
Field assistant                             4,750  
Aircore rig                                  8,000  
Mob/demob                                   2,500  
Fuel                                        800   
Vehicle hire                                2,200  
Accomm/meals                                600   
Consumables                                  575   

sub total                                  $28,925

Sample analysis                             $9,500  
Transport/courier                           1,250  
Computer services/mapping                   2,800  
Office and Administration                    2,850  

sub total                                  $16,400

Contingency 10%                             1,640   

Total                                      $46,965

Year two program and budget provides for aircore sampling of the various creek beds within the tenement area. Mapping of the sampled areas and sample analysis is included in this program.
OLYMPIA RESOURCES NL

HALE RIVER GARNET PROJECT

CAPITAL & OPERATING COST ESTIMATES

Prepared by:
SIGNET ENGINEERING PTY LTD
SEPTEMBER 1997
1.0 EXECUTIVE SUMMARY

The Hale River region in the Northern Territory of Australia has a number of river and creek beds containing sand known to be a potential source of commercial grade garnet.

Olympia Resources NL (Olympia) wish to progress a study of the technical and commercial viability of the Hale River Garnet Project (the Project).

Signet Engineering Pty Ltd (Signet) have been requested by Olympia to conduct testwork, select a suitable process design route, and prepare capital and operating cost estimates, to an accuracy level of ± 15%, for the proposed process route. The cost estimates include the processing plant, associated infrastructure and the mining operations. Transport costs for the delivery of the product are excluded from the estimates.

The annual production of garnet from the proposed plant will be a minimum of 24,000 tonnes per annum.

The Project will produce garnet in three size fractions. These are:

- + 0.2 mm to - 0.5 mm.
- + 0.5 mm to - 0.8 mm.
- + 0.8 mm to - 1.5 mm.

Samples of the host sand were taken from a number of locations, primarily over a 14 km length of the Ongeva River. These samples were despatched to laboratories for testwork. At the laboratory, the samples were composited to obtain a single sample for the testwork programme. These were considered representative of the area sampled however, a more exhaustive sampling and resource assessment programme needs to be undertaken and further confirmatory testwork will need to be carried out on samples taken during this programme. Resource assessment is outside the scope of this report.

A testwork programme was designed based on the unit processes required to separate the garnet from the host sand. This involved magnetic separation testwork conducted at MD Mineral Technologies in Queensland and air table testwork at Satake in New South Wales.

The process route developed by Signet involves dry processing. The sand will be mined from the river bed by front end loader and trucked to the processing plant. At the plant it will be screened to remove the oversize (+ 3 mm) material, then dried and screened to the desired size fractions and remove the + 1.5 mm material. The sand will then be treated through a series of magnetic separators and air tables to remove the non-magnetic fractions and the lighter fractions from the garnet. The process is designed to upgrade the sand to a marketable product containing greater than 95% garnet.

The waste material will be conveyed from the plant to a storage bin from where it will be loaded into trucks and returned to the river bed and redeposited.
The garnet product will be bagged into 2 tonne bulk bags, which will then be transported to either Darwin, Townsville and Adelaide for distribution. Olympia intend to commission a separate study into the transport and distribution of the product.

The process plant consists of four areas: screening, magnetic separation, air tables and services. The entire plant is contained within one building. A building has been incorporated to ensure the material remains dry for processing through the magnetic separators and air tables. Extensive use of bucket elevators for material transfer has been incorporated to keep the building height and floor area to a minimum.

The Project infrastructure will include an accommodation camp, communications, potable water supply, onsite power generation, an office for the resident manager/ supervisor, workshop/stores building and a small laboratory.

The estimated capital cost of the Project is A$9,500,000. The capital cost estimate is summarised and shown as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete and Earthworks</td>
<td>611,000</td>
</tr>
<tr>
<td>Structural Steel</td>
<td>1,264,000</td>
</tr>
<tr>
<td>Platework</td>
<td>150,000</td>
</tr>
<tr>
<td>Buildings</td>
<td>280,000</td>
</tr>
<tr>
<td>Mechanical Equipment</td>
<td>3,926,000</td>
</tr>
<tr>
<td>Piping</td>
<td>183,000</td>
</tr>
<tr>
<td>Electrical and Instrumentation</td>
<td>922,000</td>
</tr>
<tr>
<td><strong>Sub-total Direct Costs</strong></td>
<td><strong>7,336,000</strong></td>
</tr>
<tr>
<td>EPCM</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Temporary Facilities</td>
<td>90,000</td>
</tr>
<tr>
<td>Contingency</td>
<td>863,000</td>
</tr>
<tr>
<td><strong>Sub-total Indirect Costs</strong></td>
<td><strong>2,153,000</strong></td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td><strong>9,489,000</strong></td>
</tr>
</tbody>
</table>

The estimated operating costs for the Project are A$154.00 per tonne of product, based on annual output of 24,000 tonnes per annum of garnet using LPG and diesel as fuel sources. The operating costs are summarised in Table 1.2 below. The operating costs do not include loading and transport of the product from the site.

An alternative fuel source using naphtha condensate in the dryer and resite (fuel oil) for power generation reduces the cost to A$135 per tonne at a production rate of 24,000 tonnes per annum.
Table 1.2 - Operating Costs Summary - Base Case

<table>
<thead>
<tr>
<th>Cost</th>
<th>$/Annem</th>
<th>$/Tonne Garnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>730,000</td>
<td>30.42</td>
</tr>
<tr>
<td>Administration</td>
<td>144,000</td>
<td>6.00</td>
</tr>
<tr>
<td>Mining</td>
<td>845,358</td>
<td>35.22</td>
</tr>
<tr>
<td>Consumables</td>
<td>375,060</td>
<td>15.63</td>
</tr>
<tr>
<td>Fuel</td>
<td>1,481,201</td>
<td>61.72</td>
</tr>
<tr>
<td>Assay</td>
<td>90,750</td>
<td>3.78</td>
</tr>
<tr>
<td>Maintenance</td>
<td>33,000</td>
<td>1.38</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3,699,369</td>
<td><strong>154.15</strong></td>
</tr>
</tbody>
</table>

Table 1.3 - Operating Costs Summary - Alternate Option

<table>
<thead>
<tr>
<th>Cost</th>
<th>$/Annem</th>
<th>$/Tonne Garnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>730,000</td>
<td>30.42</td>
</tr>
<tr>
<td>Administration</td>
<td>144,000</td>
<td>6.00</td>
</tr>
<tr>
<td>Mining</td>
<td>845,358</td>
<td>35.22</td>
</tr>
<tr>
<td>Consumables</td>
<td>375,060</td>
<td>15.63</td>
</tr>
<tr>
<td>Fuel</td>
<td>1,025,008</td>
<td>42.71</td>
</tr>
<tr>
<td>Assay</td>
<td>90,750</td>
<td>3.78</td>
</tr>
<tr>
<td>Maintenance</td>
<td>33,000</td>
<td>1.38</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3,243,176</td>
<td><strong>135.13</strong></td>
</tr>
</tbody>
</table>

**Production Sensitivity**

The production rate of garnet and hence the operating cost is significantly influenced by the percentage of garnet within the plant feed.

By increasing the garnet head grade to 12.7% from 7.1%, the production of garnet increases to 34,000 tpa and the operating cost reduces to $115 per tonne of product for the base case and $96 per tonne for the alternate case.

The following assumptions were made in respect to this estimate of operating costs:

- The 12.7% garnet is based on assays of sand from the Plenty River. These were additional samples taken with the composite sample used within this report (see Table 2.7 in Appendix 5).
- The increase in head grade results in a 2% increase in recovery.
- Plant throughput remains at 80 tonnes per hour.
- Two additional air tables are required to process the additional garnet.
- The base case uses LPG and diesel for drying and power generation respectively.
- The alternative case uses naphtha condensate and reite for drying and power generation respectively.
1.0 INTRODUCTION

On behalf of Olympia Resources NL (Olympia), Signet Engineering Pty Ltd (Signet) have been engaged in March 1997 to conduct a feasibility study of proposed Garnet mining and processing operations at Hale River, some 100 km northeast of Alice Springs in the Northern Territory, Australia.

This report presents the results of a site visit and mining technical evaluation.

Site Visit

As part of proposed work to be conducted by Signet, an initial site visit was conducted over the period 20 - 22 June 1997. Parties to the site visit included:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Benger</td>
<td>Company Representative</td>
<td>Olympia</td>
</tr>
<tr>
<td></td>
<td>Mineral Resource Consultant</td>
<td></td>
</tr>
<tr>
<td>Allan Blair</td>
<td>Senior Mining Engineer</td>
<td>Signet</td>
</tr>
<tr>
<td>Ray Cary</td>
<td>Principal, Geologist</td>
<td>Northwind Resources Pty Ltd</td>
</tr>
</tbody>
</table>

All parties arrived in Alice Springs by air from Perth (Signet, Northwind) and Darwin (John Benger) on late Friday afternoon of the 20 June 1997. A hire Toyota Landcruiser vehicle and provisions were obtained and the party departed 9.00pm travelling by the southern, largely bitumenised Ross Road access to Ambalindum station (126 km, 72 km sealed), the billet for the weekend visit.

Two days were spent inspecting and collecting samples from the northern lease areas in the vicinity of Ongeva Creek, Plenty River and Mt Riddoch covered by exploration leases EL9191, EL9195 and EL9190 respectively under the direction of the client's representative Mr John Benger. The Ongeva Creek area provided the focus for sample collection of in excess of 100 kg for the purpose of metallurgical examination. Approximately 14 km of this creek was inspected and sampled by hand-dug pits sited approximately one kilometre apart. The brief visit concluded on late Sunday afternoon when the party drove back to Alice Springs via the northern Plenty Highway access road back to Alice Springs (164 km). This road is also bitumenised to within 2 km of the Ongeva Creek.

Objectives of the visit were to:

- gain initial understanding of site conditions, access, geological setting and general disposition of the resource
- obtain samples for initial testwork from area nominated by Olympia for initial mining activities to satisfy 5 years production at 24,000 tpa garnet production
- identification and preliminary assessment of practical constraints to potential materials handling systems for mining and processing operations - topography, existing access, site road establishment, creek vegetation and rivergums, environmental considerations
- preliminary assessment of logistics for mining and processing
• identify requirements for resource definition program (Northwind).

**Mining Evaluation**

A formal resource base has not been identified or confirmed for the garnet mineral deposits.

Preliminary indications of resource potential and the location and operating conditions for the Ongeva Creek area form the basis for the mining evaluation undertaken. A mineable resource will be assumed for the purpose of scoping mining requirements and costs.

Operating conditions and constraints will be identified in the process of identifying the optimum mining fleet and generating operating and capital costs.

---

**2.0 SITE CONDITIONS**

**2.1 Location**

The focus for proposed mining and processing operations is the Hale River region, famed for its garnet and gemstone alluvial resources. The area is located approximately 100 km east northeast of Alice Springs in the Northern Territory of Australia. Refer to Figure 1.

**2.2 Access**

**2.2.1 Main Road Access**

The maps of Figures 2 and 3 indicate that access to the garnet resource area from Alice Springs is afforded by two main routes consisting of predominantly sealed sections of road:

**Ross Road - Southern Route**

The southern road access to the area extends 126 km to Ambalindum Station homestead located on the south bank of the Hale River. There is 71 km of sealed road to just past the turnoff to Artunga and just short of the Ross River Homestead and Tourist Resort. A further 55 km of gravel ‘minor’ road and station roads continues and passes through Artunga Goldfield Historical Reserve (110 km) and Claraville (118 km) along the way.

The road extending from the Undoolya Bore turnoff (30 km) travels through hard rock country between ridges to the northwest and southeast and becomes increasingly less well aligned with more frequent creek crossings. This becomes even more evident on encountering the unsealed section of road past the Ross River turnoff.

The terrain within 20 km of Ambalindum appeared to be more flat and comprised of sandier soil with more frequent creek crossings. This is consistent with the location on the south bank of the Hale River. By comparison the road is still on hard base and the alignment is poor with very winding sections past the sealed section at the Ross River turnoff. The local road authorities advise that this section is limited to...
double roadtrains. They also advised that because of the hard ridge country terrain and the fact that the Aitlinga area is one of the driest in the vicinity of Alice, the numerous small creeks tend to run with water only very transiently during rainfall with access regained very quickly after creeks stop flowing.

Access to the area immediately in the vicinity of Claraville, Ambalindum and further northeast following the Hale River and lease EL9410 requires careful consideration during the wet season. This lease was not the focus of the current site visit and was not inspected. However, given that it contains the bulk of the resource (est. 900,000 tonnes garnet), albeit lower grade at approximately 10% garnet, future visits must more closely inspect this area. Main reasons for not focussing upon this site for commencement of initial mining appears to be because of more difficult access, a requirement to construct or upgrade possibly 10-20 km of station road, the need to maintain at least 70 km of unsealed winding road and the road alignment limitations.

In comparison to the relative ease of the northern sealed access route, it was most apparent that the southern access is more difficult. We are informed that the area is 4WD access only at present during both wet and dry. The Hale River was forded twice in reaching Ambalindum. The river is wide close to Ambalindum and fairly heavily covered in river gums, spinifex and other vegetation.

The road is kept in reasonably good condition by the Alice Springs Transport and Works Department due to the tourism importance. Station roads appear less well kept and less suited to heavy vehicle traffic. Due to lack of visibility at night, it was difficult to establish the terrain and extent of any future road establishment or maintenance programs.

**Plenty Highway - Northern Route**

The northern access consists of a total of 167 km of sealed road via the Stuart and Plenty Highways to a point 1 km short of the Ongeva Creek crossing and 2 km short of the Ongeva Creek access road turnoff. The Stuart Highway to Darwin extends north from Alice Springs.

Heading north from Alice on the Stuart Highway, the Plenty Highway turnoff is reached after about 70 km and turns first to the northeast and then east. This highway provides access to Queensland. A further 97 km sealed section of the Plenty Highway extends to a point within 2 km of the Ongeva Creek crossing. The gravel road extending further east to outlying Aboriginal communities and Queensland is at least 10 m wide, is well aligned, kept in very good condition and has sealed sections installed at major creek crossings. It is likely to be reasonably accessible even in the wet and will support triple roadtrain traffic.

The Plenty Highway provides access to some infrastructure on route to Ongeva. Approximately 28 km from Ongeva a tourist caravan park is located just south off the highway while 8.1 km from Ongeva a Telstra telephone communications repeater station is situated just to the north. This provides ready access, in the first instance for site visit accommodation or during the project construction phase, and secondly for communications.
2.2.2 Lease Access

Ongeva Creek

Access to the Ongeva Creek area is well afforded via a gravel road heading south from the Plenty Highway. This station road roughly follows the northern perimeter of the creek and branches and crosses the creek at 4 points. It links to a station road access on the south side of the creek and to a main access to the south which traverses the Harts Range to link up with Ambalindum station.

The northern access is readily available whereas the southern access is more difficult.

Central Link Access

A station road, approximately 56 km long via the shortest route, links the Plenty Highway, Ongeva Creek area and Ambalindum station. It traverses the Harts Range where it becomes very windy, steep and poorly maintained. Only 4WD traffic is possible through the central Harts Range area.

The ridge country provides a hard rock base. To the north and south of the range the topography becomes much flatter. These areas are more amenable to upgrade and maintenance. Some sections of the road could turn to bulldust and may be subject to flooding. Examination of topographical maps will provide a better assessment of proneness to flooding.

The journey between Ambalindum and the Ongeva Creek area requires 1.5 hours by 4WD and is quite rough with steep grades in places. It is unlikely that this route can be developed for long term haulage.

Plenty River

Access to the Plenty River leases EL9190 and EL9195 is afforded via the Plenty Highway after which it is named. The highway is fairly wide, well maintained, and with reasonably straight alignment to support triple roadtrains.

The lease target area comprises the headwaters of the Plenty River which extends east north east.

EL9190 takes in Plenty Dam and comprises the western section of the Plenty and numerous feeder creek systems. The lease crosses the highway over a 12 km stretch encountered 7 km east of Ongeva and incorporates sections of the Riddoch Creek deposits, Riddoch station homestead and Mt Riddoch. A lease area FA09, dedicated to tourist fossicking adjoins both EL9191 (Ongeva) and EL9195 (Riddoch/Plenty) to the south of the highway.

Access to a 20 km section of the Plenty River, incorporated under EL9190, is achieved by following the highway east from Ongeva creek for a distance of 21 km to a turnoff north to Corkwood Well, just west of Stones Creek tributary. The turnoff extends a distance 7.5 km to intersect the Plenty River. The remains of a tank, possibly from the windmill bore, was observed. The station track is not well-travelled nor maintained. The track is sandy and could be subject to flooding in the wet season.
2.2.3 Local - Road, Rail, Air

A summary of the various access routes to Alice Springs is given below:

**Road**

<table>
<thead>
<tr>
<th>Location</th>
<th>Distance</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelaide</td>
<td>1,552km</td>
<td>16 hrs</td>
<td>Stuart Highway, Sealed</td>
</tr>
<tr>
<td>Darwin</td>
<td>1,490km</td>
<td>15 hrs</td>
<td>Stuart Highway, Sealed</td>
</tr>
<tr>
<td>Brisbane</td>
<td>3,055km</td>
<td>2 days</td>
<td>Via Tennant Creek, Mt Isa, all sealed</td>
</tr>
<tr>
<td></td>
<td>2,723km</td>
<td>2 days</td>
<td>Via Plenty Hwy, Mt Isa, part sealed</td>
</tr>
<tr>
<td>Mt Isa</td>
<td>1,185km</td>
<td>12 hrs</td>
<td>Via Stuart Hwy all sealed</td>
</tr>
<tr>
<td></td>
<td>853km</td>
<td>10 hrs</td>
<td>Via Plenty Hwy 167km sealed</td>
</tr>
<tr>
<td>Rockhampton</td>
<td>2490km</td>
<td>27 hrs</td>
<td>Via Stuart Hwy, Mt Isa all sealed</td>
</tr>
<tr>
<td></td>
<td>2158km</td>
<td>25 hrs</td>
<td>Via Plenty Hwy, Mt Isa part sealed</td>
</tr>
</tbody>
</table>

**Rail**

One rail link exists through to Adelaide via Port Pirie, the main junction for Western Australia and the Eastern States, and extends a distance of 1555 km.

**Air**

Air link routes are summarised below according to travel times:

<table>
<thead>
<tr>
<th>Location</th>
<th>Time</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelaide</td>
<td>2 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Darwin</td>
<td>2 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Brisbane</td>
<td>4.5 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Cairns</td>
<td>3.5 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Perth</td>
<td>3 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Sydney</td>
<td>4 hrs</td>
<td>Direct</td>
</tr>
<tr>
<td>Melbourne</td>
<td>3 hrs</td>
<td>Via Adelaide</td>
</tr>
</tbody>
</table>

2.3 Topography

The dominant feature of the area is the Harts Range which strikes roughly east-west dividing the flatter and lower lying lease areas and separating the Plenty and Hale Rivers. The range sheds water and alluvials via complex creek systems to the Plenty River to the north and the Hale River to the South.

The southern access route is also characterised by the eastern extension of the McDonnell Ranges which intersect Alice Springs. A series of ridges trending easterly to north easterly runs south of the Hale River which obtains runoff from both range systems as the centre of a shallow valley between the two.

The highest elevation for the target area (and in the vicinity of Alice Springs) is 1203 m above sea level at Mt Brassey, part of the Harts Range. Mt Riddoch extends to 1094 m. The creek and shallow lying areas vary between 550 to 650 m above sea level. GPS elevation measurements at Ongeva were 616 m (2021 ft)
while at Plenty River they were much lower at 558 m (1832 ft). This variation appears consistent with some evidence of heavier peak water flows observed at Plenty River.

2.4 Climate

Appendix 2 provides details of meteorological obtained for the closest official station at Jervois, approximately 80 km east of Ambalindum. Summarised data includes:

**Wind Rosettes**  27 yrs 1967-1993  Prevailing Wind  South Easterly

**Cloud**  28.4 yrs records  Mean Clear Days  193 per annum
Mean Cloudy Days  45 per annum

**Evaporation**  8.8 yrs records  Mean Daily  7.9 mm
Mean Month Max.  13.3 mm (Jan)
Mean Month Min.  3.8 mm (Jul)
Max Range  Nov - Mar

**Temperature**  1996-1997  Mean Max Range  21.9 - 38.3
Mean Min Range  5.0 - 22.2
Mean Daily Max  30.4
Mean Daily Min  13.7
Highest Max  47.5
Lowest Min  -5.0
Hottest Months  Nov - Feb (+35)

**Rainfall**  1996-1997  Mean Annual  286.9 mm
Mean Rain Days  36.4
Highest Monthly  285 mm (Feb)
Lowest Monthly  0 mm (Jan - Nov)
Highest Recorded  139.2 mm (Feb)
Wet Period  Nov - Mar (+20 mm)

Perhaps of most interest are monthly precipitation records (1966-97) obtained for both Mt Riddoch and Ambalindum station homesteads. Further details are provided in Appendix II and summarised below.

<table>
<thead>
<tr>
<th>Annual Rainfall Index</th>
<th>Ambalindum</th>
<th>Mount Riddoch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>316.3</td>
<td>339.9</td>
</tr>
<tr>
<td>Median</td>
<td>311.7</td>
<td>291.3</td>
</tr>
<tr>
<td>Highest</td>
<td>669.2</td>
<td>973.5</td>
</tr>
<tr>
<td>Lowest</td>
<td>92.7</td>
<td>110.1</td>
</tr>
</tbody>
</table>

The stations appear to record a higher average rainfall than Jervois. The wettest period extends over the period November till March.
2.5 Pastoral and Grazing Leases

Mining and exploration lease areas fall within at least two pastoral leases identified as Ambalindum for the southern zone and Riddoch Station for the northern zone. Cattle are grazed on the leases.

Our party camped at Ambalindum and found the station people friendly and cooperative. It is understood that the client's representative is on good terms with the local pastoral people.

Cattle grazing activities and the maintenance of a good relationship with graziers is likely to impinge on proposed mining activities in terms of:

- use of station road access
- access to water or use of bores
- protection of fencing and gates - fences cut across both Ongeva and Plenty
- assistance with exploration and minor plant and mining initial earthworks
- rehabilitation requirements during active mining and closure phases
- use of facilities including accommodation during exploration and project establishment phases
- protection and safeguarding of cattle
- road construction requirements
- protection of flora and fauna - environmental impact
- access of cattle to creek water holes during active mining phases.

2.6 Existing Infrastructure and Services

Existing infrastructure and services locally available are generally associated with the pastoral grazing and tourism activities. National parks such as Aftunga are in close proximity. The area is also popular for gemstone fossicking (FA09, Aftunga gold field, Ruby Gorge) and 4WD trekking (central link road).

Accommodation

The Ambalindum Station Homestead, at which we were billeted for two nights, provides good accommodation at the rate of $20 per person per night. The accommodation is a separate house with full amenities for cooking, bathing and sleeping of up to six persons. Telephone communication is available. The existing house was refurbished to hire out for tourists and is quite popular. The facility is suitable as a staging point for the Hale River area but unsuited for ready access to the northern mining leases given the 1.5 hour travel time required to traverse 56 km through the difficult Harts Range terrain.

It is not known whether accommodation is available at Riddock station homestead.
The caravan park situated 28 km from Ongeva, just off the Plenty Highway may provide an option as accommodation for assessment and exploration of the northern leases. John Benger advised that the facility is reasonably well equipped with onsite caravans, communal toilets and shower blocks.

**Water Sources**

Details of local hydrology and the presence of ground water aquifers is not known. Further investigation will be required. It is likely that runoff from the Harts Range via creek systems will provide rapid recharge of aquifers depending on local rock permeability and discontinuities.

Station bores and dams are generally dotted around close to the various creeks visited. It may be possible to arrange to share and/or upgrade water supply from these bores. These include:

- Blackfellow’s Bones Bore - central to Ongeva
- 10 Mile Dam - north of Ongeva track turnoff
- Gough Dam - east side, Ongeva just west of central link track crossing
- Plenty River - Plenty Dam, Undippa Dam, Mallee Bore, Pinnacle Well, Corkwood Well.

**Communications**

Telephone communications are available at Ambalindum. The Telstra repeater station tower approximately 8 km from Ongeva can also be utilised using radio telephone.

**Roads**

Details have been provided in Section 2.2.

Salient aspects are:

- excellent sealed access is available to the northern leases via Plenty and Stuart Highways
- good partially sealed access is available to the southern leases, albeit less well aligned
- central link access is poor - difficult 4WD access only through Harts Range
- station roads are in reasonable condition in flat lying areas, particularly those accessing the Ongeva Creek. They will all require upgrading to allow heavy mining vehicle traffic
- the easiest area to access is Ongeva Creek via the northern route and 10-20 km of station road.

Indicative costs for gravel road upgrade and construction are provided below:

- minor widening and sheeting upgrade $5-7,000 per km
• gravel road construction $20,000 per km.

The topography of the area will require careful assessment in order to adequately define road upgrade and construction requirements. Flood proneness and well sited access points to the river beds will be major considerations.

2.7 Sample Collection Data

Samples for use in metallurgical test work supervised by Signet were collected mainly from a 14 km section of Ongeva Creek. Some sections of Plenty River, Riddock Creek and small high grade creek systems feeding the Ongave Creek were also sampled. Full details of sample collected are provided under Table 2.7.

The Ongeva Creek samples were collected on a regular 1 km interval over the 14 km of strike inspected and these formed the bulk of the composite assembled by Signet for use in process route testwork.

3.0 GEOLOGY

3.1 Local Geology

The garnet derives from amphibolite rocks of the Harts Range which includes Mt Riddock. This range lies between the Hale River to the south and Plenty River to the north. Through the action of weathering processes the hard rock amphibolite has shed via a complex system of small creeks which carry garnet in alluvial sands to the Plenty River to the north and Hale River to the south.

The principal feed sources of the Hale River Garnet sands mineral resource, known as the Harts Range alluvial accumulations, are in the Irindina Gneiss and Riddock Amphibolite of the Harts Range. These rocks are reported to yield a garnet type having the following properties:

• dominantly Almandine and Rhodolite with minor Grossular, Spessartine and Andradite components
• good angularity properties consistent with an early stage of weathering due to close proximity to the source rock
• average density 4.0 t/m³
• hardness 7.5 on Moh’s scale
• salt and radioactivity level are negligible
• low free silica levels (0.8% by weight) indicated by initial test work on prepared garnet samples.
3.2 Geological Setting

The Ongeva Creek (EL9191) and Plenty River (EL9190) garnet deposits are the two main areas nominated by Olympia as potential targets due to their setting and ease of access being located within 10 km of the Plenty Highway. A local geological description and setting for each of these deposits is provided below.

**Ongeva Creek**

Ongeva Creek appears to be underlain by a clay base with some evidence of gravel and pebble layers. The sand bed of the creek forms the basis of potential garnet resource and varies in colour from a light yellow-brown to a pinkish and dark blackish sand. Pinkish coloured sand is often consistent with higher grade garnet sands and ‘winnowed’, or wind-blown, concentration of garnet on the surface. Increased hornblende is reportedly consistent with darker sand found in the upper reaches. Smaller, reputedly high grade, tributaries feeding the Ongeva are also darker in appearance. The sand particle size appears to be a relatively consistent medium coarseness. Previous assay work indicates that it averages 96% passing 2.3 mm. Some sections appear slightly finer than others. The sand bed appeared to be quite consistent in thickness and appearance along the extent of the section examined. Depth appears to be at least 0.8 m thick over the majority of creek width and strike since the base of the creek was rarely encountered in digging sample holes.

**Plenty River**

The Plenty River sand is of similar appearance to Ongeva but the setting of the bedrock base is slightly different. The base appears to be mainly calcrite in most areas. The river wash was also observed to contain chalcedony and larger pebbles. Upper reaches were more heavily wooded with river gums. The bed and thickness of the river are not as consistent as Ongeva. The surface is more irregular and eroded by turbulent water action. Sections of the bank have been cut up to 3 m during times of peak flow and the surface is dimpled due to turbulent water flow. Some sections of the river were observed to be shallower in sand thickness. All these features pose a challenge for free mining access and efficiency.

Terracing of sand occurs quite frequently in both Ongeva and Plenty Rivers. Generally the banks are about 0.5 m in height and appear to correspond to cycles of average and peak flows.

River gums line the creek banks and dot the creek and river beds. They appeared to be based in clay but with root mats extending into the sand comprising the creek bed. Often two sections of the creek run parallel and separated only by a shallow bank of clay supporting grasses and river gums and varying between 5 to 20 m wide. These sections often occur at the confluence of tributaries.

Further work is required to confirm the disposition in terms of material type and bed topography. A relatively flat bed topography will optimise the mineability of the deposit. An irregular bed will pose problems for mining in terms of increased ore loss and dilution.
**Figure 2.7 - Metallurgical Sample Collection Details**

*Olympic Resources NL
Halie River Garnet
Site Visit - Collection of Metallurgical Samples*

**Leases:** EL9191 (Oneva), EL9195 (Mt Riddock), EL9190 (Plenty River)

**Date:** 20 to 22 June 1997

**Location:** 100km NW of Alice Springs, 164km to Ongeva by Plenty Hwy, 118km to Claravale by Ross Road

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Location</th>
<th>GPS</th>
<th>Creek</th>
<th>Northing Lat. Deg.</th>
<th>Easting Long. Deg.</th>
<th>RL Fl. +ss/ln.</th>
<th>Relative Position</th>
<th>Creek Width</th>
<th>Position</th>
<th>Depth m</th>
<th>Top m</th>
<th>Bottom m</th>
<th>Moisture</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>S21</td>
<td>Riddock Creek</td>
<td>23.08.11</td>
<td>134.40.27</td>
<td>Not Taken</td>
<td>20</td>
<td>Surface</td>
<td>Fairly dry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S22-T S22-B</td>
<td>Plenty River</td>
<td>22.56.57</td>
<td>134.48.65</td>
<td>1832ft</td>
<td>10N+40+40S</td>
<td>7S of S</td>
<td>0.7</td>
<td>0.35</td>
<td>0.35</td>
<td>Moist, more turbulent flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S23-T S23-B S24</td>
<td>Plenty River</td>
<td>22.56.50</td>
<td>134.48.09</td>
<td>Not Taken</td>
<td>1.1km W of #22</td>
<td>20N+30+20S</td>
<td>0.85</td>
<td>0.32</td>
<td>0.22</td>
<td>More wooded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plenty River</td>
<td>22.56.47</td>
<td>134.47.16</td>
<td>Not Taken</td>
<td>3.1km W of #22</td>
<td>approx. 60m</td>
<td>0.55</td>
<td>0.55</td>
<td>0.55</td>
<td>Dug to base - calcite, 0.85kmE to lance line</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Two different methods of spelling the Ongeva/Ongersa and Oneva/Onera creeks exist, depending on the plan referred to.
The Oneva refers to the southwestern reaches which flow North to form the Ongeva.*
Market study on industrial garnet
for Olympia Resources NL
Background

The client, Olympia Resources NL, is investigating a major almandine garnet deposit in the Northern Territories of Australia. The aim is to establish a mining operation with a production capacity of between 25,000 and 50,000 tpa. The garnet will be produced in five size grades (see table below). The material will, at first, have to be transported by truck from the plant, although construction is underway of a rail link from Alice Springs to Darwin, which will give the client improved and cheaper access to domestic markets (with a forecast freight rate of 2 Australian cents per tonne per km), as well as easier access to the port at Darwin, which is the nearest suitable port for exports.

Grades of garnet to be produced by Olympia Resources

<table>
<thead>
<tr>
<th>Grade</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2 to &lt; 0.5</td>
</tr>
<tr>
<td>2</td>
<td>0.5 to &lt; 0.8</td>
</tr>
<tr>
<td>3</td>
<td>0.8 to &lt; 1.5</td>
</tr>
<tr>
<td>4</td>
<td>1.5 to &lt; 2.3</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 2.3</td>
</tr>
</tbody>
</table>

Scope of work

Industrial Minerals Research was commissioned to determine the size and prospects for garnet in its main end-use applications in the Australian market and surrounding areas. The key areas of study include:

- The current world demand for industrial garnet
- The future prospects for garnet demand by end-use
- Which market sectors offer the best prospects for growth
- The outlook for new production capacity in Australia in the context of increased capacity from existing producers and several other new prospects
- The current prices for garnet in each of its principal end-uses
- How prices likely to change over the next few years
The following samples were taken on the Plenty River, by hand held auger. The samples were pre screened to 2.36mm, and split to one kilo samples. One sample was sealed in plastic bags, the other in calico bags. Samples sealed in plastic bags were forwarded to Roach Analysts Pty Ltd of Brisbane for analysis.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR1</td>
<td>S22-55-932</td>
</tr>
<tr>
<td>PR2</td>
<td>S22-57-006</td>
</tr>
<tr>
<td>PR3</td>
<td>S22-56-366</td>
</tr>
<tr>
<td>PR4</td>
<td>S22-56-087</td>
</tr>
<tr>
<td>PR5</td>
<td>S22-56-337</td>
</tr>
<tr>
<td>PR6</td>
<td>S22-56-337</td>
</tr>
<tr>
<td>PR7</td>
<td>S22-56-087</td>
</tr>
<tr>
<td>PR8</td>
<td>S22-56-287</td>
</tr>
</tbody>
</table>

Samples were submitted for Garnet concentration analysis, using a separation liquid density of 3.30g/ml@20°C.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>% Fraction 2.00-0.425</th>
<th>Garnet %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>43</td>
<td>14.7</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
<td>11.5</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>23.3</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>13.2</td>
</tr>
<tr>
<td>5</td>
<td>62</td>
<td>12.6</td>
</tr>
<tr>
<td>6</td>
<td>57</td>
<td>14.4</td>
</tr>
<tr>
<td>7</td>
<td>66</td>
<td>25.2</td>
</tr>
<tr>
<td>8</td>
<td>61</td>
<td>11.9</td>
</tr>
</tbody>
</table>

The above samples (Garnet concentration) were then examined with a stereobinocular microscope to determine its approximate mineralogy.

A riffled portion of each sample was analysed for water soluble calcium, magnesium, sodium and potassium to determine its salt content.
Results of the analysis is as follows.

Examination with the stereobinocular microscope revealed that the samples consist of approximately 60% quartz with other minerals being mainly biotite along with some muscovite and feldspar. It was concluded that the samples contained -0.8% free silica as quartz.

All samples were examined with a scintillometer to detect radioactivity. The samples were found to have no detectable radioactivity.

The chemical analysis for water soluble salts are as follows.

<table>
<thead>
<tr>
<th>Water Soluble Element</th>
<th>Analytical Result (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>51</td>
</tr>
<tr>
<td>Magnesium</td>
<td>10</td>
</tr>
<tr>
<td>Sodium</td>
<td>11</td>
</tr>
<tr>
<td>Potassium</td>
<td>18</td>
</tr>
</tbody>
</table>

The above results show that the samples contained negligible water soluble salts.

The purpose of the Garnet sand analysis was to determine the Garnet suitability for abrasive sand blasting. Industry requirements for Garnet sand has been established by the US Environmental Department, this standard is now widely accepted throughout the World.

The alluvial Garnet sand deposit contained within EL9195, meets all US Environmental Department requirements.