Agnes Water Desalination Project

DESIGN REVIEW

MIRIAM VALE SHIRE COUNCIL

6th DECEMBER 2006

Prepared by

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INDEX

1.0 INTRODUCTION

Miram Vale Shire Council are proposing to construct a sea water desalination plant at Agnes water.

John Chappell Engineers has been engaged by Miriam Vale Shire Council to carry out a design review of the work carried out by Parsons Brinckerhoff, PB, with special reference to the offshore works.

The plant has a capacity at Stage 1 of 1.5 ML/day product flow and ultimate production flow of 12 ML/day

2.0 DOCUMENTS STUDIED

Documents Supplied by Miriam Vale Shire Council
Prepared by PB & Sub-Contractors:

1. Early Studies Final Report
2. Geotechnical Investigations (Onshore)
3. Geotechnical Investigations (Offshore)
4. Archaeological (CH) Issues
5. Marine Ecology Assessment
6. Bathymetry and Engineering Survey
7. Outfall Hydraulic Modelling
8. Desk top study of beach processes and Construction Methods.

Cardno Final Report July 2006
Coleridge Water Engineers study carried out in 1994
Other Data Sources

- Admiralty chart of area.
- Aerial photographs.
- Information from Design and Construction of outfall and intake for a Desalination Pla nt at Kangaroo Island, South Australia.
- Information regarding Desalination Plants – WA.

3.0 SELECTION OF CHINAMANS BEACH

Chinamans Beach was selected as reasonably close to the proposed Desalination Plant. The alignment for the intake and outfall pipelines was based on causing least disturbance to the fragile nature of the existing onshore reserve between Springs Road and the beach.

Following investigations PB confirmed that the intake arrangement and brine outfall system could be located off Chinamans Beach.

The geotechnical work showed that apart from close inshore that the pipeline trench would be located in sand which suited the PB construction approach. They proposed that the offshore selections of the pipelines could be laid in a trench excavated by a dredge and the inshore section within a cofferdam with conventional equipment.

4.0 PERMITS AND APPROVALS

It is recognised that any work on this site is subject to environmental requirements.

5.0 GEOTECHNICAL INVESTIGATIONS TO DATE

The onshore geotechnical investigation with reference to the bore holes at the top of Chinamans Beach indicated weathered rock at a level of –2 AHD.

Referring to investigation carried out by Coleridge Water Engineers for the Miriam Vale Shire Council in 1994 AGNES WATER VOLCANIC ROCK is indicated as occurring up to the level plus 10 m to plus 15 m AHD.

The cross sections presented by Coleridge indicated that rock would be encountered from the Desalinisation Plant site to the rocky outcrops on the beach.

The rocky outcrop north of the Chinamans Beach is composed of an igneous rock.

The offshore jet-probing carried out for PB showed medium/coarse sands to depths of at least approximately 4 m with shelly gravel layers and mud layers from the surf zone out to the end of the pipe zone.

6.0 MARINE ECOLOGY

FRC was commissioned by PB to undertake a marine ecology assessment on the proposed desalination facility at Agnes Water.

FRC provided an overview of:

- water quality, marine plant communities, reefs, fish and fisheries and identified conservational significant species

PB Summary of FRC Findings

- Water quality within the region is generally considered to be very good; water temperatures typically range from 18/29°C and salinity is relatively uniform along the coast at 35 ppt (parts per thousand).
- The coastal waters offshore of Chinamans Beach may provide habitat for a number of conservational significant species. In particular, turtles nest at Chinamans Beach, and the waters offshore of the beach form part of the humpback whale migration corridor.
- Construction of pipelines and other infrastructure at Chinamans Beach should therefore take place in the winter months (June – August) if possible to avoid disturbing turtles during breeding, the most vulnerable stage of their life cycle. If this is not possible, construction should only occur during the day and measures should be in place to ensure that there is no noise or lighting on the beach at night.

7.0 BATHYMETRY AND ENGINEERING SURVEY

A preliminary detailed survey carried out by McNee Surveys extends to the north sufficiently to cover the area for the alternative pipeline routes proposed in Section 13.0.

8.0 WATER QUALITY STUDIES

WBM presented recommendations regarding the preservation of water quality and the requirements for properly dispersing brine.

9.0 PRELIMINARY FINDINGS

Following a study of documents provided and with a special reference to the works at Penneshaw as well as other projects I have been involved in requiring pipes or channels to cross beaches or foreshores I found myself with some serious concerns about the PB proposal from a construction viewpoint.

Inshore Work

The installation of the three pipelines across the beach and surf zone is clearly a difficult task and PB have highlighted the problems and have also developed a possible construction scenario for this zone.

There is no doubt that the inshore works proposed will be difficult, costly and very disruptive to the ecological systems. I think it would take considerable time so it's unlikely that it could be carried out without interrupting the turtle season as suggested in the reports.

Offshore Work

The use of a cutter suction dredge is proposed and PB have indicated that some contractors expressed concern about the swell. My own experience on a large number of dredging projects certainly confirms this.

With this in mind the amount of dredging work should be kept to a minimum and the possibility of eliminating dredging is discussed in Section 13.

10.0 LOOKING AT ALTERNATIVES

In the case of the Penneshaw Desalination Plant a site was selected in essentially a rocky area with a narrow inlet where the pipe could be installed. This meant that trenching could be carried out working off a solid surface and infilling was not a serious problem. The work was carried out with an excavator fitted with an extended turret which enabled it to work in approximately 4 m of water.

Offshore the pipeline was laid on the seafloor and secured with concrete anchor blocks.

With these considerations in mind and with reference to aerial photographs and the Admiralty chart of the area I decided to investigate the possibility of coming out from one of the several rocky protrusions along the coast line at Agnes Water where the seabed contours indicated that deeper water was closer inshore.

11.0 HORIZONTAL DIRECTIONAL DRILLING

I noted in the Minutes of meetings with Council that they had shown considerable interest in HDD and therefore decided to look further into this method.

A considerable user of this technique has been the Sydney Water Board. They do have very good ground conditions for this type of work and did indicate that it has been successful.

12.0 SITE VISITS

Agnes Water 31st October and 1st November

I met Mr Steen and the Mayor on-site and indicated my interest in moving the pipelines to a rocky headland.

We went to the nearest available outcrop just north of the proposed pipelines at Chinamans Beach and concluded that this would be a good place to construct a pump house.

From the pump house a pipeline through the rocks could be taken out to an adequate depth of water from where the pipeline could be extended.

A very different proposal was also discussed which involved HDD commenced at the treatment plant and taken out as far as possible.

Penneshaw 30th November

Mr Steen and myself visited the Desalination Plant at Penneshaw and were shown over the plant by the operator Mr Troy Kirby.

Troy went through the whole operation of the plant itself with special reference to the pre-treatment processes.

We also observed the pump station and the arrangements for "pigging" the intake and outfall lines.

At this plant no chemicals are used to control growth in the pipelines.

Cleaning is solely by "pigging" at fairly long intervals of time and this has kept the pipelines well cleaned at Penneshaw.

The pipeline had been excavated from the pumping station through rock out to beyond the surf zone. From this point the polyethylene pipeline is laid on the surface and retained in position with concrete blocks bolted on at intervals.

Of particular interest was the experience with the pipeline laid upon the sea floor. This area is subjected to very high current flows and wave action but the pipeline had remained securely in place and no damage to the pipelines was experienced from fishing boat anchors and the like.

13.0 PROPOSALS

Two OPTIONS are now detailed below:

OPTION 1 – Refer Drawing Nos. 50-06, 50-07 A and 50-08 A.
PUMP WELL ON ROCKS

From the treatment plant to the pump station both pipelines are laid in a trench excavated across the top of the sand dunes.

At the pump station a pump well is excavated in the rocks at approximately high water mark.

The section from the pump well out to the extent of the rock could be carried out by HDD. The HDD would be commenced some distance away from the pump well with the machine at ground level. The holes would be sloped down to the correct levels. In this case the two pipelines would follow different routes diverging from the pump well.

Alternatively from the pump well a trench could be excavated with machinery especially developed for working in these conditions in a similar manner to the work at Penneshaw. This would be extended as far as possible out to sea approximately to the extent of the rocks.

The preferred option for this section is the HDD because the effect on the environment would be extremely small.

At the end of the rock section with either construction method the pipelines could be laid in a trench or consideration could be given to laying the pipelines on the surface. Based on the experience at Penneshaw polyethylene lines with adequate ballasting would operate very well. This would of course make the pipelines even more accessible and eliminate dredging with considerable cost saving.

With OPTION 1 the pipelines are accessible over most of their length. The section from the pump well outwards within the rocks is not accessible and special care would need to be exercised with the pipeline installation and possibly stronger pipelines utilised in this area.

OPTION 2 – Refer Drawing Nos. 50-09, 50-10 and 50-11 A.
PUMP WELL AT TREATMENT PLANT

The HDD would be commenced at a distance landward of the pump well at ground level and sloped down to the appropriate level at the pump well in the case of the intake line and at a higher elevation for the outfall.

The pump chamber would have to be excavated deep enough so that the intake pipeline starting point would be approximately 3 m below LAT. This would result in a fairly large concrete structure.

Both pipelines would be extended as far as possible by HDD depending on the rock contours. From the end of the HDD the pipeline will be extended by dredging a trench for each or consideration could be given to laying the pipelines on the surface. Based on the experience at Penneshaw polyethylene lines with adequate ballasting would operate very well. This would of course make the pipelines very accessible in this section.

The interface between the HDD and the near surface pipeline will need special consideration. The drilled hole should leave the rock at approximately seabed level.

A concern with Option 2 is that a large section of the pipeline would be almost totally inaccessible due to the depth below the natural surface and/or presence of rock in the event of pipeline failure. Such a failure would almost certainly result in an extended shutdown of the desalination plant.

14.0 ROCK LEVELS

In Section 5.0 rock levels have been established out to Low Water Mark. More information is needed especially for sections constructed by HDD in Options 1 and 2.

Offshore I would suggest a penetrometer survey. This would determine the depth to rock. I have carried out such a survey for several projects with suitable modified equipment and reliable results have been achieved relatively inexpensively.

To obtain core samples offshore a jack up platform would be required so a diamond core drill could be operated but this may not be necessary as we have considerable information on the type of rock likely to be experienced.

The actual extent of the HDD could be determined during the HDD process.

15.0 EXTENT OF PIPELINES

Seawater Intake

The seawater intake in the PB proposal is located in 10 m of water and this depth is obtained with the alternative proposals but it is closer inshore.

Brine Outfall

At Penneshaw the Brine outfall was located well inshore of the intake. This approach should be considered as there would be some cost saving.

The prevailing South East winds do create a surface current towards the shore which should assist in moving the brine away from the intake structure.

However it is understood that EPA approvals may require taking the brine out to approximately 10 m so this arrangement is shown on the drawing no. 50-08A.

16.0 INTAKE ARRANGEMENT

The sea water intake pipeline could be fitted with a purpose built screen similar to that fitted at Penneshaw, Kangaroo Island.

The intake structure and screening box as shown on drawings no. 50-01, 50-02 and 50-03.

The screen box itself is fabricated from polyethylene and a large number of 15 diameter holes are drilled in the box to provide the screen.

The box is designed to be easily disconnected from the base and the procedure for cleansing is that the box is removed and replaced with a clean box and the box that has been in use will be taken to shore and thoroughly cleaned.

The box is supported on a stainless steel four-legged structure with tubular legs which would be jetted into the seabed.

At some stage at Penneshaw the polyethylene box was replaced with a stainless steel box which was bolted permanently to the support structure. An opening flap has been provided on the top of the box to allow the pig to be recovered. This is an alternative approach which could be considered.

With the PB proposed intake air is required to keep the intake clear. This requires a long additional pipeline. Failure of this pipeline would be very serious.

17.0 CLEANING LINES

All the lines at Penneshaw are able to be cleaned by forcing a "pig" through the line from shore.

In my opinion to be able to "pig" the lines is essential.

Pipeline pigs are extensively used in the mining and petrochem industries and are essentially a bullet or spherical shaped device that more or less fits to the inside bore of the pipe and may be made of foam.

Various coatings, scrapers, and brushes assist in removing buildup from the pipe interior can also be used.

18.0 BRINE DISPOSAL SYSTEM

A suitable diffuser system will need to be provided to provide a spread of brine as considered in the PB reports.

It is proposed that the main diffuser pipe will be 350 OD stainless steel pipe and that this will be supported on tubular stainless steel legs as detailed on drawings nos. 50-04 and 50-05.

The outlet pipes from the main diffuser line would be stainless steel of 75 diameter with a fish tail end.

Provision for forcing a "pig" through this line should also be provided and the main pipe would be extended past the last diffuser outlets and provided with a removable cover designed especially for opening readily by divers.

Pig bypass bars should be installed at each of the offtakes to prevent spragging of the pig and a simple method of closing the outlets included in the design.

It is my opinion that the main diffuser pipe should extend directly out from the feed pipe line rather than at right angles as shown on the PB proposal. This should improve the diffusing efficiency as the principal currents are transverse to the pipeline.

19.0 CONCLUSION

In my opinion construction problems and considerable disruption to the beach with the present proposal require that an alternative approaches be considered.

The proposals put forward will have less impact on the environment.

OPTION 1 should be the least costly and has a big advantage that the pipelines are reasonably accessible in case of problems. HDD is the preferred method for the section from the pump house out to the end of the rocky area.

OPTION 2 includes a very long section of pipeline which is inaccessible. With this proposal the pipeline would be inaccessible over most of its length. Failure of the pipeline would result in closure of the plant.

20.0 RECOMMENDATIONS

The alternative proposals OPTION 1 and OPTION 2 outlined in this report should be included in the present submission to obtain environmental approvals.

OPTION 1 would be the preferred alternative as being simpler, less costly and because of its greater accessibility in event of any failure.

Consideration should be given for laying the offshore section of the pipelines on the sea floor without any excavation.

21.0 REFERENCE DRAWINGS

MIRIAM VALE SHIRE COUNCIL
DESALINATION PLANT AGNES WATER

50-01	ALTERNATIVE DESIGN – INTAKE STRUCTURE
50-02	ALTERNATIVE DESIGN – INTAKE PIPE CONNECTION
50-03	ALTERNATIVE DESIGN – INTAKE BOX DETAILS
50-04	ALTERNATIVE DESIGN – OUTFALL SUPPORTS
50-05	ALTERNATIVE DESIGN – OUTFALL SUPPORTS DETAILS
50-06	ALTERNATIVE DESIGN – OPTION 1 INTAKE PIPE LONGITUDINAL SECTION
50-07 A	ALTERNATIVE DESIGN – OPTION 1 OUTFALL PIPE LONGITUDINAL SECTION
50-08 A	ALTERNATIVE DESIGN – OPTION 1 PIPE LINE LAYOUT
50-09	ALTERNATIVE DESIGN – OPTION 2 INTAKE PIPE LONGITUDINAL SECTION
50-10	ALTERNATIVE DESIGN – OPTION 2 OUTFALL PIPE LONGITUDINAL SECTION
50-11 A	ALTERNATIVE DESIGN – OPTION 2 PIPE LINES LAYOUT

John Chappell

Director

MIRIAM VALE SHIRE COUNCIL

DESALINATION PLANT AGNES WATER

ALTERNATIVE DESIGN

50 00	LIST OF DRAWINGS
50 01	INTAKE STRUCTURE
50 02	INTAKE PIPE CONNECTION
50 03	INTAKE BOX DETAIL

JOHN CHAPPELL ENGINEERS
CONSULTING CIVIL ENGINEERS
COASTAL STRUCTURAL HARBOUR MARINAS
5 HAWTHORN CRES. HAZELWOOD PARK S.A. 5066
FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499
MOBILE: 0428 282 130

CLIENT: MIRIAM VALE SHIRE COUNCIL		DRAWN: JC	CHECKED:	DATE: 13/11/2006
DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN		SCALE	DIRECTOR	
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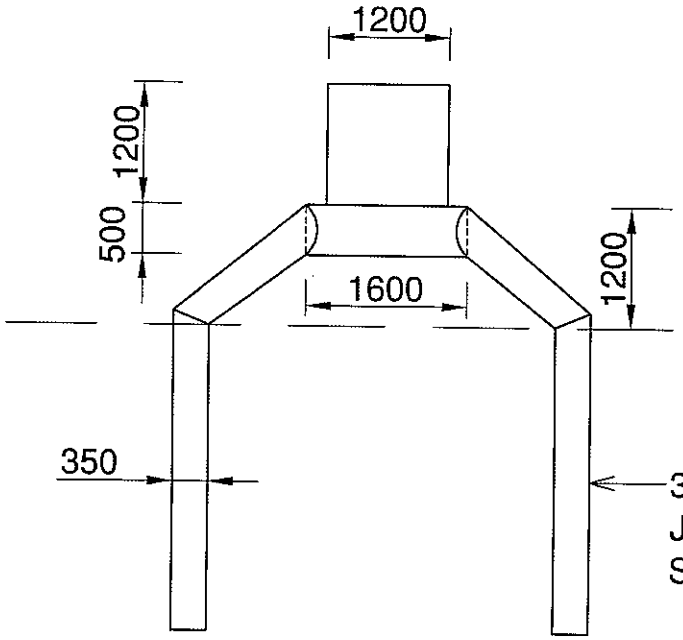

END ELEVATION

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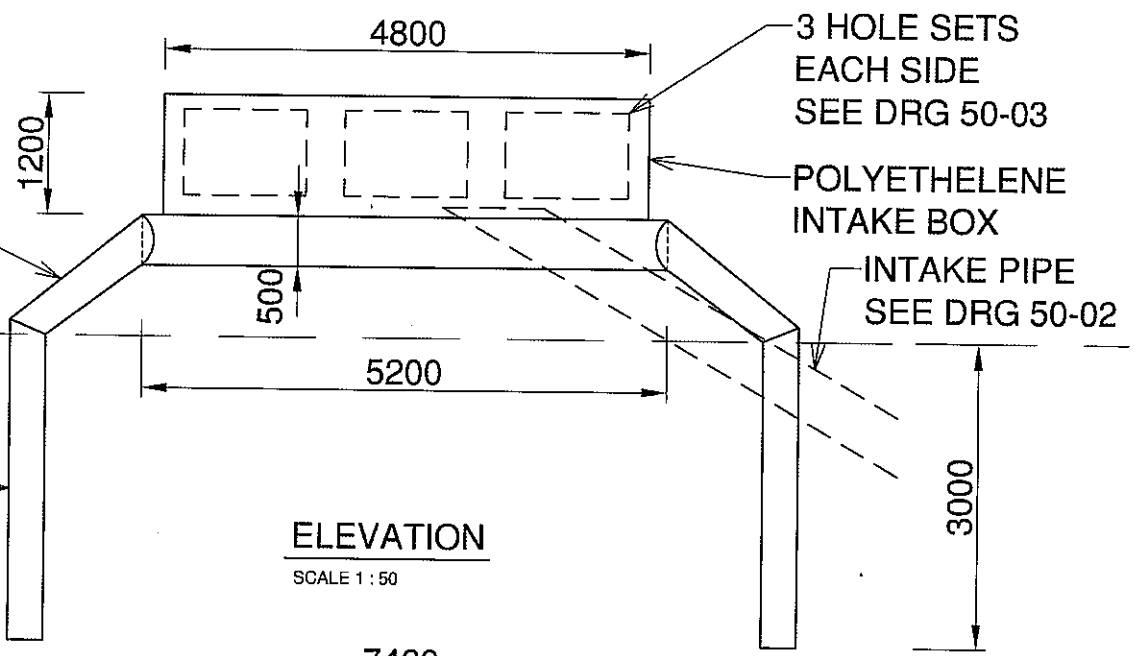
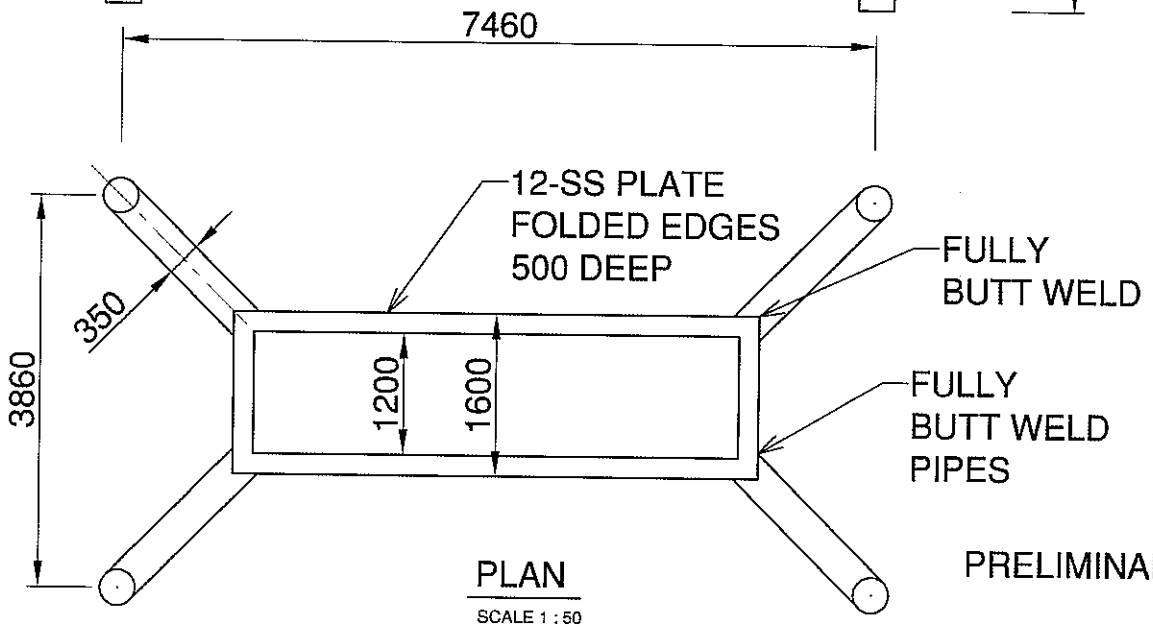


ELEVATION

SCALE 1 : 50

NOTE:
BOX SET WITH LONGITUDINAL AXIS
APPROX. PARALLEL TO
MAIN TIDAL CURRENTS



PLAN

SCALE 1 : 50

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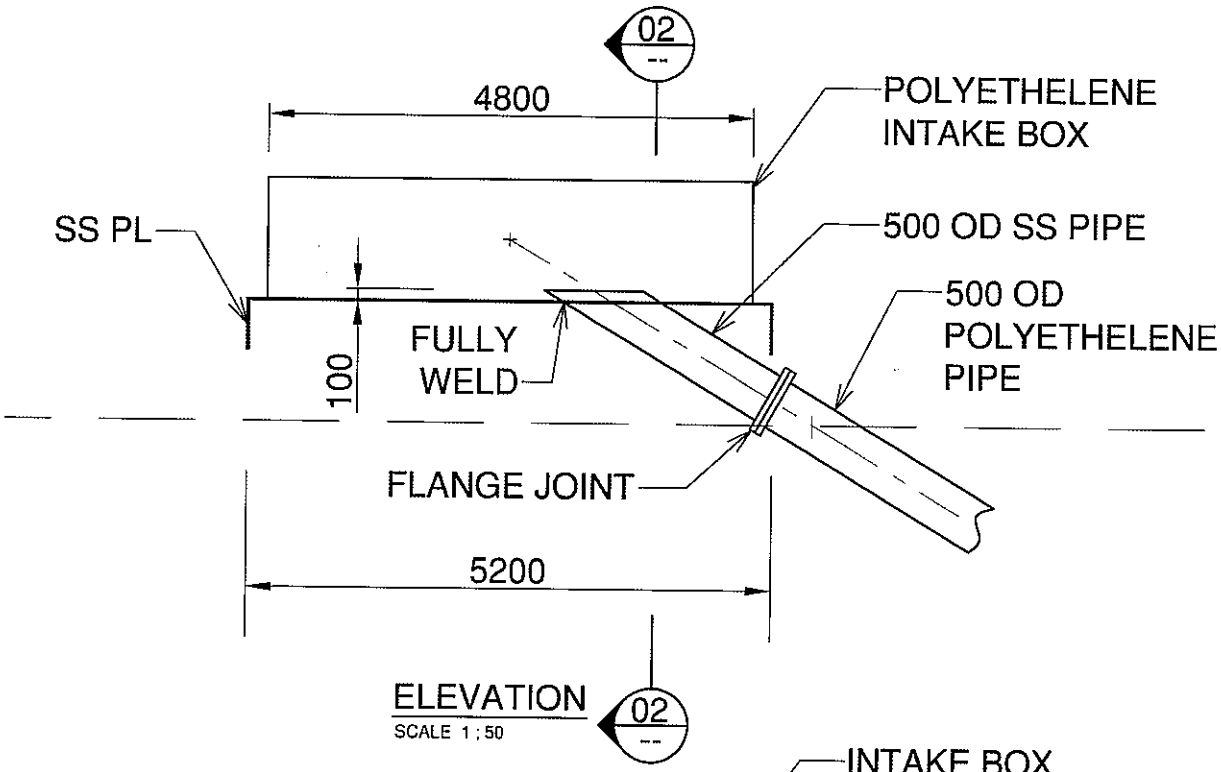

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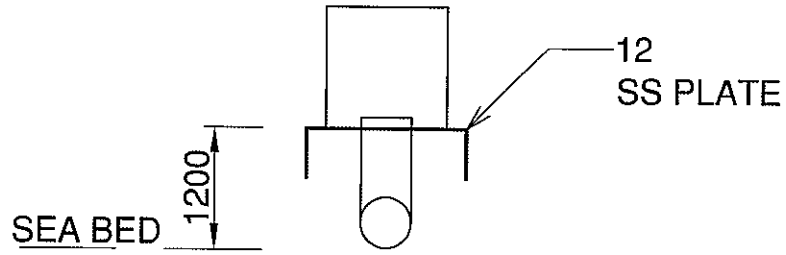

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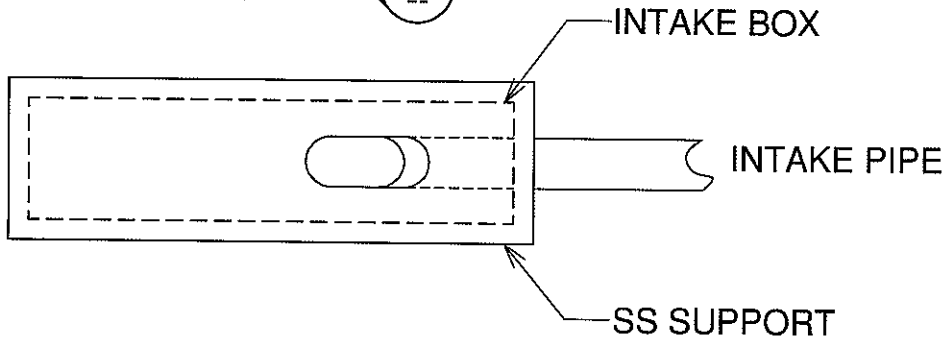

PLAN
SCALE 1 ; 50

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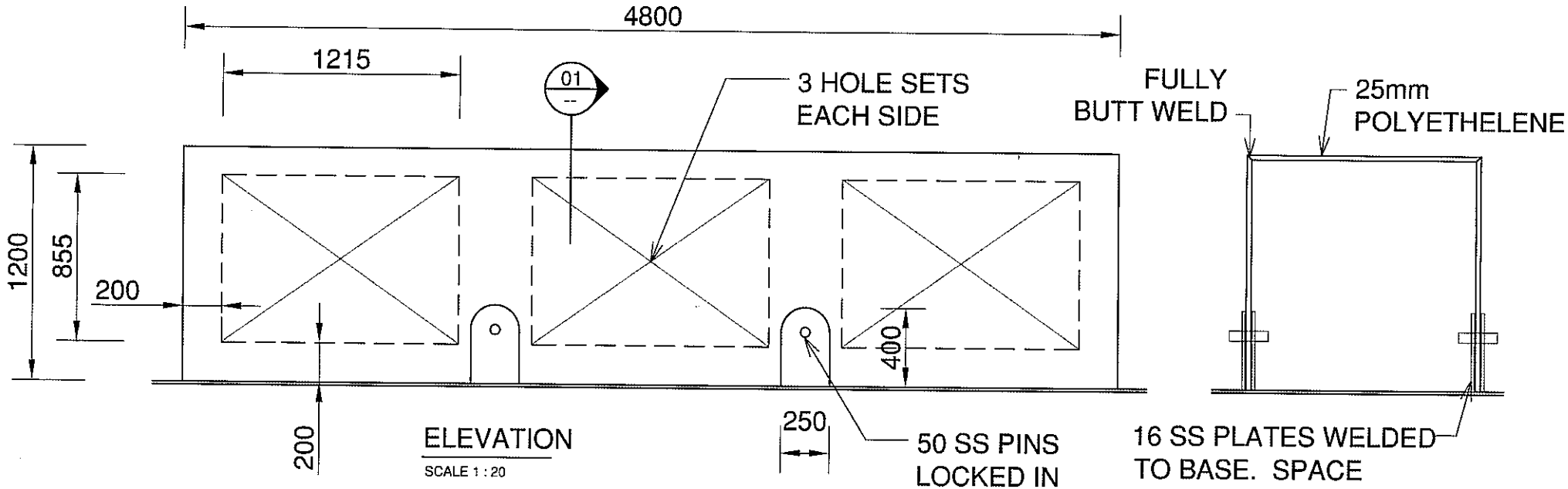

ELEVATION

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SECTION 01 --

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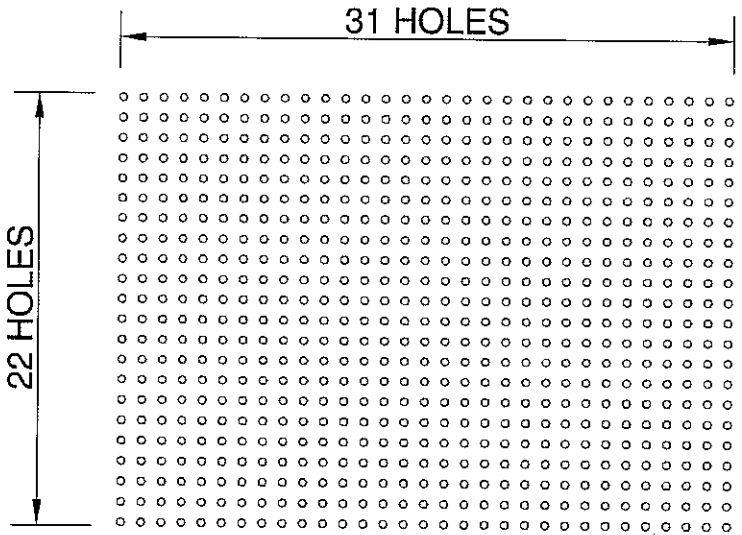

HOLE SET

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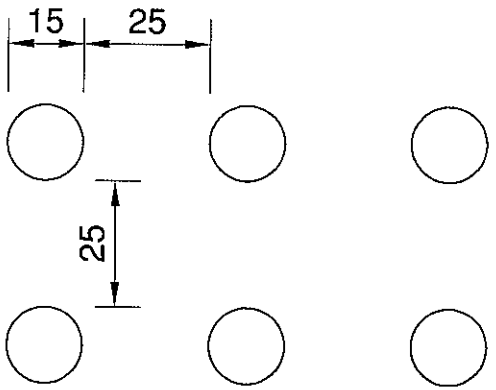

HOLE DETAILS

SCALE 1 : 1

PRELIMINARY

682 HOLE SET
TOTAL No. 4092 HOLES

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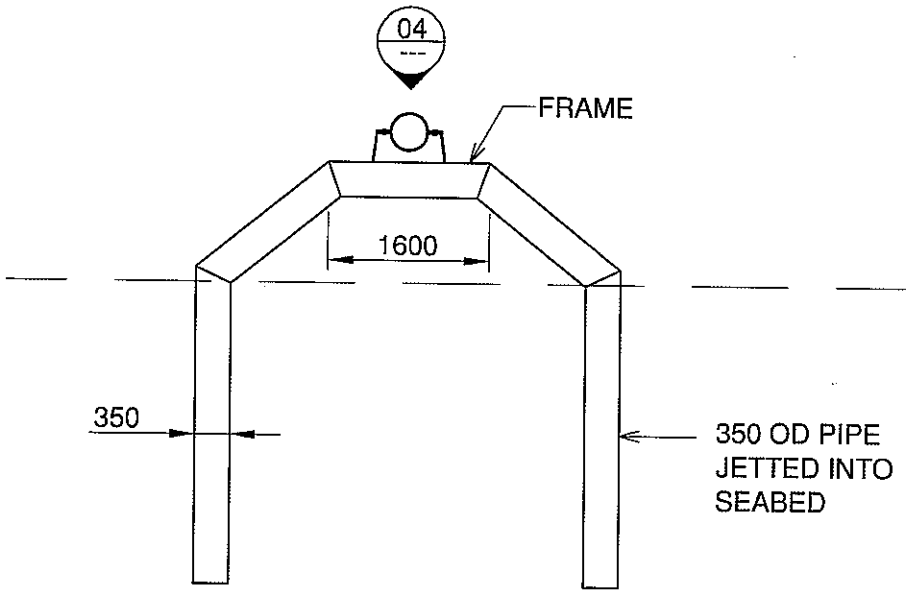

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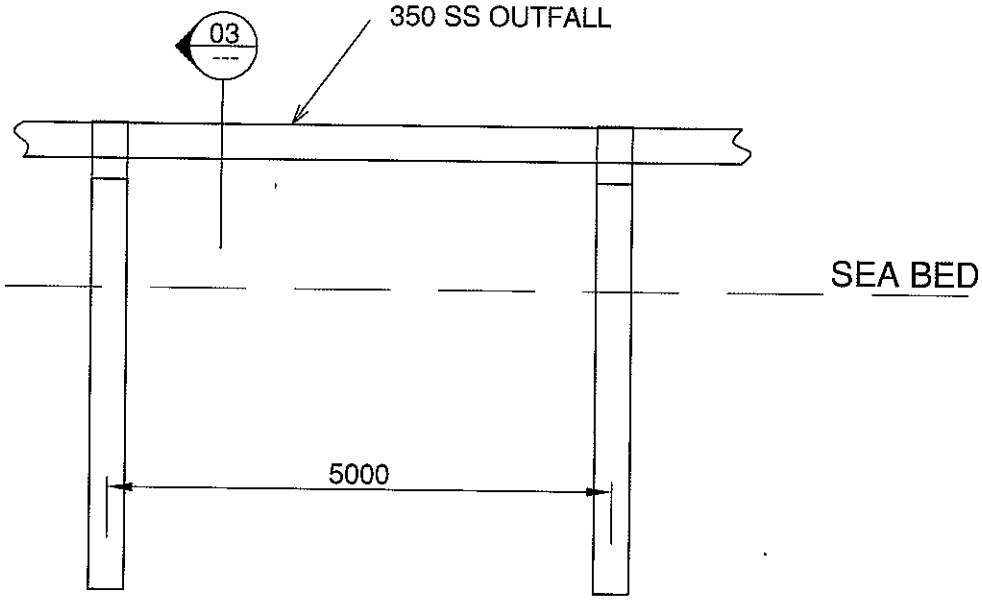

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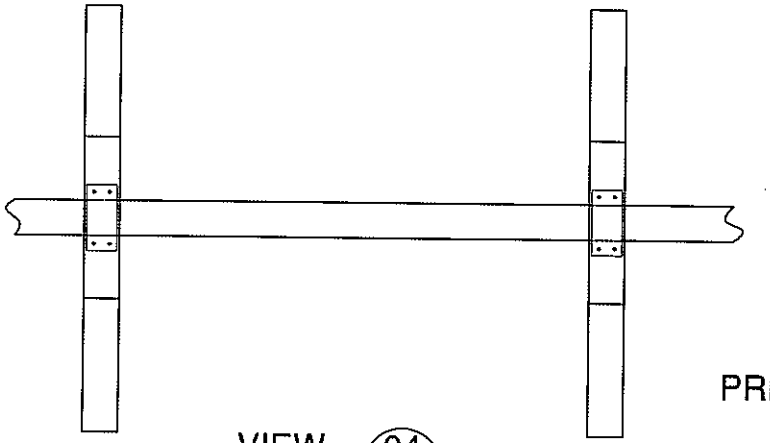

VIEW 04
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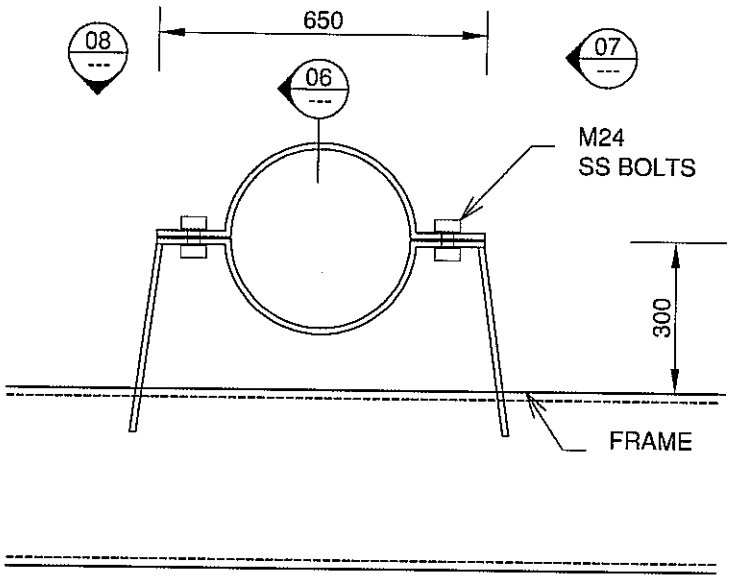

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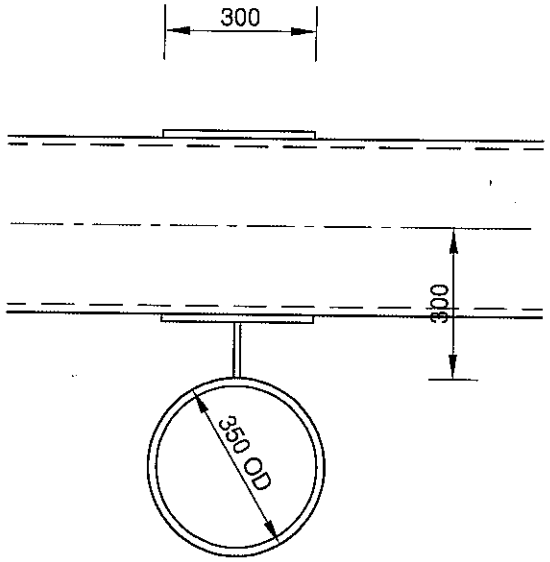

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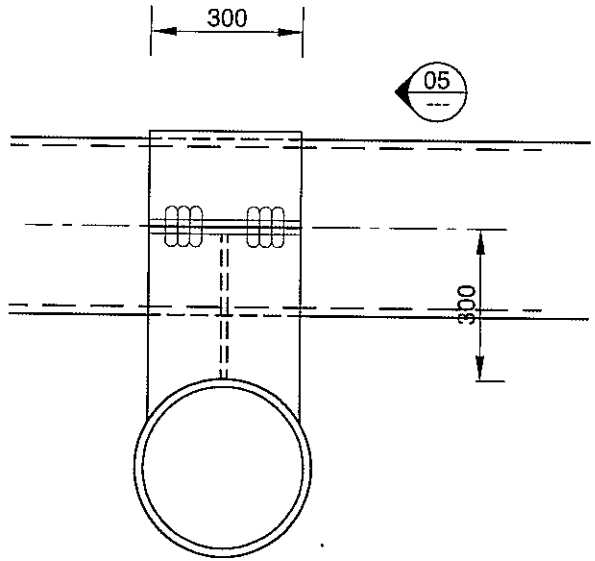

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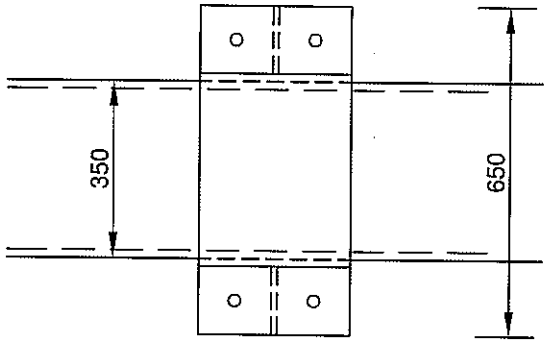

PLAN 08
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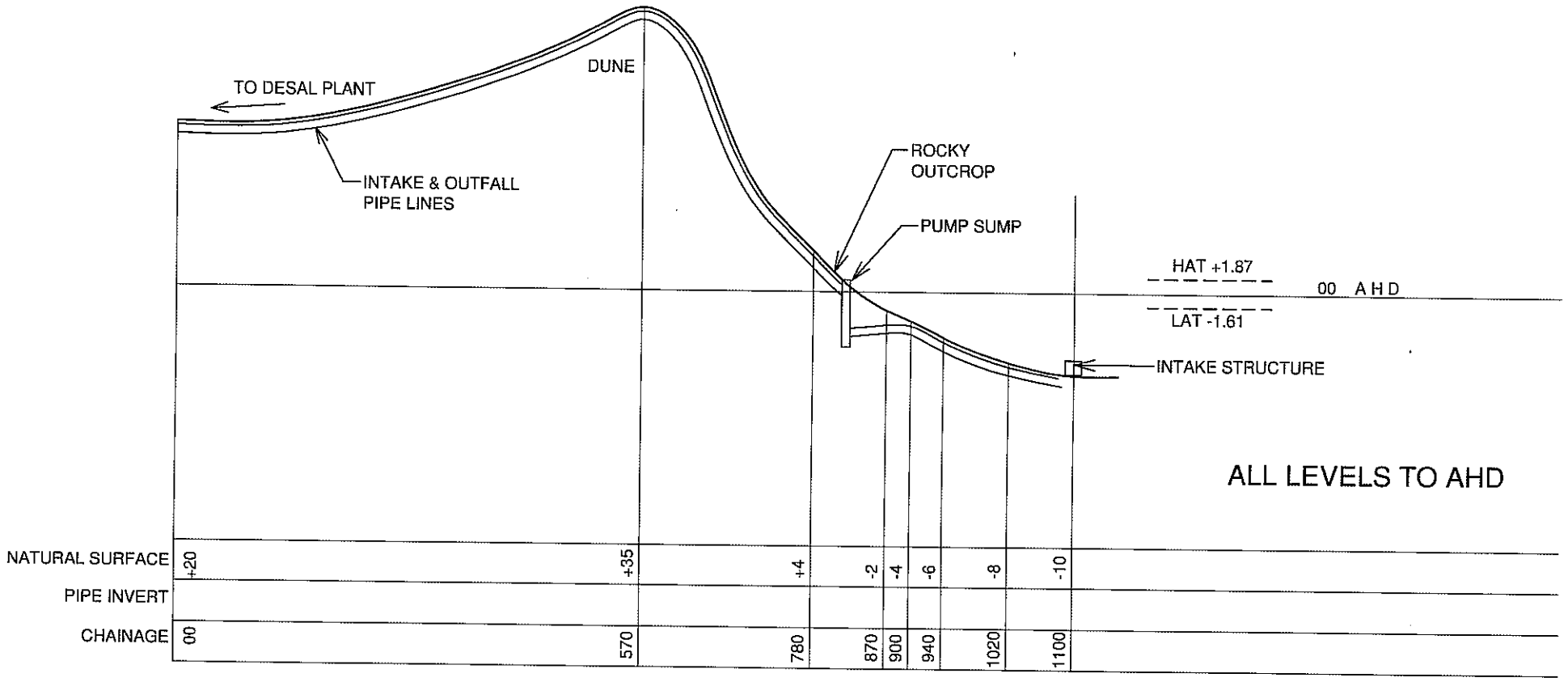

LONGITUDINAL SECTION

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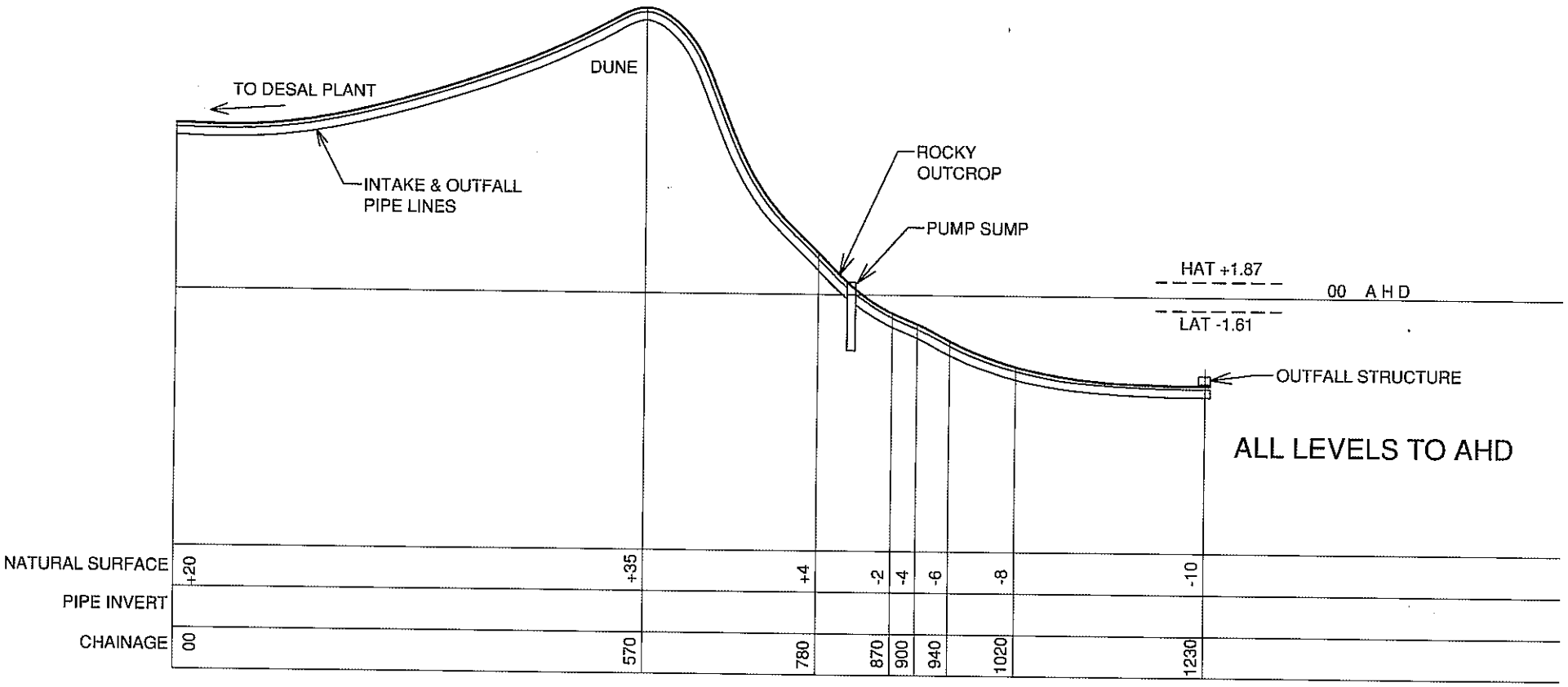

LONGITUDINAL SECTION

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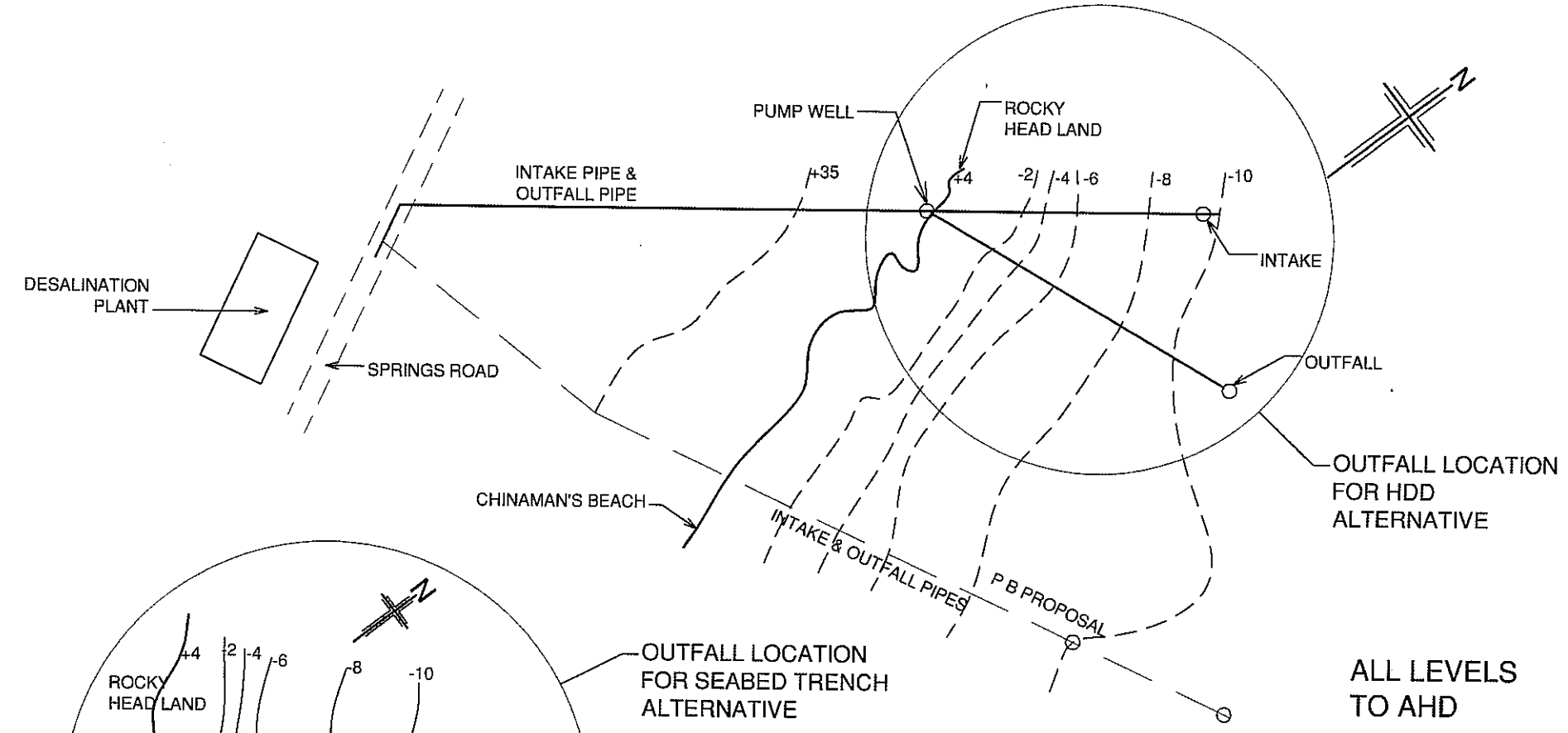
VER 1 : 500

PRELIMINARY

JOHN CHAPPELL ENGINEERS CONSULTING CIVIL ENGINEERS COASTAL STRUCTURAL HARBOUR MARINAS 5 HAWTHORN CRES. HAZELWOOD PARK S.A. 5066 FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499 MOBILE: 0428 282 130	CLIENT: MIRIAM VALE SHIRE COUNCIL	DRAWN: JC	CHECKED:	DATE: 04/12/2006
	DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN **OPTION 1**	SCALE AS SHOWN	DIRECTOR	
	OUTFALL PIPE LONGITUDINAL SECTION	THIS DRAWING COPYRIGHT	**50 07**	REVISION **A**



ALL LEVELS TO AHD

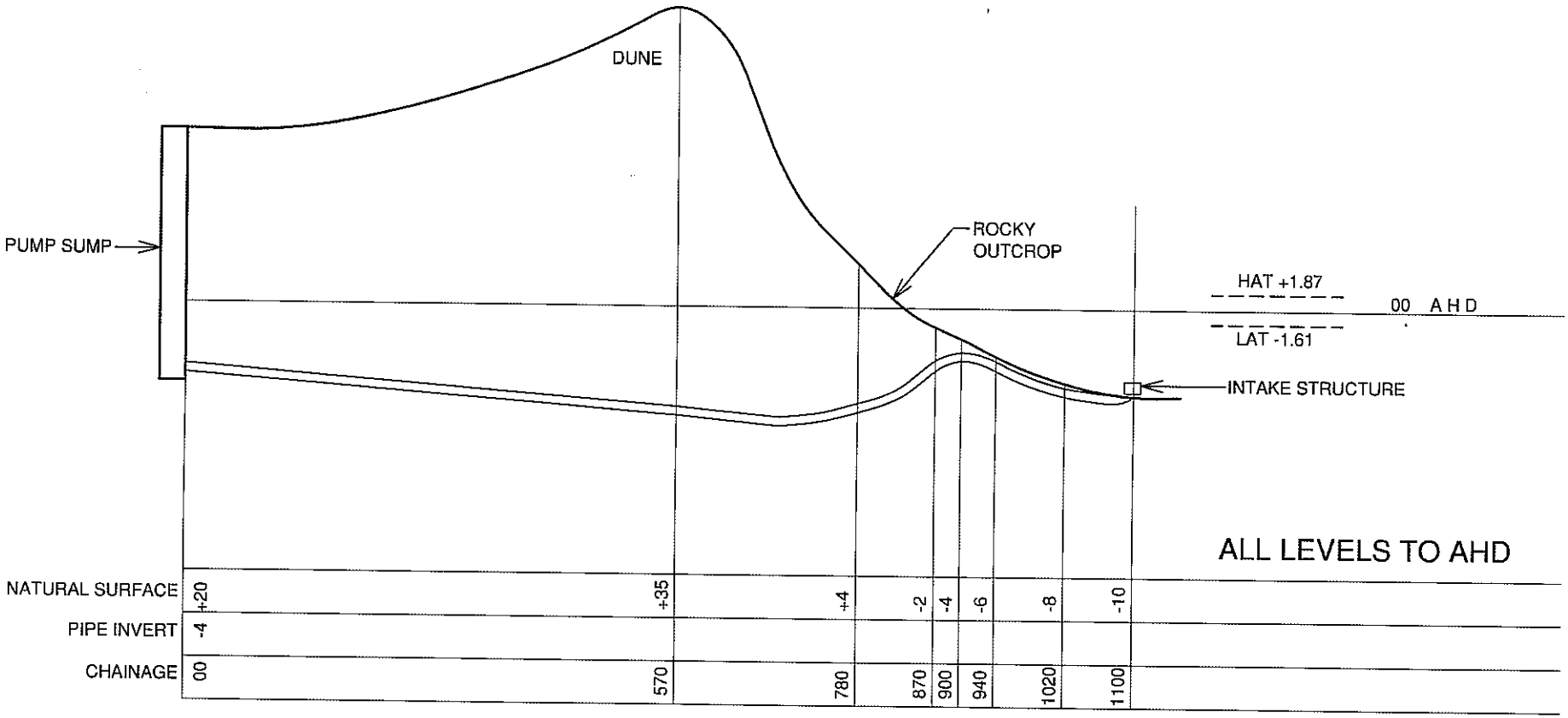
INTAKE & OUT FALL PIPE LINE LAYOUTS

SCALE 1 : 5000

PRELIMINARY

JOHN CHAPPELL ENGINEERS
CONSULTING CIVIL ENGINEERS
COASTAL STRUCTURAL HARBOUR MARINAS
5 HAWTHORN CRES. HAZELWOOD PARK S.A. 5066
FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499
MOBILE: 0428 282 130

CLIENT: MIRIAM VALE SHIRE COUNCIL	DRAWN: JC	CHECKED:	DATE: 04/03/2007
DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN **OPTION 1**	SCALE 1 : 5000		DIRECTOR
PIPE LINE LAYOUT	THIS DRAWING COPYRIGHT	**50 08**	REVISION **B**

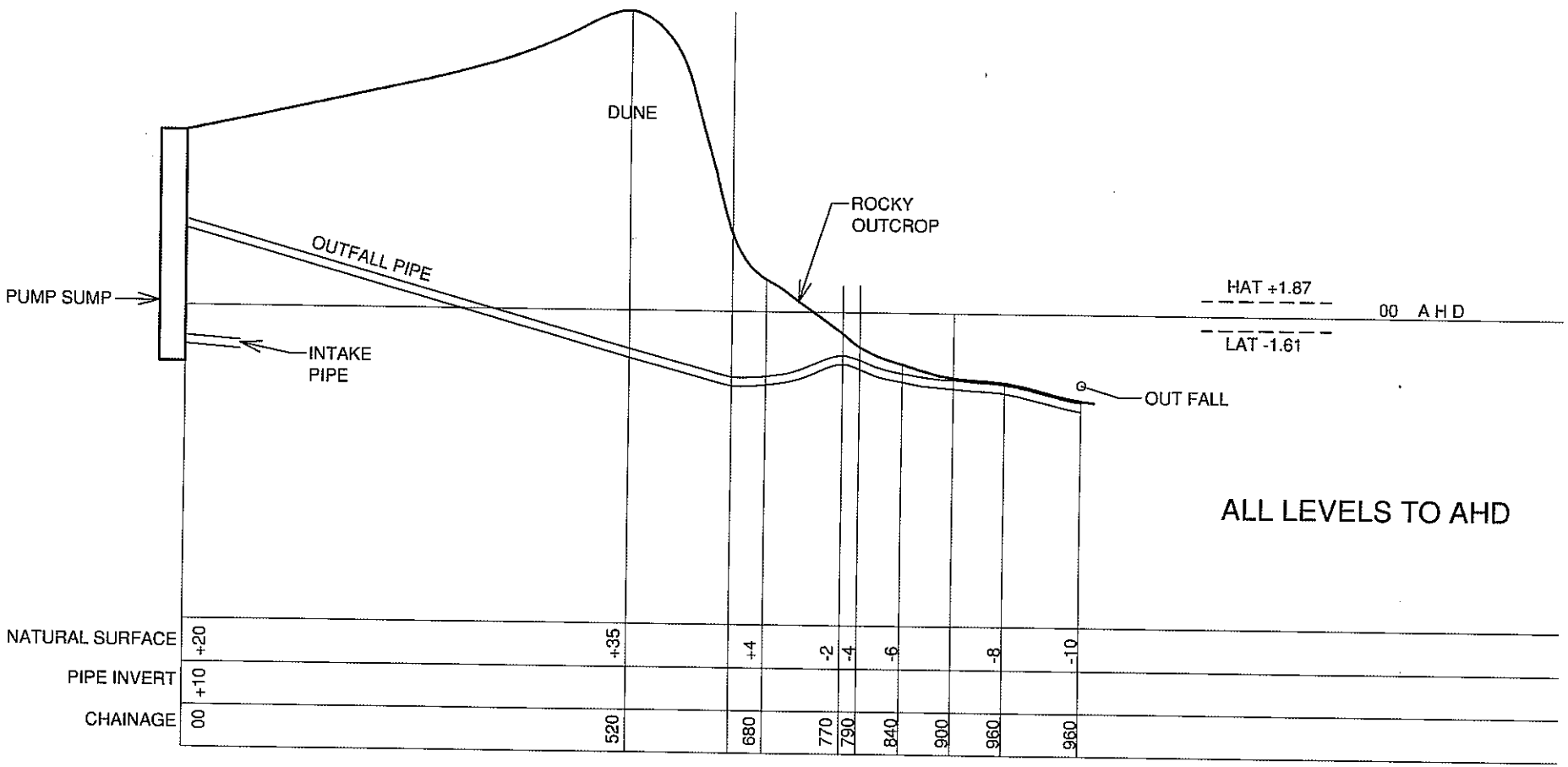


LONGITUDINAL SECTION

SCALE HOR 1 : 5000
VER 1 : 500

PRELIMINARY

JOHN CHAPPELL ENGINEERS CONSULTING CIVIL ENGINEERS COASTAL STRUCTURAL HARBOUR MARINAS 5 HAWTHORN CRES. HAZELWOOD PARK S.A. 5066 FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499 MOBILE: 0428 282 130	CLIENT: MIRIAM VALE SHIRE COUNCIL	DRAWN: JC	CHECKED:	DATE: 07/12/2006
	DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN **OPTION 2**	SCALE AS SHOWN		DIRECTOR
	INTAKE PIPE LONGITUDINAL SECTION	THIS DRAWING COPYRIGHT	**50 09**	REVISION **A**

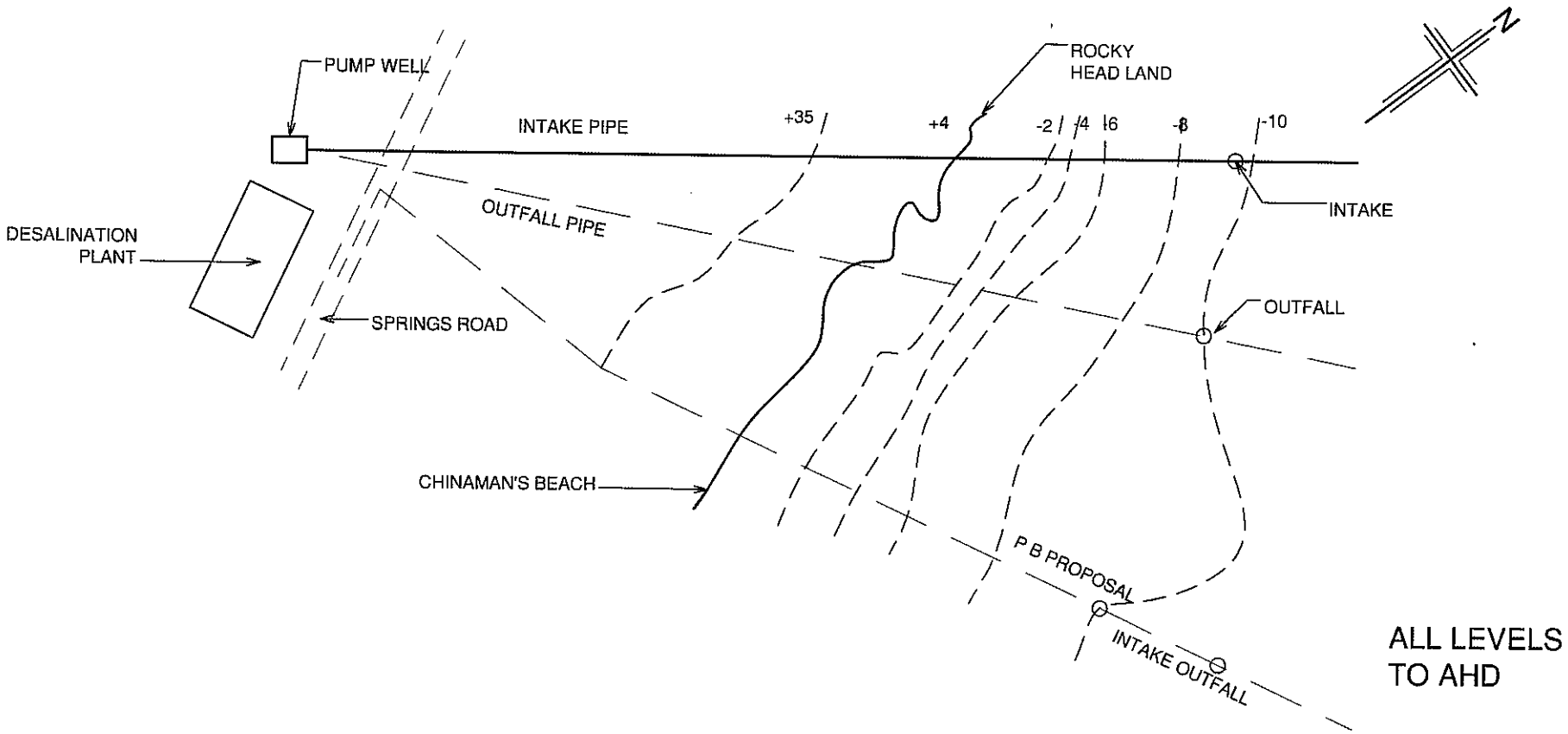


LONGITUDINAL SECTION

SCALE HOR 1 : 5000
VER 1 : 500

PRELIMINARY

JOHN CHAPPELL ENGINEERS CONSULTING CIVIL ENGINEERS COASTAL STRUCTURAL HARBOUR MARINAS 5 HAWTHORN CRES, HAZELWOOD PARK S.A. 5066 FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499 MOBILE: 0428 282 130	CLIENT: MIRIAM VALE SHIRE COUNCIL	DRAWN: JC	CHECKED:	DATE: 07/12/2006
	DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN **OPTION 2**	SCALE AS SHOWN		DIRECTOR
	OUTFALL PIPE LONGITUDINAL SECTION	THIS DRAWING COPYRIGHT	**50 10**	REVISION **A**



INTAKE & OUT FALL PIPE LINE LAYOUTS

SCALE 1 : 5000

PRELIMINARY

JOHN CHAPPELL ENGINEERS CONSULTING CIVIL ENGINEERS COASTAL STRUCTURAL HARBOUR MARINAS 5 HAWTHORN CRES. HAZELWOOD PARK S.A. 5066 FACSIMILE: 08 8332 9919 PHONE: 08 8331 9499 MOBILE: 0428 282 130	CLIENT: MIRIAM VALE SHIRE COUNCIL	DRAWN: JC	CHECKED:	DATE: 07/12/2006
	DESALINATION PLANT AGNES WATER ALTERNATIVE DESIGN **OPTION 2**	SCALE 1 : 5000		DIRECTOR
	PIPE LINES LAYOUT	THIS DRAWING COPYRIGHT	**50 11**	REVISION **A**