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インドネシア国
南バリ再生水利用事業準備調査
(PPP インフラ事業)

最終報告書
第Ⅲ部　付属資料

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南バリ再生水利用事業準備調査

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再生水水需要に関する
インタビュー調査

付属資料 1　　再生水水需要に関するインタビュー調査

1.a はじめに

南バリの調査対象地域における再生水の需要を把握するため、発電所、港湾施設、大規模ホテル、ゴルフ場、ショッピングモール等を対象に再生水需要調査を行った。調査は対象施設の給排水施設管理責任者を直接訪問し、事前に準備した質問票によりインタビューを行った。

1.b 調査方法

再生水の需要は、その水質および料金によって影響を受ける。このため、インタビュー調査では、以下の３つの再生水の水質レベルを設定し、それぞれの水質レベルを持つ再生水の需要量を把握するよう努めた。なお、レベル１の再生水は、調査対象者の再生水に対するイメージ等を聞くために設定したレベルである。

レベル 1 の再生水：直接および間接的な飲用水および調理用水として利用できる再生水。

レベル 2 の再生水：飲用水、調理用水として利用できる水質（レベル１）ではないが、その他の用途（シャワー、プール、手洗い、トイレのフラッシング、景観用の池、庭への散水等）には水質上問題なく利用できる再生水。

レベル 3 の再生水：池等の景観用水、庭木への散水用水に利用できる再生水。なお、それ以外の用途には水質上問題がある。

つぎに、再生水の料金については、必要な再生水処理施設の処理プロセスの種類と規模、再生水の送水に必要となる管路施設の規模（口径と延長等）、ポンプ施設の規模により大きく変わる。インタビュー調査は、本調査の調査開始時期に実施しており、これらの施設の建設や維持管理に必要な費用を考慮した再生水料金を設定できる段階にはなかった。このため、インタビュー調査では、再生水の料金を設定せず、各レベルの再生水に対する支払意志額（再生水の料金単価）を質問することとした。また、調査対象施設において再生水を利用するために必要となる受水槽、建物内の二元給水配管（上水用と再生水（中水）用の独立した配水管、給水管）等の設置の必要性や設置費用の最大負担額についても質問することとした。

なお、インタビュー調査では、各施設における再生水需要の背景を理解するため、現在の水源および用途別の水量、給水施設の現状と規模、排水施設・汚水処理施設とこれらの設置や維持管理に要する費用等についても質問した。

1.c 調査表

JICA Preparatory Survey on Application of Wastewater Reclaiming in Southern Bali Water Supply System

Request of Cooperation for a Demand Survey on Water Reuse in Bali

To: Potential Customers

We, Japan International Cooperation Agency (JICA) Study Team, are now planning a water reuse project in Bali to further purify the treatment effluent from Denpasar Wastewater Treatment Plant and distribute the purified wastewater (i.e. reclaimed water) to hotels, golf courses, airport, etc. We believe that this reuse of wastewater can significantly benefit the hotels, golf courses, airport, etc. where expensive or low-quality alternative water sources are used.

In order to plan an effective water reuse project, we would like to interview you about the current water usages, the demand on the reuse of wastewater at your facility, etc. We would highly appreciate your cooperation.

Dr. Harutoshi UCHIDA
Team Leader
Nihon Suido Consultants, Co., Ltd.

＜Questionnaire＞

【General Information】

Facility Name:
Date of Interview: 2011 / / (AM/PM : ~ :)
Area:
Name & Position (1):
Name & Position (2):
Name & Position (3):

Q1: Size of facility and business

If hotel, please answer 1) to 6). Otherwise, please answer 1) to 3).

1) Total site area (m^2):
2) Total green area (m^2):
3) Number of employees (m^2):
4) Room number (Num.):
5) Monthly occupancy ratio in highest season (%):
6) Monthly occupancy ratio in lowest season (%):

Q2: Water quality, water quantity and costs of each water source in 2009 and 2010

Which water sources does your facility use? 1) PDAM's Clean Water 2) Own Deep Well 3) Treated Wastewater 4) Rain Water 5) BTDC's irrigation water 6) Water Tank Truck 7) Others	Water Quality: Water Quality (Qualitative and/or Quantitative Descriptions)	Water Quantity: Water Consumption in Dry Season (m^3/month) Note: Highest among July, August and September. Enough or not Enough?	Water Consumption in Rainy Season (m^3/month) Note: Lowest among December, January and February	Average Operating Cost (electricity, chemicals, maintenance contract, etc.; Rp./month and/or Rp./m^3)	Expected Timing of Renovating or Rebuilding the Hotel and Rehabilitating and Improving Internal Water Related Facilities (Qualitative and/or Quantitative Descriptions)

Q3: Does your facility have different water supply pipes separately for flushing toilet and others in the buildings?

Q4: Water sources and consumption for the Level 1 and Level 2 usages in dry and rainy seasons?

Required Water Quality	Level 1	Level 2					Level 3		
Water Usages	Drinking, Cooking and Dish Washing	Hot Bathtub and Shower	Pool	Hand Wash	Washing Clothes	Cleaning (including car, floor)	Flushing Toilet	Cooling Water	Landscape (fountain, pond, etc.)	Watering Plants (Gardening)
Water Sources						(mixing or not mixing?)				
Consumption in Dry Season										
Consumption in Rainy Season										

Q5: Please express your feeling about the usages of our reclaimed water (Level 2 and Level 3) in your facility.

Q6: Willingness to pay and demand of the reclaimed water of Level 2 and Level 3 water quality

Level 2: Unit Price ____ Rp./m^3 Initial Cost ____ Rp.
Demand ____ m^3/month
Level 3: Unit Price ____ Rp./m^3 Initial Cost ____ Rp.
Demand ____ m^3/month

Q7: Any conditions which encourage usages of the reclaimed water (e.g. subsidy for installing additional service pipes)

1.d 調査対象

調査対象施設を表 1.d.1 に示す。

表 1.d.1　再生水需要調査の対象と需要見込み

対象施設	想定した再生水の用途と需要見込み
空港	- 空港内の緑地部への散水用水およびターミナル施設内のトイレのフラッシュ用水として見込める。特にトイレフラッシュ用水は、利用者が多いため、多量の再生水の需要が見込める。
発電所	- 大量の冷却用水が見込める。敷地内の散水用水、管理棟内のトイレフラッシュ用水としての需要も見込める。
ブノア港	- 水産加工業への洗浄・清掃用水として大量の水需要が見込める。 - 船舶の洗浄用水、バラスト用水の需要も見込める。
大規模な高級ホテル（４および５スター）	- 広い庭園があり、多量の散水用水の需要が見込める。 - 宿泊者が多いため、施設内で多量のトイレフラッシュ用水の需要が見込める。 - 高い地下水の利用税が課せられており、地下水の代替水として再生水を利用する可能性が期待される。
ゴルフ場	- ゴルフコース維持のため、多量の散水用水の需要が見込める。
新規のリゾート開発（スランガン島）	- 過去にリゾート開発構想がスランガン島にあった。その後の開発動向次第では、ホテル等の施設立地に伴う、散水用水、トイレフラッシュ用水等の需要が見込める。
大型ショッピングモール	- トイレフラッシュ用水や散水用水等の需要が見込める。（カウンターパートの提案でもある）

図 1.d.1 に、需要調査の対象とした地域および施設の位置図を示す。なお、レギャン地区については、大型で高級ホテルが少なく、散水用水需要が期待できないと考え、再生水需要調査の対象外とした。

図 1.d.1　再生水需要調査の対象とした施設および地域

1.e インタビュー調査結果

レベル 1 の再生水については、インタビュー調査を通じて、感覚的な問題（再生水とはい

え、下水を飲用、調理に使用したくない）により、需要はほとんどなかった。このため、以下のインタビュー調査結果では、レベル 2 および 3 の再生水を中心に、調査対象とした施設別、地域別の再生水需要を整理して述べる。

(1) 発電所 (Indonesia Power)

この発電所は、再生水処理施設の建設を検討しているデンパサール下水処理場の近くにあるため、再生水の供給先として期待された。しかし、冷却水を多量に使用する発電システムではないことが判明した。また、発電所内の汚水処理施設からの処理水を庭木の散水用水として使用しており、レベル 3 の再生水に対する需要は少ないことが分かった。一方、レベル 2 の再生水については､発電所への地下水の利用税の単価である Rp.228/m^3(2 円/m^3) 以下なら可能性があるとの回答を得たが、現行の地下水単価がかなり安価に設定されているため、現状では地下水による生活用水の代替水源としてレベル 2 の再生水需要は期待できないと思われる。

(2) グラライ国際空港

この空港では、PDAM の上水は少量しか使用してなく、空港敷地内にある深井戸からの地下水に頼っている。現在、空港ターミナルを拡張する計画（現在入札段階にあり、2013 年に施設完成を予定）を進めており、今後も地下水を主な水源として利用する計画となっている。一方、発生した汚水は、現在汚水処理施設から処理水を直接海に放流しているが、施設拡張に伴い処理施設も改善して、処理水を散水用水、トイレフラッシング用水、冷却用水等として利用する構想がある。また、この処理水量は、ターミナル拡張後の再生水の需要に対して十分であるとの回答があり、レベル 2 およびレベル 3 の再生水の需要は、現状では厳しい状況にある。

しかし、今後、給水計画の柱となっている地下水が、法的な利用規制、水質上の問題等から地下水利用が抑制され、汚水処理施設の再生水利用の採算性や維持管理上の問題から改善計画の実施や運転が困難となった場合には、再生水利用の需要先として有望と考えられる。従って、将来の需要先として有望であることから、再生水利用を検討してもらうよう積極的な営業活動が継続して実施する必要があると思われる。

(3) ブノア港

バリ州政府が独自に検討した再生水事業において、再生水の供給先となっているが、再生水の具体的な用途については言及されていない。

再生水としては、船舶の洗浄用水、バラスト用水、水産加工業への洗浄用水、清掃用水として大量の水需要が見込めると期待された。船舶の洗浄用水、バラスト用水についての需要は今回のインタビュー調査では把握できなかった。水産加工業では現在地下水を利用し

ているが、地下水の利用税は 2011 年 1 月から Rp. 1,216/m^3 (約 11 円/m^3)とかなり安価な設定となっている。地下水が主に使われている現状では、レベル 2 及びレベル 3 の再生水の需要はかなり厳しい状況にある。

しかし、今回の調査では明らかにすることができなかった船舶の洗浄用水やバラスト用水の需要が見込めれば有望な需要先となる。また、地下水利用が法的に規制されるような状況になると、再生水の需要は増加することが期待される。

(4) ゴルフ場

調査対象地域には、ふたつのゴルフ場がある。ひとつは、サヌール地区にあるグランド・バリ・ゴルフ場（9 ホール）である。もうひとつは、ヌサドゥア地区にあり、国家的な観光プロジェクトとして開発されたバリ観光開発公社（Bali Tourism Development Cooperation 、BTDC）エリア内にあるバリ・ゴルフ・カントリークラブである。これらのゴルフ場での再生水用途としては、コース内の散水用水（レベル 3 の再生水）とクラブハウスでのトイレフラッシュ用水、シャワー用水等（レベル 2 の再生水）が考えられるが、レベル 2 の再生水については、大量の需要を見込めず、また、二元給水配管工事等が必要となるため、需要は期待できない。そこで、以下では、レベル 3 についての調査結果を述べる。

サヌール地区にあるグランド・バリ・ゴルフ場では、隣接するイナ・グランド・バリ・ビーチホテル（Inna Grand Bali Beach Hotel）で発生した汚水の処理水をゴルフコースでの散水に利用している。また、最悪ホテルの処理水を散水利用できない緊急事態が発生しても、近くの河川水を緊急的に確保して利用できることが可能となっているため、現時点ではレベル 3 の再生水の需要は少ない。しかし、サヌール地区では、下水管が整備されつつあり、下水道への接続が法的に強制され、ホテル敷地内での汚水処理施設の利用が難しくなれば、レベル 3 の再生水の需要が期待される。

ヌサドゥア地区にあるバリ・ゴルフ・カントリークラブでは、発生した汚水を BTDC の下水処理場にて処理し、その処理水を再生水（以後、BTDC 灌漑用水と記す）として購入して散水用水等に利用している。通常乾期には 500m^3/日程度の散水用水が必要であり、その内 100m^3/日程度はゴルフ場内の雨水貯水池の水を利用し、残りの 400m^3/日程度は、BTDC 灌漑用水をできるだけ用い、不足分は地下水を用いている。

バリ・ゴルフ・カントリークラブへの BTDC 灌漑用水供給量実績（後述の表 1.e.1）によると、BTDC の下水処理場からゴルフ場への再生水最大供給量は 10,200m^3/月（2009 年 10 月）であり、日量換算で 329m^3/日であった。この実績を元に、レベル 3 の再生水需要量は、乾期に散水のため必要な 500m^3/日から、雨水 100m^3/日および BTDC の再生水 329m^3/日を差し引いた約 70 m^3/日程度となる。BTDC 灌漑用水は水質が悪いため、ゴルフ場内にある別の池で、BTDC 灌漑用水と深井戸から取水した地下水を混ぜて散水用水として利用してい

る。2009 年以降は、地下水の利用税が高くなったため、地下水の代替水源として再生水の需要はあるが、その需要量はわずか 70 m^3/日程度である。なお、BTDC 灌漑用水の価格 Rp. 6,812/m^3 (約 64 円/m^3)よりも安く供給できれば、レベル 3 の再生水を購入する可能性もあるとの回答を得ている。

以上の調査結果から、ゴルフ場でのレベル 3 の再生水の需要量は、現状では少ないが、下水道への接続や BTDC の今後の再生水供給サービスの動向次第ではレベル 3 の再生水の需要は期待される。

(5) 大規模ホテル

1) サヌール地区

サヌール地区には、客室数が多く、庭園も広く、再生水の需要が高いと考えられる大規模ホテル（4 もしくは 5 スターホテル）が 10 箇所程度ある。本調査では、バリ・ハイアットホテル（Bali Hyatt、5 スターホテル）とサヌール・パラダイス・プラザホテル（Sanur Paradise Plaza Hotel、4 スターホテル）等を対象にインタビュー調査を行った。

バリ・ハイアットホテルでは、汚水処理施設があり、その処理水を庭園の散水用水および池の景観用水として使用しており、将来は、冷却水としても利用できるように汚水処理を改善する構想がある。このため、レベル 3 の再生水の需要は少ないと考えられる。また、レベル 2 の再生水をトイレのフラッシング用水等に利用するには、建物内の配管を二元給水配管にするため大掛かりな工事が必要となり、レベル 2 の再生水の利用は想定していないとの回答があった。現状ではレベル 2 の再生水の需要は、二元給水配管が設置できるかどうかにより左右されると考えられる。

サヌール・パラダイス・プラザホテルについて、まずホテルの庭園が狭く、散水用水の需要は乾季でも 5m^3/日程度しかないため、レベル 3 の再生水の需要はほとんど期待できない。レベル 2 の再生水については、二元給水配管設置工事は難しいことからトイレフラッシュ用水の利用は限定されること、またプール用水については循環利用されており、追加分の水使用量は少量であり、再生水は水質が良くてもイメージ上悪いため、レベル 2 の再生水の利用は難しいとの意見があった。

2) ヌサドゥア地区

ヌサドゥア地区には、国家的な観光プロジェクトとして開発された BTDC のサービスエリア（以後、BTDC エリアと記す）があり、大規模ホテル（4 もしくは 5 スター）が 10 箇所程ある。これらのホテルでは、発生した汚水を BTDC の下水処理場で有料で処理してもらい、一部の処理水を BTDC 灌漑用水として購入し、庭園の散水用水等に利用している。

BTDC が持つ下水処理場の計画設計能力は 10,000m^3/日だが、現在は平均 5,000m^3/日程度、最大 6,000m^3/日程度の流入下水しか処理していない。この現処理水量の 40%である

2,400m^3/日程をさらに処理（施設設計処理能力、3,000m^3/日）して、BTDC 灌漑用水として有償で供給している。現在 BTDC は、下水処理施設及び再生水処理施設の改善計画を BOT 事業として進めており、今後も改善計画の動向を注視する必要がある。

BTDC エリア外では、大規模ホテル（４もしくは５スターホテル）が４箇所ほど存在するが、ホテル内の発生汚水は自前の処理施設で処理しており、BTDC 灌漑用水を利用していない。

以上の状況を踏まえ、ヌサドゥア地区の大規模ホテルでの再生水需要調査結果について、BTDC エリア内及びエリア外のホテルの順に記述する。

< BTDC エリア内にある大規模ホテル>
BTDC エリア内にある大規模ホテルのうち、BTDC の下水処理場の近くに位置するクラブメドホテル（Club Med)、遠くに位置するアユドヤ・リゾートホテル（Ayodya Resort）とノボテル・ヌサドァホテル（Novotel Nusa Dua)、およびそれらの中間に位置するメリア・バリ・リゾートホテル（Melia Bali Villas Resort）等のホテルを対象に、インタビュー調査を行った。

当初、BTDC エリアでは、BTDC 灌漑用水の供給が行われているため、建物内の給水配管が二元給水配管となっているホテルが存在すると聞いていたが、BTDC およびホテルへのインタビュー調査を通して、そのようなホテルは存在しないことが明らかとなった。

まず、レベル 2 の再生水の需要について、ノボテル・ヌサドァホテルとクラブメドホテルは、レベル 2 の再生水を供給するには、ホテルの壁を壊して再生水専用の配管工事を実施する必要があり、工事実施は難しいとの回答があった。

アユドヤ・リゾートホテルでは、ホテル内の配管が老朽化（20 年以上利用）により水漏れが頻繁している。このため、二元給水配管を含めた改善策を検討する必要があり、レベル 2 の再生水の料金次第では、その再生水の利用を検討しても良いとの回答があった。このホテルでは、深井戸の地下水を最大 200m^3/日程度使用しており、再生水の利用を検討する際には、再生水料金が地下水利用税よりも安価であるかどうかが大きく影響するものと考えられる。

BTDC エリア内では、2011 年中に 3 つのホテル（マリオットホテル 250 室、ロイアル・カムエラホテル 50 室、ラグナー・ビラ 50 室）が建設され、合計 350 室増える予定である。さらに３つの施設（ビラ NW-2 20 室、N-5 200 室、会議場 5000 席）の建設も予定されている。これらの施設が建設されれば、上水の需要はさらに増えることになるが、現状では給水量の増加には限界があることは前節で述べたとおりである。したがって、ホテル施設内に二元給水配管の設置を図り、レベル 2 の再生水の利用を積極的に推進することは、限られた上水を効率的に利用することにもなる。

つぎに、レベル 3 の再生水の需要については、アユドヤリゾートホテル以外の 3 つのホテルでは、BTDC 灌漑用水の給水量が十分であるとの回答があった。表 4.3.2 に示したように、BTDC の下水処理場から最も遠くに位置するセイント・レジス・バリ・リゾートホテル（St. Regis Bali Resort）に対しても BTDC 灌漑用水が多量に供給されている。BTDC 灌漑用水の供給が少ないといった苦情もないことから、BTDC 灌漑用水供給で満足されている。このような現状では、レベル 3 の再生水の新規の需要はほとんど期待できない。

なお、アユドヤリゾートホテルでは、BTDC の下水処理場からの再生水の給水量が十分でないため、乾期にはホテル内の池に貯めた雨水を 100m^3/日程度、庭園用に利用しているとの回答を得た。しかし、ホテル内の池に貯めた雨水は無料であること、ノボテル・ヌサドゥアホテルには BTDC からの再生水が十分に届いていることから、アユドヤリゾートホテルだけが、BTDC 灌漑用水の供給量が不足しているとは考えにくく、有償である BTDC 灌漑用水と比べ無償の雨水の利用を図っている可能性が高い。

以上のことから、BTDC 灌漑用水の供給は、水量の面で BTDC 内における散水用水の需要を満たしていると考えられる。

表 1.e.1　BTDC 灌漑用水の施設別供給水量（2009 年）

NO	NAMA INVESTOR	AIR IRIGASI TH 2009 (VOLUME DALAM M3)												TOTAL TH 2009
		JAN	PEB	MAR	APRIL	MEI	JUNI	JULI	AGST	SEPT	OKT	NOP	DES	
1	Club Med	47,00	-	-	4.352,00	6.012,00	5.681,00	7.095,00	8.334,00	2.718,00	6.981,00	4.381,00	1.808,00	47.409,00
2	NDBH (PT. Sejahtera Ind)	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Melia Bali	488,00	94,00	4,00	1.761,00	1.979,00	1.690,00	5.082,00	9.036,00	5.916,00	8.423,00	7.860,00	7.130,00	49.463,00
4	Hotel Putri Bali	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Sheraton Nusa Indah/NDGI	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Grand Hyatt	-	-	1.324,00	-	3.346,00	4.786,00	7.690,00	8.566,00	5.143,00	7.601,00	4.952,00	1.414,00	44.822,00
7	PT. KAKL/Sheraton Lagoon	-	-	-	-	-	-	-	-	-	-	-	-	-
8	PT. Banigati Betegak	-	-	-	-	-	-	-	-	-	-	-	-	-
9	PT. Bali Nusadewata Villaqe	-	-	-	-	-	-	-	-	-	-	-	-	-
10	PT. Chikara Inti Bahagia	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Bali Golf & C. Club	-	-	-	23.000,00	15.000,00	11.000,00	10.500,00	575,00	1.000,00	10.200,00	16.500,00	19.500,00	107.275,00
12	PT. Inti Putra M/Bali Desa	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Metafora (LOT SW2)	-	98,00	101,00	127,00	318,00	546,00	879,00	1.776,00	820,00	1.098,00	582,00	611,00	6.956,00
14	Sentral Telephone	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Melia Benoa/Citra Rapi	162,00	128,00	392,00	1.154,00	1.059,00	1.103,00	996,00	270,00	215,00	220,00	99,00	157,00	5.957,00
16	Hann Restaurant/PT. BSS	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Hotel Grand Bali/Intersis	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Conrad Bali Resort/OIB	705,00	267,00	911,00	1.971,00	4.862,00	1.756,00	4.712,00	5.363,00	2.453,00	5.144,00	3.500,00	1.300,00	32.944,00
19	Villa Kayu Manis/Blok S/Partha Stana	33,00	3,00	67,00	275,00	334,00	547,00	570,00	529,00	524,00	468,00	478,00	209,00	4.037,00
20	St. Regis/PBRI (S-6)	-	-	1.583,00	3.304,00	1.216,00	2.369,00	6.349,00	6.753,00	7.800,00	11.019,00	9.590,00	7.198,00	57.181,00
21	Common Area	233,00	2.193,00	6.668,00	9.910,00	17.727,00	12.948,00	22.356,00	37.109,00	21.681,00	27.544,00	22.580,00	7.742,00	188.691,00
22	GPL	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Bali Tropic	-	-	-	-	-	-	-	-	-	539,00	49,00	13,00	
24	Proyek N-5	98,00	-	-	-	-	-	-	112,00	1.053,00	211,00	244,00	368,00	2.086,00
	TOTAL	1.766,00	2.783,00	11.050,00	45.854,00	51.853,00	42.426,00	66.231,00	78.423,00	49.323,00	79.448,00	70.815,00	47.450,00	546.821,00

BTDC エリアでは、前述したように、宿泊施設が 2011 年中に 350 室、その後さらに 220 室増設され、会議場 5,000 席の建設も予定されている。これらの施設は、BTDC 内で元々緑地であった土地に建設されることから、結果的には緑地面積が減り、BTDC 内のレベル 3 の再生水の需要量は今後多少減少する方向にあるとも考えられる。

< BTDC エリア外にある大型ホテル >
BTDC エリア外のホテルで、最も客室数が多いニッコウ・バリ・リゾート&スパホテル（Nikko Bali Resort and Spa）を対象にインタビューを実施した。このホテルでは、深井戸の地下水を使用しており、汚水はホテル敷地内に設置した汚水処理施設で処理し、処理水の全てを庭園の散水用水、冷却用水、池等への景観用水に利用している。これらの用途の水は今後も不足することはなく、レベル 3 の再生水の需要はほとんど期待できないことが明らかになった。一方、レベル 2 の再生水については、建物内を二元給水配管にする工事を全額負担してくれるならば、プール用水（20-25m^3/日）、洗濯用水(70-80m^3/日)およびトイレのフラッシュ用水として、Rp.10,000/m^3 程度であれば購入してもよいとの回答を得た。

ヌサドゥア地区の BTDC エリア外では、今後 3 つのホテル（Mulia、Ritz Calton、Kedung New Wall Hotel）と 1 つのビラの建設が予定されている。そこで今後上水の需要はますます増えるが、前節で述べたように、給水量の増加は難しいと考えられる。BTDC エリア外のホテルでも、今後レベル 2 の再生水の利用を図る必要性は高いと考えられる。

以上の観点から、ヌサドゥア地区の BTDC エリア外の大規模ホテルにおいては、レベル 3 の再生水は、ホテル内に設置した汚水処理施設での処理水を散水利用しているため、その需要はあまり期待できない。一方、レベル 2 の再生水については、今後上水の需要が増加するが上水の供給量の増加は難しいため、再生水の需要を喚起し積極的利用を図る必要があると考えられる。

3) ブノア地区
ブノア地区では、BTDC の下水処理場の近くに位置する 3 つのホテル(Melia Benoa, Bali Tropic Resort and Spa, および Conrad Bali Resort）等の大規模ホテルを対象にインタビュー調査を行った。

レベル 2 の再生水については、ヌサドゥア地区と同様、二元給水配管の設置がその需要量を左右する。

BTDC の下水処理場の近くに位置する 3 つのホテル(Melia Benoa, Bali Tropic Resort and Spa, および Conrad Bali Resort）では、BTDC エリア外にあるにも関わらず、処理場に近いことから、ホテルで発生した汚水を BTDC の下水処理場が受け入れて処理しており、またこれらホテルも BTDC 灌漑用水を利用している。また、この 3 つのホテル以外のブノア地区にある大規模ホテルでは、独自の下水処理施設を設置し、その処理水を庭園の散水用に利用している。このような状況から、レベル 3 の再生水に対する需要は少ないと考えられる。

4) ジンバラン地区
ジンバラン地区には 3 つの大型ホテルがあり、バリ・インターコンチネンタルホテル（Bali Intercontinental）およびフォーシーズンズリゾート（Four Seasons Resort）を対象にインタ

ビュー調査を実施した。ホテルの敷地内に独自の汚水処理施設を設置し、処理水を散水利用していることからレベル 3 の再生水の需要は現状ではあまり期待できない。一方、レベル 2 の再生水については、二元給水配管設置の設置できれば、再生水の需要をある程度は見込めると考えられる。

5) クタ地区

クタ地区ではバリダイナスティリゾート（Bali Dynasty Resort）、ハードロックホテルバリ（Hard Rock Hotel Bali）等を対象にインタビュー調査を実施した。この地区も他の地区の大規模ホテル同様、ホテルの敷地内に独自の汚水処理施設を設置し、処理水を散水利用していることからレベル 3 の再生水の需要は現状ではあまり期待できない。一方、レベル 2 の再生水については、二元給水配管設置の設置できれば、再生水の需要をある程度は見込めると考えられる。

(6) スランガン島

スランガン島の開発は 1994 年に始まり、埋め立てにより島を 100ha から 400ha に拡張したが、1998 年のスハルト政権の崩壊とともに、開発は凍結された。この開発は住民との合意形成を行わずに進めたため、住民との利害関係上の問題が解決されていない。また、この島の埋め立て部分（現在はほぼ空き地）は、シンガポールの会社に売却されたため、バリ州政府はスランガン島開発の動向を把握できていないようである。さらに、スラガン島とブノア半島を繋ぐ橋の建設計画があったが、ブノア港と空港の反対により、建設計画が承認されなかったとの情報もある。

このような状況から、スランガン島において、近い将来にリゾート開発が行われるとは考えにくく、再生水の需要が期待できる状況にはないと考えられる。

(7) 大型ショッピングモール

本調査の対象地域であるデンパサール市およびバドン県には、５つ程度の大型ショッピングセンターがあるが、その中で最大のショッピングモールであるマル・バリ・ギャラリー（Mal Bali Galleria）を対象に、インタビュー調査を実施した。この施設では、再生水の対象となる用途として、トイレのフラッシュ用水に 30m^3/日程度、散水用水に 30m^3/日程度が期待された。しかしトイレのフラッシュ用水としてレベル 2 の再生水に対する支払意志額は、Rp. 1,000～2,000/m^3 程度とかなり低かった。また、散水用水には現在無料の河川水を使用している。水量や支払い意志額の点から、レベル 2 及びレベル 3 の再生水の需要はほとんど期待できないと考えられる。

(8) 幹線道路沿いの緑地帯および公園

バドン県政府の Dinas DKP による幹線道路沿いの緑地帯および公園への散水に対する再生

水の需要についてもインタビュー調査を実施した。Dinas DKP では、散水のため複数の川の水を無料で利用しているが、ヌサドゥア地区およびクタ地区での散水用水として利用している Mati 川から取水した水は、塩分濃度が高く、乾季には水量が減り土砂が入るなど、散水用水としては問題がある。このため、Badung 県における地下水利用税（値下げ後）の価格よりも安く再生水を購入できるのであれば、60m^3/日程度（2 台のタンクトラック（6m^3）をそれぞれ 1 日に 5 往復）の購入利用は可能であるとの回答を得た。しかし、値下げ後の政府機関向けの地下水の利用税は Rp.1,000/m^3(約 9 円/m^3)程度とかなり低く設定されると予想されるため、レベル 3 の再生水の需要は料金がネックとなると考えられる。

Result of Water Demand Survey (Hotels)

Area	No.	Hotel	Rating	Rooms	Address	Contacts(0361-)		JICA Team Attendant **)	Interview Date(2011)/Time		Current Condition							Demand Survey					Other Information
						tel.	Main Person				PDAM Tariff (Rp./m3)	Deep Well Consumption (m3/d)	Deep Well Tax (Rp./m3)	Gardening Consumption (m3/d)	Internal WWTP Operating Cost (Rp./m3)	Indoor Dual Piping System	Renovation Schedule	Possibility of the reclaimed water use	Willingness to pay	Water Use Tolerance Level: Pool	Water Use Tolerance Level: Gardening	Indoor Dual Piping Installtion Work	
Sanur	1	Aston Legend Villas	Villa	10	Jl. Cemara 33 Sanur	270567	Putu Budiarta (Chief Eng)	NT,DP	30-Mar	14.05 – 14.40	NA	500 m3/month	NA	NA	Septic tank	not installed	no schedule	can be considered	2000-3000Rp/m3	NG	OK	can not, need new investment	will connect DSDP
	2	Bali Hyatt	5 star	380	Jl. Danau Tamblingan No89 Sanur PoBox392	281234	Mikael Yaneti (Asst. Director of Engineering)	SK,SM,YK,DP	24-Feb	14:00-15:20	8,916	Abolished in 1996	Abolished in 1996	Ave300,Max700	equipped with WWTP (600m3/d),Cost: NA	not installed	Will be renovated in 2012	not required	less than 4,500Rp./m3	NG	OK	can not be installed because large scale work is required	has some interest but not necessary because they are already investing in WWTP
	3	Gazebo Beach	2 star	76	Jl. Danau Tamblingan No35 Sanur	288212	Ida Bagus Wira Adnyana(Opeation Mgr)	NT,DP	30-Mar	15.50-16.10	9,800	Capacity: NA	NA	40	Septic tank	not installed	no schedule	can be considered	2000-3000Rp/m3	NG	OK	can not, need new investment	will connect DSDP
	4	Inna Grand Bali Beach Hotel	5 star	523	Jl. Hang Tuah Sanur PoBox3275	288511	Nyoman Sukarsda(Chief Eng)	NT,DP	21-Mar	13.05-14.15	11,506	1800	9165	700	equipped with WWTP (700 m3/day) investment 300millionRp	not installed	proposal to improve cost estimated 3 billion Rp	no idea, because of new proposal for WWTP	no idea	NG	OK	can not, need new investment	waiting to connect DSDP, but the price to high
	5	La Tavelna Bali	2 star	39	Jl. Danau Tamblingan No29 Sanur	288497	Ida Ayu Armini(HRD) Pitono (Ass Chief Eng)	NT,DP	30-Mar	16.20-16.45	NA	NA	NA	9	Septic tank	not installed	no schedule	can be considered	2000Rp/m3	NG	OK	can not, need new investment	will connect DSDP
	6	Mercure Resort Sanur	4 stars	189	Jl. Mertasari Sanur	288833	I B Supresna(Chief Eng)	NT,DP	30-Mar	10.30-11.05	6,539	only back up	NA	70	equipped with WWTP (300m3)	not installed	just build new STP cost 1.3 billion	can be considered	2000-3000Rp/m3	OK	OK	can not, need new investment	will use the water 50 m3/day
	7	Puri Santrian Hotel	4 stars	182	Jl. Cemara 35 Sanur PoBox3055	288009	I Wayan Sukarsa(Chief Eng)	NT,DP	30-Mar	11.35-12.15	stand by condition	334	NA	NA	Septic tank	not installed	no schedule	can be considered	3000-4000Rp/m3	NG	OK	can not, need new investment	will use reclaimed water 50 m3/day
	8	Sanur Beach Hotel	5 stars	428	Jl. Danau Tamblingan Sanur PoBox3279	288011	Erwin Lewy Rensus(Chief Eng)	NT,DP	21-Mar	14.25-15.35	use only for kitchen	1100	NA	600	equippd with WWTP (600 m3/day)	not installed	new WWTP proposal already discussed	can be considered	3000-3500Rp/m3	OK	OK	can not be installed because large scale work is required	
	9	Sanur Paradise Plaza Hotel	4 stars	329	Jl. Hang Tuah 46 Sanur 80228	281781	I Made Sudarsana (Chief Engineering)	HU,SK,SM,DP	18-Feb	14:00-15:50	7,950	Capacity: NA	4,104	5 (Dry season)	not equipped	not installed	under renovation	can be considered	3,000Rp./m3	NG	OK	will not be installed	customer awareness is more important than hotel intention
	10	Segara Village	4 stars	120	Jl. Segara Ayu Sanur PoBox3091	288407	Kadek Ariana(Chief Eng)	NT,DP	30-Mar	13.05-13.40	for back up	334	NA	NA	Septic tank	not installed	no schedule	can be considered	4000-5000Rp/m3	NG	OK	can not, need new investment	will use reclaimed water 100 m3/day
	11	Waka Maya Resort	Buriqiue Resort	25	Jl. Tanjung Pinggir Pantai No41 Sanur	289912	Komang Agus Sujarwadi (Finance-Adm Mgr)	NT,DP	30-Mar	15.10-15.40	NA	no deep well	no deep well	NA	Septic tank	not installed	no schedule	can be considered	4000Rp/m3	NG	OK	can nott, need new investment	will use reclaimed water 100 m3/day
Nusa Dua	1	Amanusa Resort *)	5 stars	35	Nusa Dua PoBox 33 Nusa Dua 80363	772333	I G N Udayana (Chief Eng)	NT,DP	1-Apr	11.55-12.45	use water from Bali Golf	no deep well	no deep well	NA	use BTDC	not installed	no schedule	can be considered 5000-6000Rp/m3		OK	OK	can not, need new investment	will use reclaimed water 50-80m3/day
	2	Ayodya Resort *)	5Bstars	451	Jalan Pantai Megiat PoBox 46 Nusa Dua 80363	771102	Ketut Wijaya (Director of Engineering)	SK,SM,YK,DP	1-Mar	10:15-11:00	12,700	Max200	NA	Max100	use BTDC	not installed	no plan	needs cost comparison with the planned internal WWTP		NG	OK	depends on the cost	Installation of self WWTP and desalination facility will be planned soon.
	3	Bali Tropic Resort	4 stars	150	Jl. Pratama 34A Nusa Dua	772130	Gusti Lanang Swastik(Chief Eng)	NT,DP	18-Mar	15.10-15.55	11,365	no deep well	no deep well	75	eqquiped with WWTP	not installed	no schedule	can be cosidered	no idea	OK	OK	can not, need new investment	they plan to improve the WWTP facility to get a drink water quality
	4	Club Med *)	4 stars	400	PoBox7 Lot No6 Nusa Dua	771521	Michel Naulot (Technical Services Manager)	SK,SM,TY,YK,DP	28-Feb	10:00-11:00	12,491	no deep well	-	Ave60	use BTDC	not installed	no hotel expansion plan	may be used	less than BTDC IW tariff (6,156Rp./m3)	NG	OK	will not be installed unless new building is constructed	BTDC irrigation water is not used in rainy season
	5	Grand Hyatt Bali *)	5Bstars	750	PoBox53 Nuda Dua	771234	Edward Teh (Director of Engineering)	SK,NT,SM,DP	8-Mar	14:00-15:30	NA	no deep well	-	NA	use BTDC	not installed	no plan	less than 40cent		NG	NG	will be installed if the cost is subsidized	Reclaimed water cannot be used for gardening because people may touch it.
	6	Inna Putri Bali *)	5 stars	392	Lot 3-3 Nusa Dua PoBox1 Nusa Dua	771020	Made Sudiarta(Chief Eng)	NT,DP	18-Mar	16.10-17.05	12,520	no deep well	no deep well	NA	use BTDC	not installed	no plan	can be considered	7000Rp/m3	OK	OK	can not, need new investment	will use reclaimed water 30% of PDAM water uses
	7	Melia Bali Villas Resort *)	5Bstars	500	Lot N-1 Nusa Dua PoBox88	771510	Binbin Gin Wibowo (Chief Engineering)	HU,SK,SM,YK,DP	25-Feb	16:45-17:00	NA	Max240	NA	NA	use BTDC	not installed	NA	NA	NA	NA	NA	will not be installed	interview time was not enough
	8	Nikko Bali Resort	5Bstars	395	Jl. Raya Nusa Dua Selatan PoBox18	773377	I WAYAN SUDIARSA (Chief Engineer)	SK,SM,DP	23-Feb	16:00-17:00	12,500(2010.Aug)	252(2010.Jul)	6,856(2010.Jul)	NA	equipped with WWTP (550m3/d),Cost: NA	not installed	no plan	may be used for flashing toilet, washing clothes, pool	less than 10,000Rp./m3	OK	OK	will be installed if the cost is subsidized	PDAM water and deep well water are mixed in the 2,000m3 receiving tank
	9	Novotel Nusa Dua Bali *)	5 stars	268	BTDC Complex PoBox116 Nusa Dua 80363	8480555	Tri Adhi Wirya Astama (Chief Engineer)	SK,SM,YK,DP,SS	1-Mar	14:00-15:00	6,514-15,122	no deep well	-	Max25	use BTDC	not installed	NA	NA		NG	OK	will not be installed if the wall is damaged	better to sell the reclaimed water via BTDC
	10	Nusa Dua Beach Hotel *)	5 stars	381	Lot N-4 Nusa Dua PoBox217	771210	Dwi Sutoyo(Ass.Chief Eng)	NT,DP	23-Mar	09.55-10.50	current price	120	current price	NA	use BTDC	not installed	no plan	can be considered	5000Rp/m3	OK	OK	need investment	will use 100m3/day
	11	Nusa Dua Golf Resort *)	5 stars	225	Lot SW 2 BTDC	8480555			1-Mar	11.45-12.45	10,300	19	20,000	1,000	use BTDC		NA	can be considered	less than BTDC	NA	OK	can be considered	
	13	Swiss Grand Bali *)	4 stars	63	Jl. Nusa Dua Selatan No8 Nusa Dua	776688	I Wayan S Saputra(Chief Eng)	NT,DP	1-Apr	14.05-14.55	13,797	125	11,380	NA	use BTDC	not installed	no plan	can be considerd	4000Rp/m3	NG	OK	need investment	will use 1000m3/month
	15	The St. Regis Bali Resort *)	5 stars	123	Kawasan Nusa Dua Lot S6	8478111	Wy Winantaja (Chief Eng)	NT,DP	23-Mar	11.55-12.50	12,499	137	13,768	NA	use BTDC	not installed	no plan	can be consired	2500-3000Rp/m3	OK	OK	need investment	if TDS less than 2500 ppm
	16	The Westin Resort Nusa Dua *)	5 stars	334	Kawasan BTDC Lot2 Nusa Dua	771906	I Gde Somonita	NT,DP	23-Mar	11.05-11.45	12,501	no deep well	no deep well	NA	use BTDC	not installed	no plan	can be considered	2500Rp/m3	OK	OK	need investment	will use 300 m3/day
Benoa Area	1	Bali Reef Resort	Villa	28	Jalan Pratama Tanjung Benoa PoBox5000	776291	Mr. Dedi Suweca (Engineer)	SK,SM,DP	28-Feb	12:00-12:30	14,908	no deep well	-	NA/PDAM water is not used	Septic Tank	not installed	NA	needs confirmation to hotel owner		NA	NA		will not connect to BTDC WWTP (Expensive and far)
	2	Conrad Bali Resort	4 stars	313	Jl. Pratama No.168Tj Benoa Nusa Dua	778788	Mr.Rai Puslaka (Chief Engineer)	SK,NT,SM,DP	7-Mar	10:00-11:30	13,740	no deep well	-	NA	equipped with WWTP, use BTDC	not installed	no plan	may be used if the water wuality is better than BTDC-IW.	same as BTDC-IW	NG	OK	may be installed at renewal period after 10 years	rainwater is collected to use (consumption is NA)
	3	Melia Benoa Bali	5 stars	128	Jl. Pratama Tanjung Benoa Nusa Dua	771714	Wayan Mardiasa(Chief Eng)	NT,DP	23-Mar	14.10-15.45	actual price	no deep well	no deep well	NA	use BTDC	not installed	no plan	can be considered	3500Rp/m3	NG	OK	need investment	will use 100 m3/day
	4	Novotel Rsesort Bali Benoa	5 stars	186	Jl. Pratama Tanjung Benoa PoBox39	772239	Agus Subagio (Chief Engineer)	SK,SM,TY,YK,DP	28-Feb	11:20-11:45	13,000	no deep well	-	NA	equipped with WWTP / Capacity , Cost : NA	not installed	NA	NA	NA	NG	OK	NA	will not connect to BTDC WWTP (self WWTP has no problem)
	5	The Royal Santrian	Villa	22	Jl. Pratama Tanjung Benoa 80362	778181	Mr. Wayan Subawa (Chief Engineering)	SK,SM,DP	28-Feb	14:15-14:45	NA	Max10	NA	NA	Septic Tank + Underground Penetration	not installed	NA	needs confirmation to hotel owner					will not connect to BTDC WWTP (self WWTP is cheaper)
Jimbaran	1	Bali Intercontinental	5Bstars	425	Jl. Uluwatu 45 Jimbaran	701888	I Made Suwinten (Assistant Chief Engineer)	SK,NT,DP	11-Mar	10:00-11:00	10,113	no deep well	-	NA	equipped with WWTP (600m3/d),Cost: NA	not installed	no plan	may be used for pool	8,000Rp./m3	OK	OK	will not be installed	low price, continous supply and water quality test is required for use
	2	Four Seasons Resort Jimbaran	5 stars	147	JL. Bukit Permai Jimbaran Badung	701010	Ida Bagus Suparana(Dir of Eng)	DP	24-Mar	14.05-14.50	10,343	no deep well	no deep well	7000-8000m3/month	equiped with STP	not installed	no plan	can be considered	3000-4000Rp/m3	OK	OK	need investment	
Kuta	1	Bali Bintang	5 stars	401	Jl Kartika Plaza PO Box 1068 Kuta	753288	Anang E(P (Chief Eng)	NT,DP	29-Mar	16.05-16.30	for back up only	917	7,323	NA	equped with STP	not installed	no plan	can be considered	2000-3000Rp/m3	NA	OK	need investment	will use 100 m3/day
	2	Bali Dynasty Resort	4 stars	312	Jl Kartika Plaza Po Box 2047 Kuta	752403	Dewa Yudiarta(Chief Eng)	NT,DP	29-Mar	11.30-12.35	no PDAM water	656	actual price	NA	equped with STP	not installed	no plan	can be considered	3000-4000Rp/m3	OK	OK	need investment	will use 250 m3/day
	3	Discovery Kartika Plaza Hotel	5 stars	318	Jl Kartika Plaza PO Box 1012	751067	Nur Chamid(Chief Eng)	NT,DP	29-Mar	15.20-16.00	only use for kitchen	470	7,155	NA	equiped with STP	not installed	no plan	can be considerd	5000-6000/m3	OK	OK	need investment	will use 100-150 m3/day
	4	Hard Rock Hotel Bali	4 stars	418	Jl Pantai Kuta, Br pande Mas Kuta	761869	Abdullah(Ass Chief Eng)	NT,DP	1-Apr	10.35-11.05	actual price	300	actual price	NA	equiped with STP	not installed	no plan	can be considered	5000Rp/m3	NA	OK	need investment	will use 300 m3/day
	5	Kuta Paradiso Hotel	5 stars	243	Jl Kartika Plaza PO Box 1133 Kuta	761414	Anung Suryana(Chief Eng)	NT,DP	29-Mar	14.00-15.10	actual price	50	actual price	NA	equiped with STP	not installed	no plan	can be considerd	3000Rp/m3	OK	OK	need investment	will use 250 m3/day

*) BTDC : Bali Tourism Development Corporation IW : Irrigation water NA : Not Available

**) HU : Harutoshi UCHIDA SK : Shinichiro KAWAMURA NT : Naoto TAKATOI SM : Shozo MORI KF : Kiyoshi FUKUI TY : Tokuya YAZAWA YK : Yoshiro KANTO DP : K.G.Dharma Putra SS : Sunjoyo SADIARTO

Result of Water Demand Survey (Except for Hotels)

No.	Facilities	Name	Area	Address	Contacts(0361-)		JICA Team Attendant **)	Interview Date(2011)/Time	Current Condition							Demand Survey					Other Information
					tel.	Main Person			PDAM Tariff (Rp./m3)	Deep Well Consumption (m3/d)	Deep Well Tax (Rp./m3)	Gardening Consumption (m3/d)	Internal WWTP Operating Cost (Rp./Month)	Indoor Dual Piping System	Renovation Schedule	Possibility of the reclaimed water use	Willingness to pay	Water Use Tolerance Level: Pool	Water Use Tolerance Level: Gardening	Indoor Dual Piping Installtion Work	
101	Generating Station	Indonesia Power	Pesanggaran	Jl. By Pass I Gusti Ngurah Rai No535	720421	IR.IGAN SUBAWA PURTA (MANAGER TEKNIK)	SK,SM,KF,DP	2/21 15:30-16:30	PDAM water is not used	Ave132	228	NA	NA	not equipped	under FS (water will not used)	possible	less than 228Rp./m3	NA	OK	can invest upto 250,000KRp.	Treated water will be supplied from WWTP in the future. Therefore gardening water will be enough.
102	Golf Course	The Grand Bali Beach Golf Course	Sanur	Jl. Hang Tuah 58 Sanur	287733	I Ketut Raka Adnyana (HR, GA. & Leagal Manager)	HU,SK,SM,DP	2/18 16:00-18:20	8,000	NA	NA	NA	equipped with WWTP Capacity, Cost: NA	not equipped	not equipped	may be used only in emergency	1,000Rp./m3	NA	OK	will not be installed even if the cost is subsidized	Our group, Inna Grand Bali Beach Hotel owns WWTP.
103		Bali Golf & Country Culb	Nusa Dua	Kawasan Wisata Nusa Dua 80363	771791	Wayan Nawa (Executive Asst. Manager General Affairs)	SK,SM,YK,DP	3/1 16:00-18:20	10,300	(2010)Ave233	20,000	Max1,100	use BTDC	not equipped	not equipped	possible	less than BTDC-IW (5,200Rp./m3)	NG	OK	will not be installed	The pond which stores the rain water, well water, BTDC-IW and PDAM-IW is used for gardening.
104	Airport	Ngurah Rai Internationarl Airport	Tuban	Bandar Udara Ngurah Rai Gedung Wisti Sabha Lt.3 Tuban Kuta	751011	Gunung Banendro (Manager of General Engineering and Equipment)	HU,SK,SM,YK,DP	2/25 14:20-15:00	NA	(2010)Ave2,247	7,434	NA	equipped with WWTP Capacity, Cost: NA	not equipped	has expansion plan	will not be used (deep well has enough capacity and expansion of WWTP will be planned)		NA	OK	will be installed at expansion part	Current well capacity is 4,200m3/d, while actual consumption is 2,247m3/d.
105	Shopping Mall	Mal Bali Galleria	Kuta	Jl. By Pass I Gst. Ngurah Rai Simpang Dewa Ruci Kuta	755277	Jeffry M. Lomban (Building Manger)	SK,SM,DP	3/9 15:50-16:15	5,000	not in operation	NA	NA	equipped with WWTP Capacity, Cost: NA	not equipped	not equipped	Depends on the cost for dual piping installtion work and tariff	1,000-2,000Rp./m3	NA	OK	may be installed if the cost is subsidized	Current consumption for toilet is around 30m3/day, for gardening is around 30m3/day.
109	Harbour	Benoa Harbour Authority	Benoa Harbour	Jl. Raya Pelabuhan Benoa Denpasar	720560	Judiharto (Technical Manager)	SK,NT,SM,DP	3/7 14:00-16:20	See attachment: Current volume of gardening water in dry season is around 20m^3/d, future volume is around 75m^3.							possible	3,000Rp./m3	NA	OK	needs confirmation to Surabaya headquarter due to high installation cost	There is a harbour expansion plan, but reclaim water use potential is low.
110		PT. Inti Mas Surya (Fish Processing Company)	Benoa Harbour	Jl. Ikan Tuna Barat Pelabuhan Benoa	724246	Mr. Amin(Manager)	SK,SM,DP	3/10 10:00-10:30	See attachment: Current volume of PDAM water is around 66m3/d. 90% of that is used for fish processing.							See attachment: Difficult to use for fish processing considering becteria					Water quality for fish processing follows ISO and Japanese Minister of Health, Labour and Welfare standards
111		PT.SARI SEGER LAUT INDONESIA (Fish Processing Company)	Benoa Harbour	Jl. Ikan Tuna Raya Timur1 Pelabuhan Benoa	770233	Mr. Maruko (Director Factory Manager)	SK,SM,DP	3/10 10:45-11:15	See attachment: Current volume of PDAM water is around 39m3/d. 90% of that is used for fish processing.							See attachment: Difficult to use for fish processing considering becteria					Reclaimed water may be used for fish washing before processing
112	Public Office	DINAS DKP Badung	Badung	Pusen Badung Jl. Raya Sempidi Mangupura Badung	9004263	Eka Mertawan (Head of Dinas DKP Badung)	SK,SM,DP	3/8 10:0-11:00	See attachment: 135m3/d is used for roadside plant by tank trucks.							See attachment: 54-60m3/d may be used if price is cheaper than PDAM water and deep well tax					
113		PDAM Badung	Badung	Jln. Bedahulu No3 Denpasar	421845	KOMARUDIN,ST(DIRTEK)	HU,SK,SM,KF,TY,DP	2/22 14:00-15:30	See attachment							See attachment					
114		BTDC*) part1	Nusa Dua	PoBox3 Nusa Dua80363	771010	A. A. I. Ratna Dewi, St (Head of WWTP Unit)	HU,SK,SM,KF,TY,DP	2/22 09:15-11:20	See attachment							See attachment					
		BTDC*) part2	↑	↑	↑	I Putu Trisna Wijaya (Business Dev. Division)	SK,SM,YK,DP,SS	3/2 09:00-11:00	See attachment							See attachment					
		BTDC*) part3	↑	↑	↑	Mr. Nyoman Wedastra (Supervising Operator of BTDC's WWTP)	SK,NT,SM,DP	3/8 15:30-14:30	See attachment							See attachment					

*) BTDC : Bali Tourism Development Corporation IW : Irrigation water NA : Not Available

**) HU : Harutoshi UCHIDA SK : Shinichiro KAWAMURA NT : Naoto TAKATOI SM : Shozo MORI KF : Kiyoshi FUKUI TY : Tokuya YAZAWA YK : Yoshiro KANTO DP : K.G.Dharma Putra SS : Sunjoyo SADIARTO

付属資料 2

水質調査

付属資料 2　　水質調査

2.a 調査実施仕様書

原水である二次処理水の特性を水質の面から把握し、再生水処理施設で必要となる処理ユニットプロセスを決定するための基礎資料とすることを目的とした水質調査を実施した。水質調査は、以下に示した内容で実施した。

水質調査概要

項　目	実　施　内　容
1. 採水場所	デンパサール下水処理場流入水および流出水（２箇所）
2. 採水頻度	週１回×4 回×２箇所＝計 8 回
3. 分析項目	流入水：pH、水温、COD、BOD、SS、全窒素（T-N)、全リン（T-P)（7 項目） 流出水：pH、水温、COD、BOD、SS、UV_{254}、濁度、色度、塩素イオン、重炭酸、全窒素（T-N)、アンモニア性窒素、亜硝酸性窒素、硝酸性窒素、リン酸イオン、全リン（T-P)（16 項目）

Appendix A

TERM OF REFERENCE

ON

WATER QUALITY SURVEY

1. PURPOSE

The work called for water quality survey (hereinafter referred to as the Work) will be conducted as a part of on the Preparatory Survey on Application of Wastewater Reclaiming in Southern Bali Water Supply System in the Republic of Indonesia. The Work results will be used by the JICA Survey Team (hereinafter referred to as the Client) to understand the present water quality of Influent and effluent at the Suwung Wastewater Treatment Plant for preparation a preliminary design of reclamation plant.

2. GENERAL REQUIREMENTS

Water samples shall be taken at sites as specified, water quality analysis on the parameters specified for each sample shall be conducted at the contractor's laboratory and submit Reports on the result of the analysis.

The followings are general requirements in undertaking the Work.

(1) Analysis methods shall be according to "Standard Method for the Examination of Water and Wastewater, 19th or 20th Edition, APHA, AWWA, WEF." Analysis method other than this may be allowed as the Survey Team judged adequate and acceptable.
(2) Water quality analysis shall be carried out with the precision as specified in the above methods.
(3) The Contractor shall assign a specialist familiar with water quality survey and the sampling and analysis shall be conducted under supervision of the specialist.
(4) The Contractor shall assign sufficient number of personnel in order to carry out sampling smoothly.
(5) All necessary work and equipment for sampling including car arrangements, staff assignment, sampling bottles shall be provided by the Contractor.
(6) All necessary work and equipment for water quality analysis and reporting of its result shall be provided by the Contractor.

3. SCOPE OF WORK

3.1 Sampling

Two (2) samples shall be taken at two different locations in the Suwung WWTP, total 8 water samples shall be taken at four different events. The sampling shall be conducted once a week around at 10 A.M. The sampling details and locations are shown in Table 1 and Figure 1, respectively.

Table 1 Sampling Locations and Sample Numbers

Sampling Location	Sampling	Sample Number
1. Influent	one sample x 4 events	4
2. Effluent	one sample x 4 events	4
3. Total	two samples x 4 events	8

The exact sampling locations shall be as designated by the Client. Samples shall be preserved around 4 Celsius after taken.

When the samples are taken, some photos shall be taken, and the site conditions, weather and other field observations shall be recorded by the Contractor.

3.2 Measurements at the sites

When samples are taken, the following parameters shall be measured and recorded at the site immediately samples are taken:

- Weather, date and time, and ambient temperature
- Water temperature and pH of each sample

3.3 Water Quality Analysis

Samples shall be analyzed on parameters instructed by the following table except water temperature and pH as specified above.

Table 2 Water Quality Parameters and Sample Number

No.	Parameter	Sample Number per event			event	Total Sample Number for Analysis
		Influent	Effluent	Sub-total		
1	pH	1	1	2	4	8
2	Water Temp, °C	1	1	2	4	8
3	COD, mg/L	1	1	2	4	8
4	BOD_5, mg/L	1	1	2	4	8
5	Suspended Solid, mg/L	1	1	2	4	8
6	UV_{254}	0	1	1	4	4
7	Turbidity, NTU	0	1	1	4	4
8	Color,	0	1	1	4	4
9	Cl, mg/L	0	1	1	4	4
10	CO_3^{2-}, mg/L	0	1	1	4	4
11	KMO_4, mg/L	0	1	1	4	4
12	Total Nitrogen (T-N), mg/L	1	1	2	4	8
13	NH_4^+-N, mg/L	0	1	1	4	4
14	NO_2-N, mg/L	0	1	1	4	4
15	NO_3-N, mg/L	0	1	1	4	4
16	Total Phosphorus (T-P), mg/L	1	1	2	4	8

4. SUBMITTAL

Upon the completion of water quality analysis, analysis results shall be submitted to the Client within two weeks after the sampling date.

A report shall be prepared and submitted in English (A4 size) to the Client within three weeks after the final sampling date, which shall contain the followings:

- A description of the work carried out, including sampling date and time, and records of observations and findings during sampling events, including the weather of previous day.
- Analytical methods, and equipment used if any special equipment
- Results of analysis

The report shall be comprised with one (1) set of hard copy and one set of electronic files with compact disks (CD) saving the contents of the report. The application software shall be mutually agreed.

Source: BLUPAL

Figure 1 Sampling Locations at the Suwung WWTP

2.b 調査実施

第 2 回調査（5 月 18 日） 	第 3 回調査（5 月 26 日） 
第 4 回調査（6 月 1 日） 	

2.c 調査結果

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Air Limbah Inffluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan

KEPADA
YTH. HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN TANGGAL PENGAMBILAN / NO LAB.			
					11-5-2011/927	18-5-2011/935	26-5-2011/970	1-6-2011/990
	FISIKA							
1	Suhu	Pemuaian	^{o}C	38	28	29	29	29
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	192	140	149	124
	KIMIA							
3	pH	Elektrometri	-	6 - 9	7,0	7,0	6,0	7,0
4	BOD	Elektrometri	mg/l	50	15,8	55,8	35,8	49,0
5	COD	Titrimetri	mg/l	100	50,0	120,0	184,7	100,0
6	Total N	Spektrofotometri	mg/l	-	11,259	12,258	11,612	11,818
7	Total P	Spektrofotometri	mg/l	-	0,4	1,1	0,6	0,6

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka.UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 13 Juni 2011
Pemeriksa,

Dra Rahmawati.B.Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Air Limbah Effluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan

KEPADA
YTH. HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN TANGGAL PENGAMBILAN / NO LAB.			
					11-5-2011/927	18-5-2011/935	26-5-2011/970	1-6-2011/990
	FISIKA							
1	Suhu	Pemuaian	^{o}C	38	29	31	29	28
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	50	11	17	140
	KIMIA							
3	pH	Elektrometri	-	6 - 9	7,0	7,0	7,0	7,6
4	Ammonia Bebas (NH_3-N)	Nessler	mg/l	1	7,30	6,8	10,3	8,7
5	Nitrat (NO_3-N)	Brusin	mg/	20	0,662	1,426	0,18	3,102
6	Nitrit (ion NO2)-N	Sulfanilat	mg/	1	0,039	0,040	0,058	0,420
7	BOD	Elektrometri	mg/l	50	12,6	24,6	26,8	16,8
8	COD	Tetrimetri	mg/l	100	40,0	80,0	87,48	50,0
9	Turbidity	Spektrofotometri	mg/l	-	16,1	23,9	15,4	18,7
10	Warna	Spektrofotometri	mg/l	-	35,0	53,0	97,0	79,0
11	CaCO3	Titrimetri	mg/l	-	297,28	319,77	336,36	301,66
12	$KMnO_4$	Titrimetri	mg/l	-	60,04	36,02	10,112	21,49
13	Total N	Spektrofotometri	mg/l	-	8,001	5,933	10,538	12,172
14	Total P	Spektrofotometri	mg/l	-	0,7	0,4	0,5	0,8
15	Khlorida	Titrimetri	mg/l	-	49,32	58,11	50,625	54,98
16	UV pada 254 nm	Spektrofotometri	-	-	0,1257	0,1142	0,2056	0,153

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka.UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 13 Juni 2011
Pemeriksa,

Dra Rahmawati.B.Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 536 / KES / LAB.KES
Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Influent
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 11 Mei 2011
Nomor Laboratorium : 927

KEPADA
YTH HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	28
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	192
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	BOD	Elektrometri	mg/l	50	15,8
5	COD	Titrimetri	mg/l	100	50,0
6	Total N	Spektrofotometri	mg/l	-	11,259
7	Total P	Spektrofotometri	mg/l	-	0,4

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 19 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 536 / KES / LAB.KES
Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Influent
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 11 Mei 2011
Nomor Laboratorium : 927

KEPADA
YTH HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	28
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	192
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	BOD	Elektrometri	mg/l	50	15,8
5	COD	Titrimetri	mg/l	100	50,0
6	Total N	Spektrofotometri	mg/l	-	11,259
7	Total P	Spektrofotometri	mg/l	-	0,4

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 19 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 551 / KES / LAB.KES
Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Air Limbah Inffluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 18 Mei 2011
Nomor Laboratorium : 935

KEPADA
YTH HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	29
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	140
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	BOD	Elektrometri	mg/l	50	55,8
5	COD	Titrimetri	mg/l	100	120,0
6	Total N	Spektrofotometri	mg/l	-	12,258
7	Total P	Spektrofotometri	mg/l	-	1,1

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 24 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 551 / KES / LAB.KES
Perihal : Hasil Pemeriksaan Air Limbah Domestik
Contoh berasal dari : Air Limbah Effluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 18 Mei 2011
Nomor Laboratorium : 935

KEPADA
YTH HARUTOSHI UCHIDA
DI DENPASAR

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	31
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	11
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	Ammonia Bebas (NH_3-N)	Nessler	mg/l	1	6,8
5	Nitrat (NO_3-N)	Brusin	mg/	20	1,426
6	Nitrit (ion NO2)-N	Sulfaniiat	mg/	1	0,040
7	BOD	Elektrometri	mg/l	50	24,6
8	COD	Tetrimetri	mg/l	100	80,0
9	Turbidity	Spektrofotometri	mg/l	-	23,9
10	Warna	Spektrofotometri	mg/l	-	53,0
11	CaCO3	Titrimetri	mg/l	-	319,77
12	$KMnO_4$	Titrimetri	mg/l	-	36,02
13	Total N	Spektrofotometri	mg/l	-	5,933
14	Total P	Spektrofotometri	mg/l	-	0,4
15	Khlorida	Titrimetri	mg/l	-	58,11
16	UV pada 254 nm	Spektrofotometri	-	-	0,1142

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 24 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 578 / KES / LAB.KES — KEPADA
Perihal : Hasil Pemeriksaan Air Limbah Domestik — YTH HARUTOSHI UCHIDA DI DENPASAR
Contoh berasal dari : Air Limbah Effluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 26 Mei 2011
Nomor Laboratorium : 970

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	29
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	17
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	Ammonia Bebas (NH_3-N)	Nessler	mg/l	1	10,3
5	Nitrat (NO_3-N)	Brusin	mg/	20	0,18
6	Nitrit (ion NO2)-N	Sulfanilat	mg/	1	0,058
7	BOD	Elektrometri	mg/l	50	26,8
8	COD	Tetrimetri	mg/l	100	87,48
9	Turbidity	Spektrofotometri	mg/l	-	15,4
10	Warna	Spektrofotometri	mg/l	-	97,0
11	CaCO3	Titrimetri	mg/l	-	336,36
12	$KMnO_4$	Titrimetri	mg/l	-	10,112
13	Total N	Spektrofotometri	mg/l	-	10,538
14	Total P	Spektrofotometri	mg/l	-	0,5
15	Khlorida	Titrimetri	mg/l	-	50,625
16	UV pada 254 nm	Spektrofotometri	-	-	0,2056

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 31 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 578 / KES / LAB.KES — KEPADA
Perihal : Hasil Pemeriksaan Air Limbah Domestik — YTH HARUTOSHI UCHIDA DI DENPASAR
Contoh berasal dari : Air Limbah Effluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 26 Mei 2011
Nomor Laboratorium : 970

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	29
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	17
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	Ammonia Bebas (NH_3-N)	Nessler	mg/l	1	10,3
5	Nitrat (NO_3-N)	Brusin	mg/	20	0,18
6	Nitrit (ion NO2)-N	Sulfanilat	mg/	1	0,058
7	BOD	Elektrometri	mg/l	50	26,8
8	COD	Tetrimetri	mg/l	100	87,48
9	Turbidity	Spektrofotometri	mg/l	-	15,4
10	Warna	Spektrofotometri	mg/l	-	97,0
11	CaCO3	Titrimetri	mg/l	-	336,36
12	$KMnO_4$	Titrimetri	mg/l	-	10,112
13	Total N	Spektrofotometri	mg/l	-	10,538
14	Total P	Spektrofotometri	mg/l	-	0,5
15	Khlorida	Titrimetri	mg/l	-	50,625
16	UV pada 254 nm	Spektrofotometri	-	-	0,2056

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 31 Mei 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 570 / KES / LAB.KES — KEPADA
Perihal : Hasil Pemeriksaan Air Limbah Domestik — YTH HARUTOSHI UCHIDA DI DENPASAR
Contoh berasal dari : Air Limbah Inffluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 1 Juni 2011
Nomor Laboratorium : 990

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	29
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	124
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,0
4	BOD	Elektrometri	mg/l	50	49,0
5	COD	Titrimetri	mg/l	100	100,0
6	Total N	Spektrofotometri	mg/l	-	11,818
7	Total P	Spektrofotometri	mg/l	-	0,6

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 7 Juni 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

PEMERINTAH PROVINSI BALI
DINAS KESEHATAN
UPT BALAI LABORATORIUM KESEHATAN
JALAN NUSA TENGGARA SANGLAH DENPASAR TELP/ FAX (0361) 222218

Nomor Agenda : 440.52 / 570 / KES / LAB.KES — KEPADA
Perihal : Hasil Pemeriksaan Air Limbah Domestik — YTH HARUTOSHI UCHIDA DI DENPASAR
Contoh berasal dari : Air Limbah Effluent IPAL Suwung
Diambil Oleh : Petugas Lab. Kesehatan
Diambil/diterima Tgl : 1 Juni 2011
Nomor Laboratorium : 990

NO	UNSUR-UNSUR	METODE	SATUAN	MAKS.YG DIPERBOLEH KAN	HASIL PEMERIKSAAN
	FISIKA				
1	Suhu	Pemuaian	^{o}C	38	28
2	Zat padat tersuspensi (TSS)	Pengendapan	mg/l	100	140
	KIMIA				
3	pH	Elektrometri	-	6 - 9	7,6
4	Ammonia Bebas (NH_3-N)	Nessler	mg/l	1	8,7
5	Nitrat (NO_3-N)	Brusin	mg/	20	3,102
6	Nitrit (ion NO2)-N	Sulfanilat	mg/	1	0,420
7	BOD	Elektrometri	mg/l	50	16,8
8	COD	Tetrimetri	mg/l	100	50,0
9	Turbidity	Spektrofotometri	mg/l	-	18,7
10	Warna	Spektrofotometri	mg/l	-	79,0
11	CaCO3	Titrimetri	mg/l	-	301,66
12	$KMnO_4$	Titrimetri	mg/l	-	21,49
13	Total N	Spektrofotometri	mg/l	-	12,172
14	Total P	Spektrofotometri	mg/l	-	0,8
15	Khlorida	Titrimetri	mg/l	-	54,98
16	UV pada 254 nm	Spektrofotometri	-	-	0,153

Per.Gubernur Bali No.8 tahun 2007

Mengetahui
Ka UPT Balai Lab.Kes.Prov.Bali

dr. Gede Bagus Darmayasa, M.M., M.Repro.
NIP. 19610726 198803 1 004

Denpasar, 7 Juni 2011
Pemeriksa,

Dra Rahmawati.B,Apt.M.Si
19640410 199403 2 008

付属資料 3

測量調査

付属資料 3　　測量調査

3.a 調査実施仕様書

送水管布設ルートを選定し、以下の仕様の路線測量を実施した。

総延長：　　16km 程度、幅 25m 程度
平面測量図：縮尺 1/500
縦断測量図：縮尺 H=1/500、V=1/100、測量間隔：概ね 100m 及び変化点
横断測量：　縮尺 1/100

SECTION III

SPECIFICATIONS

3.1 PURPOSE

The work called for under this Contract (hereinafter referred to as the Work) will be conducted as a part of the JICA Preparatory Survey on Application of Wastewater Reclaiming in Southern Bali Water Supply System in the Republic of Indonesia. The survey results will be used by the JICA Survey Team (hereinafter referred to as "the Engineer", and will serve as the basis for the preparation of preliminary designs of major water transmission pipeline.

3.2 GENERAL REQUIREMENTS

The Contractor shall comply with the following requirements in undertaking the Work.

(1) All measurements and results of the survey shall be in SI units.

(2) Locations of bench marks in the vicinity of the sites for the Work shall be confirmed by the Contractor and shall be approved by the Engineer before the commencement of the survey works in field.

(3) The Contractor shall provide temporary bench mark at the convenient location of project site.

(4) Prior to the commencement of the Work, the Contractor shall submit an Initiation Report prepared in English describing:

- List of survey and investigation equipment to be used by the Contractor
- Methods of survey and investigation to be used by the Contractor
- Work Schedule
- Staff Assignment Schedule

(5) The Contractor shall provide, and therefore shall include the associated costs in his proposal, all survey equipment, personnel, transportation and others required to complete the Work.

(6) The Contractor shall not commence the Work in field without receiving a written Notice to Proceed from the Engineer.

(7) Drawings shall be prepared using AUTOCAD 2009 or later release. Drawings and reports to be submitted by the Contractor shall, unless otherwise specifically directed by the Engineer, be sized as follows :

- All drawings; One (1) set of A1 size and one (1) set of A3 size, including one set of electric files with compact disks.
- All reports; Two (2) sets of A4

(8) The progress of the Work shall be described in the form of a weekly report and submitted to the designated address of the Engineer by a facsimile at the end of each week throughout the tenure of this Contract.

(9) Accuracy of the survey shall, unless otherwise specifically directed by the Engineer, be as described everywhere in these specifications.

3.3 SCOPE OF WORKS

Location of the Work shall be done for the route of a treated water transmission pipeline. The route is along the main road from the Sumung WWTP, located at Jl. Bypass Ngurah Rai No.90, Suwung Denpasar, to the Reservoir UPA Nusa Dua, located at Jl. Siligita, Nusa Dua. Total length of the route is about 16 km. Approximate survey route for the treated water transmission pipeline is shown in the location map of Figure 1. The line survey also includes some spot surveys to measure the locations and the levels of three points of borehole sites at the Suwung WWTP and four corners of reservoir structure at the Reservoir UPA, as directed by the Engineer. The Work comprises the following schedule:

Schedule 3.3.1: Line Survey
Schedule 3.3.2: Reporting

3.3.1 Line Survey

The Line Survey is composed of centerline survey and profile survey along the pipeline alignment as directed by the Engineer. The centerline survey is to measure distance at every station markers and angle at each turning point along the pipeline alignment. Width and depth of culvert and rivers/streams if any along the route shall be measured. Along the route of line survey, features of land use such as houses, buildings, sidewalks, electric poles, signboards, traffic lights, ditches, cultivated land etc., shall be investigated and marked with their limit. The range of cross section survey shall be not less than 20 meter from the centerline at its both sides. The profile survey is to measure ground level at every station markers and points directed by the Engineer.

The Contractor shall provide a temporary bench mark at the conventional locations under the direction of the Engineer. The temporal bench mark shall be fixed into the ground with durable materials as approved to avoid any movement and loss. The Line Survey shall be carried out by the following manner:

(1) Survey Instrument
- Measurement of Angle: Total Station
- Measurement of Distance: Steel tape or esrone tape
- Measurement of Level: Level with 1mm reading

The survey instruments other than the above may be allowed as the Engineer judged them adequate and acceptable.

(2) Interval of station marker: every 100 m plus every turning points and other necessary points as directed.

(3) Bench Mark: shall be followed from National 1st Grade Bench Mark.

(4) Accuracy of Survey
Accuracy of each survey shall be as follows:
- Angle Survey: measurement: Two times
  Deviation: 20"
- Distance Survey: 1/2,000
- Leveling Survey: within value of 2 cm $\sqrt{S}$
  (S: one-way distance in kilometer)

3.3.2 Reporting

The Contractor shall prepare and submit the drawings with the following scales upon the completion of field survey.

- Plan: 1 / 500
- Longitudinal Section:
  Horizontal; 1 / 500
  Vertical; 1 / 100
- Cross Section: 1 / 100

As mentioned, the drawings of the plans shall present range of road or street, houses, rivers/streams/watercourses, factories, concrete shelters, buildings, and any features of land use and along the routes of treated water transmission pipeline.

The drawings shall be printed out and digital files of drawings with format of AUTOCAD 2009 or later release shall be submitted. Font size of information and notes in the drawings shall be readable when the drawings are printed out in A3 size.

In addition to the above drawings, the Contractor shall submit daily work records describing time, climate and incidents/trouble with the land owner or people living in the vicinity if any, all survey data including field notes, photographs of site survey, other obtained during field surveys.

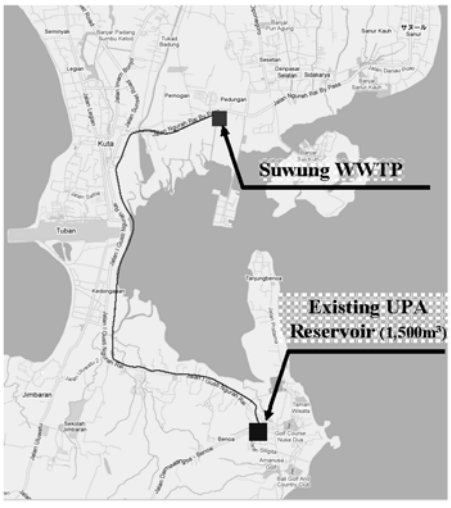
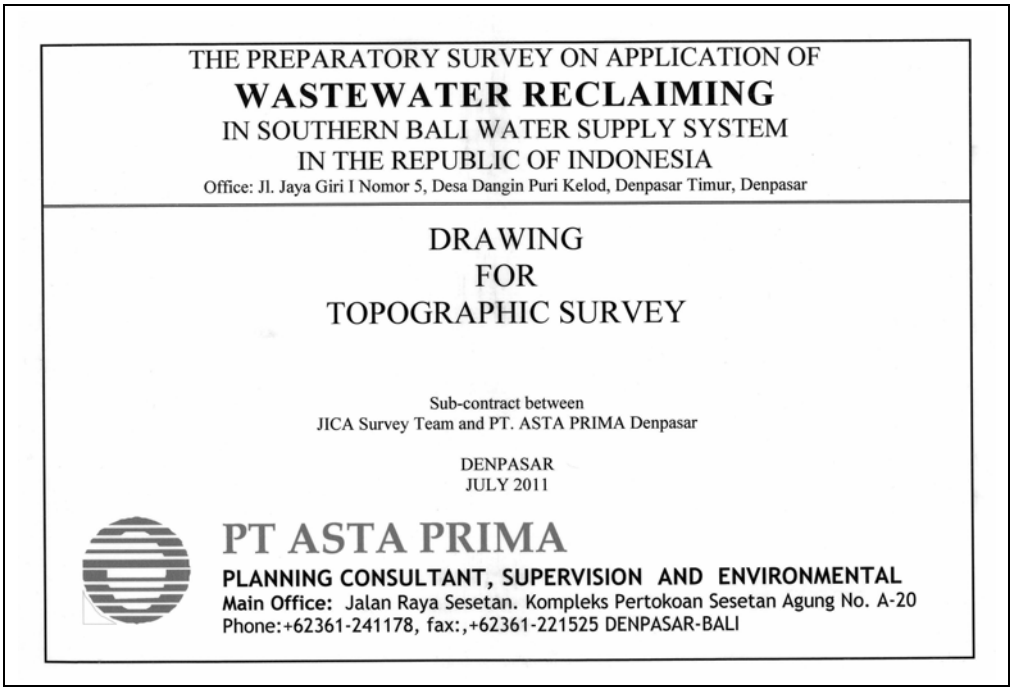


Figure 1 Locations of Topographic Surveys

3.b 調査実施

3.c 調査結果



THE PREPARATORY SURVEY ON APPLICATION OF

WASTEWATER RECLAIMING

IN SOUTHERN BALI WATER SUPPLY SYSTEM

IN THE REPUBLIC OF INDONESIA

Office: Jl. Jaya Giri I Nomor 5, Desa Dangin Puri Kelod, Denpasar Timur, Denpasar

DRAWING

FOR

TOPOGRAPHIC SURVEY

Sub-contract between

JICA Survey Team and PT. ASTA PRIMA Denpasar

DENPASAR

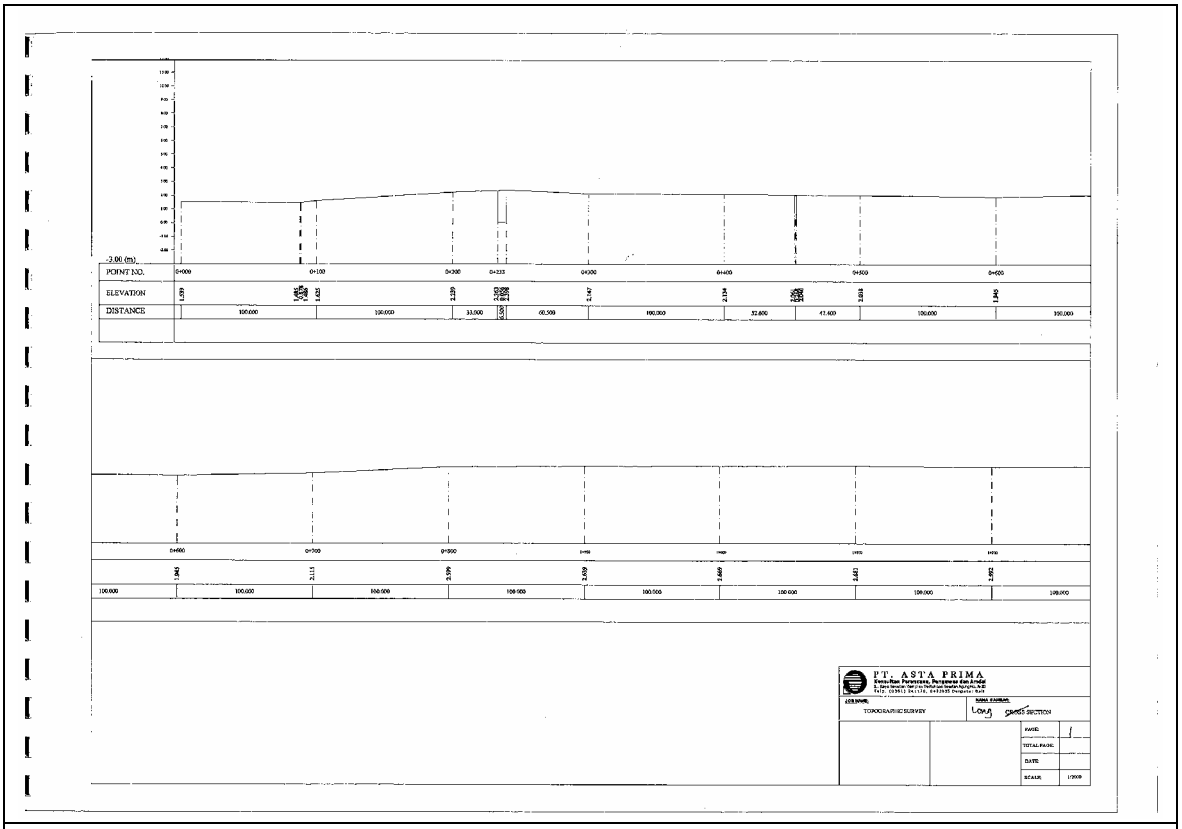
JULY 2011

PT ASTA PRIMA

PLANNING CONSULTANT, SUPERVISION AND ENVIRONMENTAL

Main Office: Jalan Raya Sesetan. Kompleks Pertokoan Sesetan Agung No. A-20

Phone:+62361-241178, fax:,+62361-221525 DENPASAR-BALI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DISTANCE
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Long CROSS SECTION
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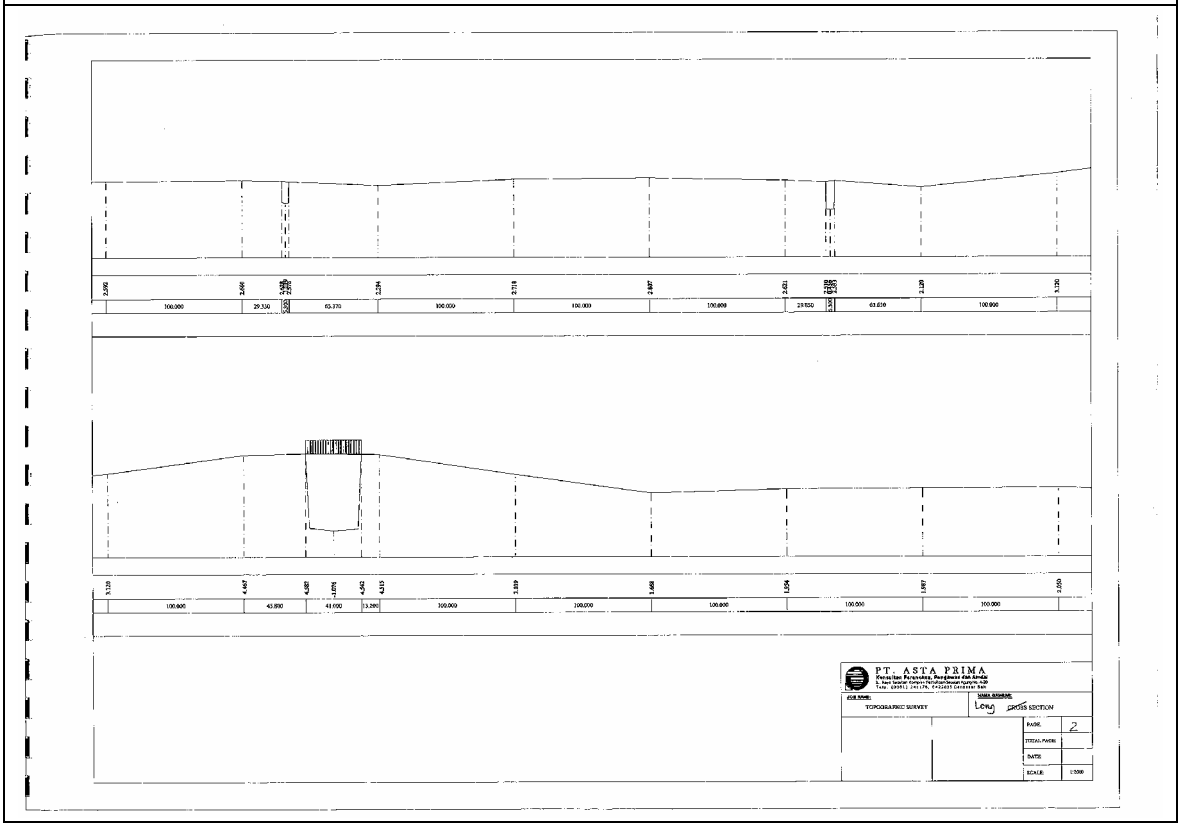
TOTAL PAGE
DATE
SCALE 1/2000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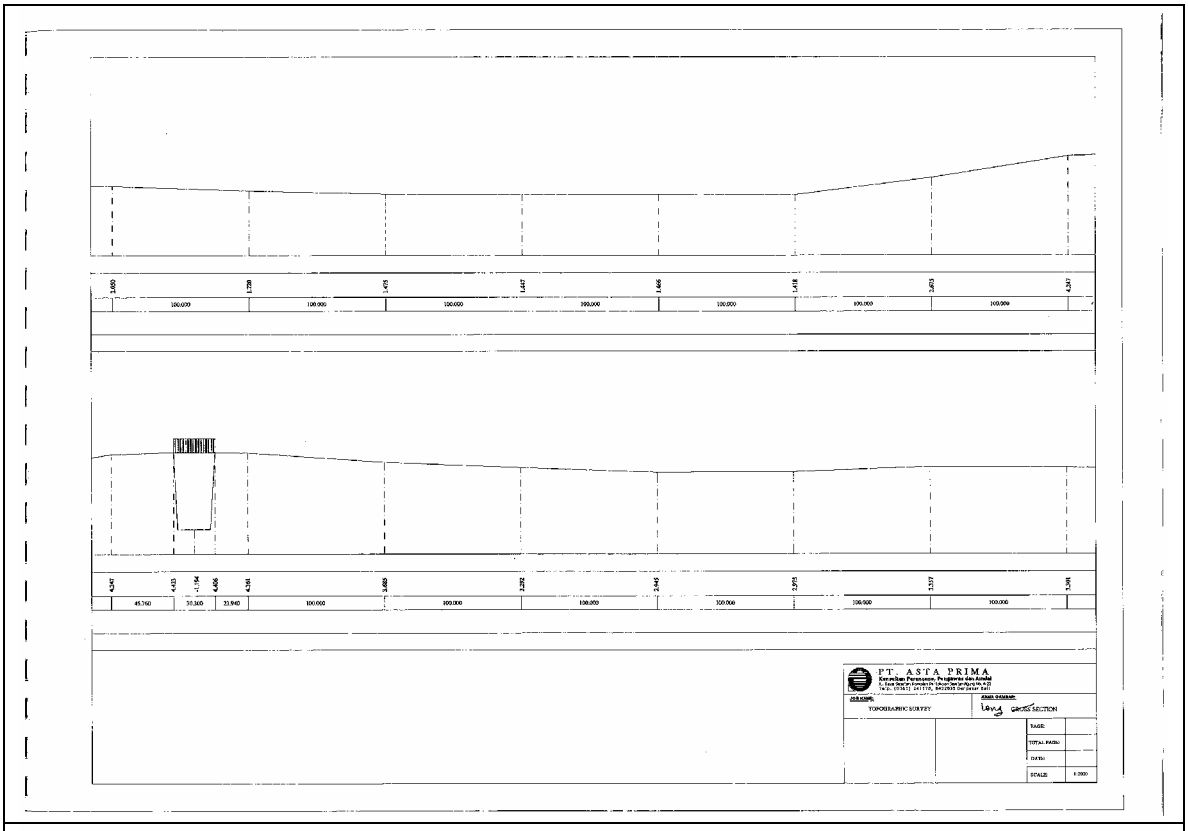
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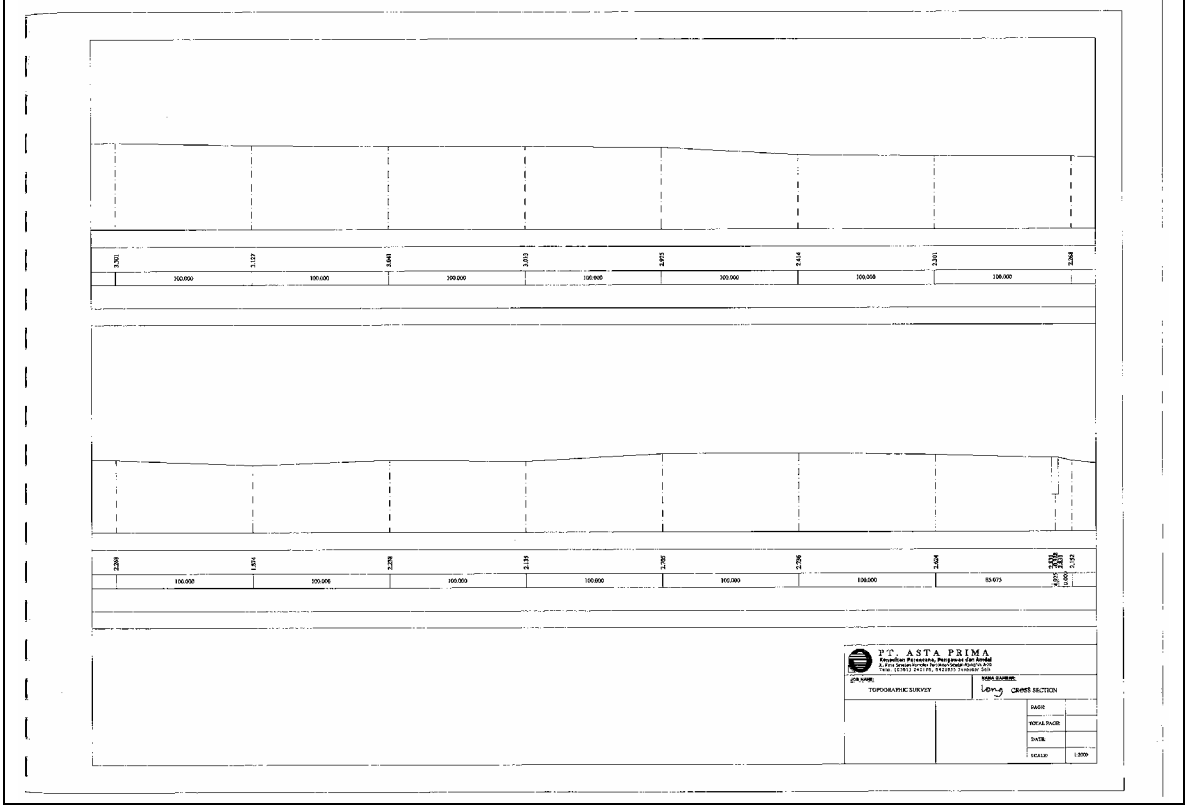
CROSS SECTION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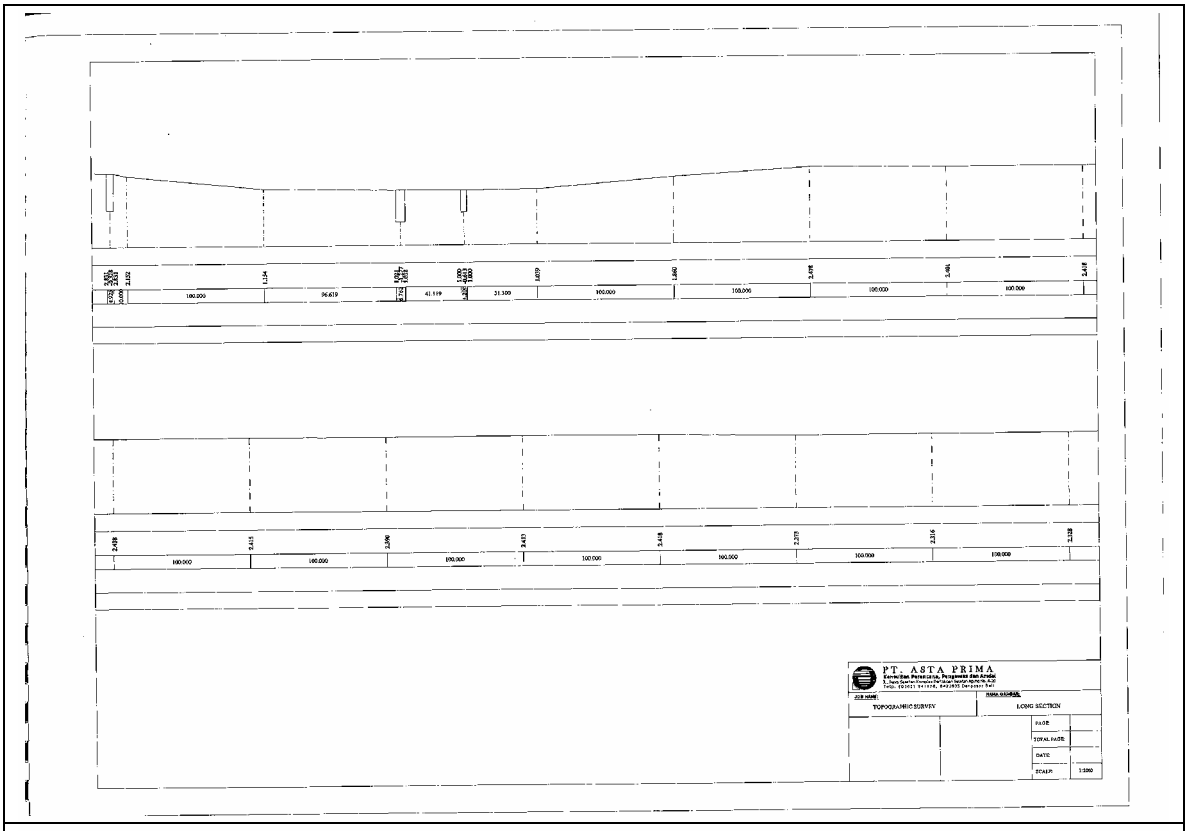
TOPOGRAPHIC SURVEY
CROSS SECTION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TOPOGRAPHIC SURVEY
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DATE
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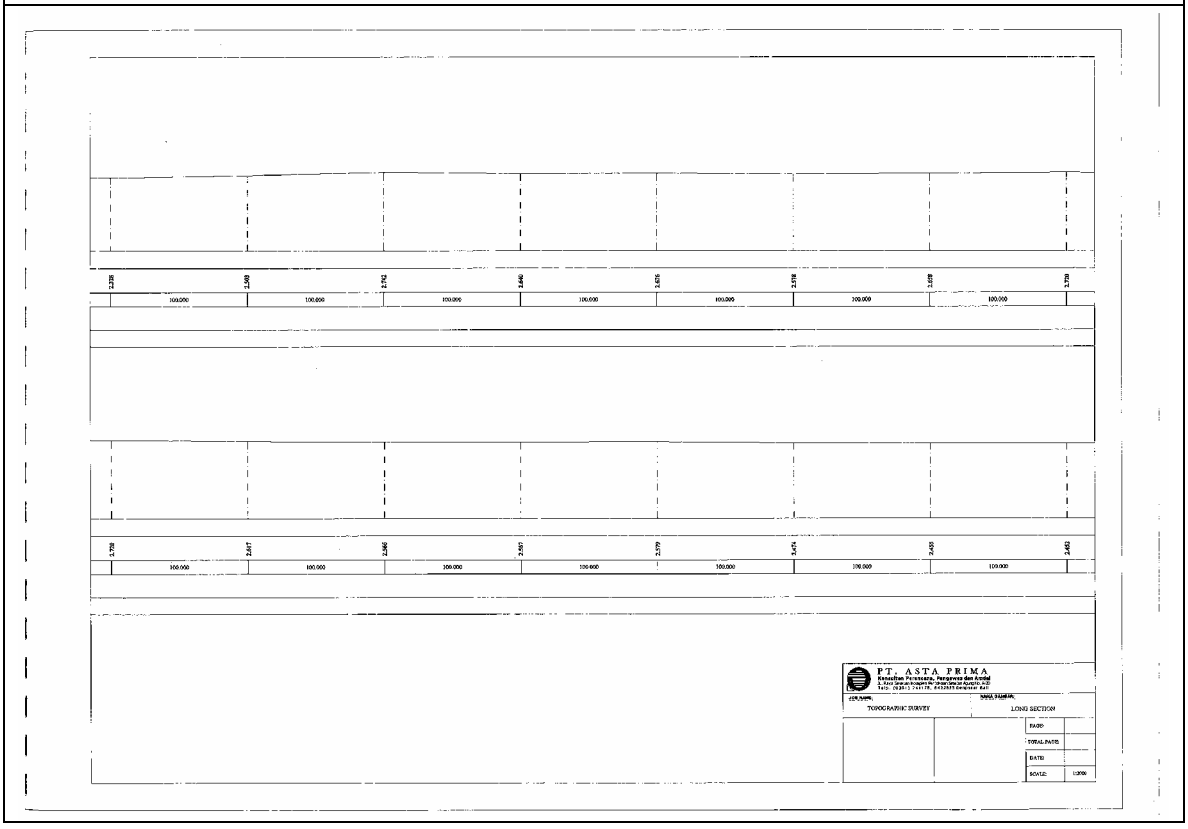
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JOB NAME
TOPOGRAPHIC SURVEY
DRAWING NAME
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DATE
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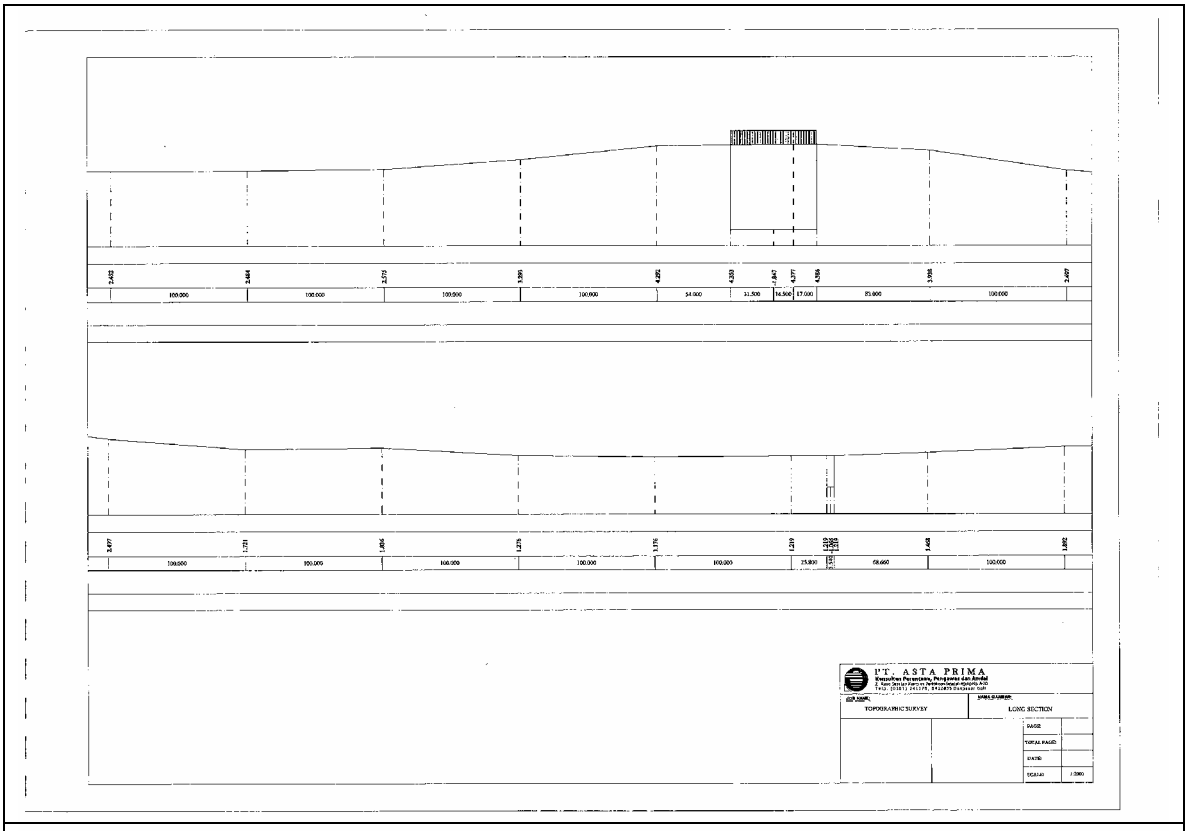
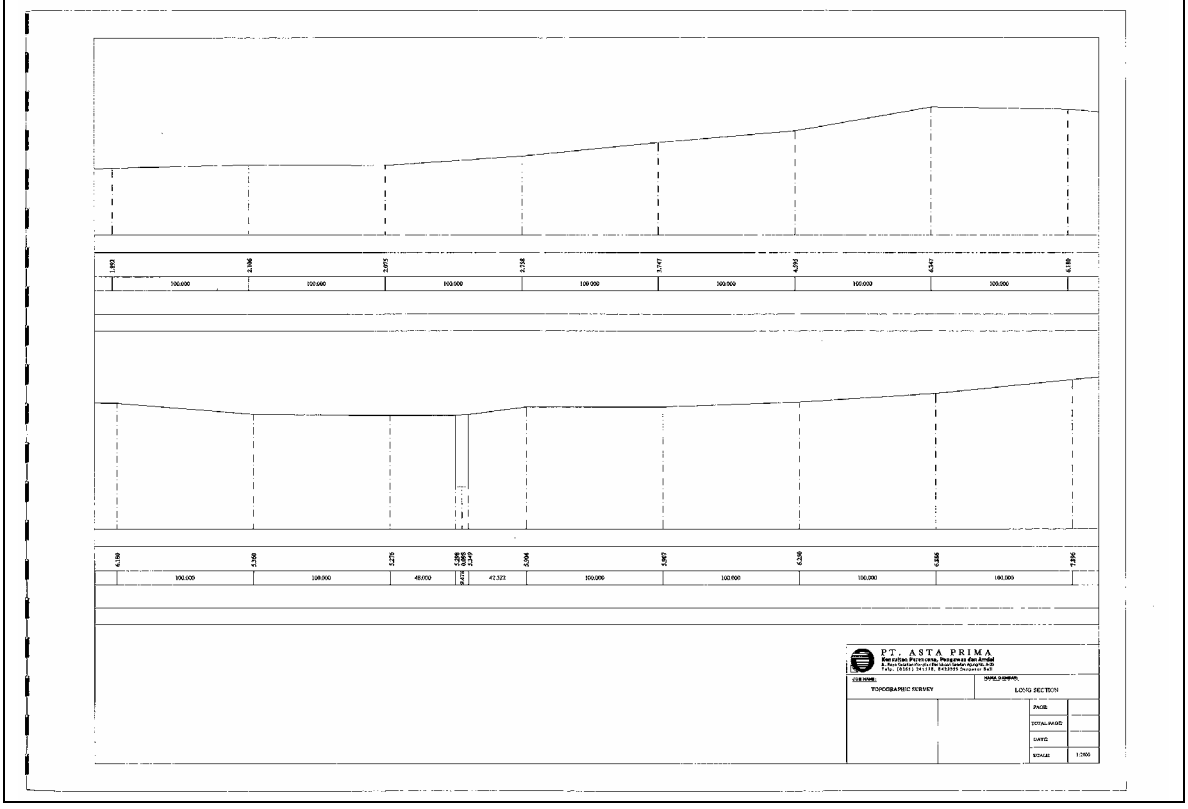
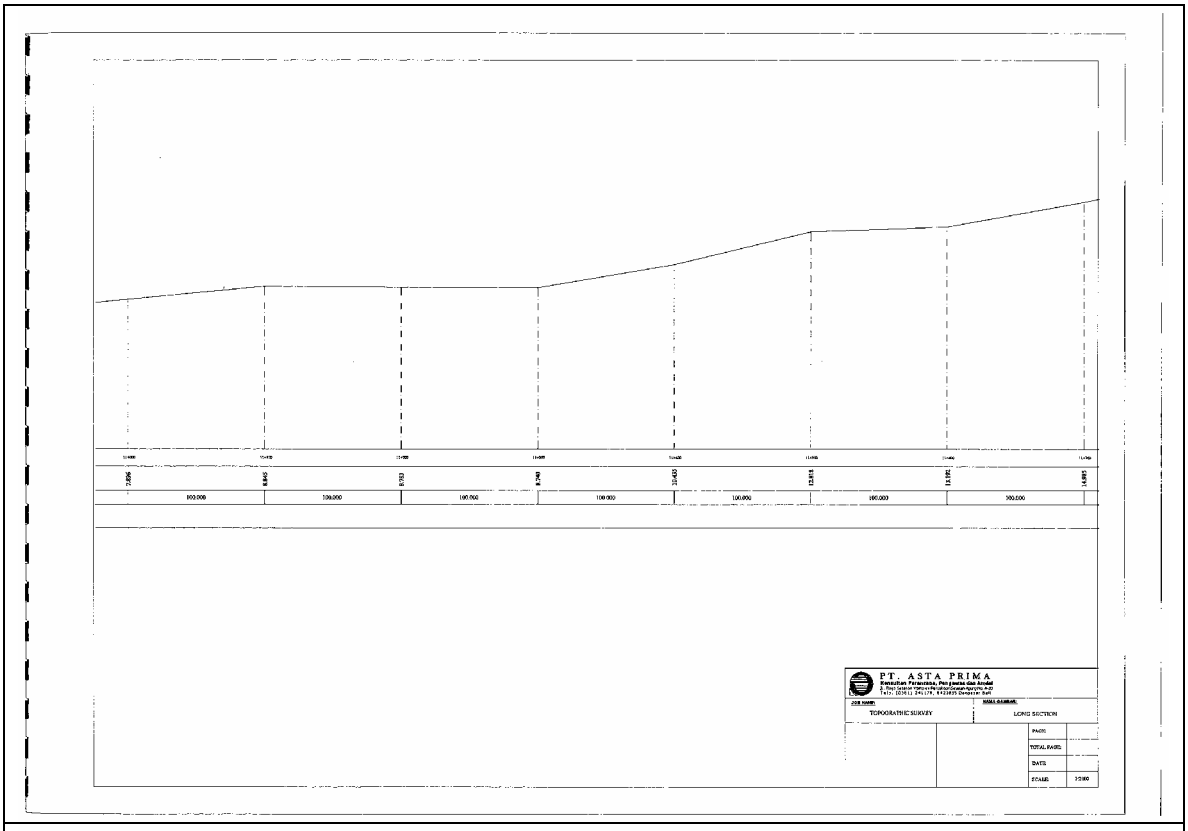

P.T. ASTA PRIMA
TOPOGRAPHIC SURVEY
LONG SECTION


P.T. ASTA PRIMA
TOPOGRAPHIC SURVEY
LONG SECTION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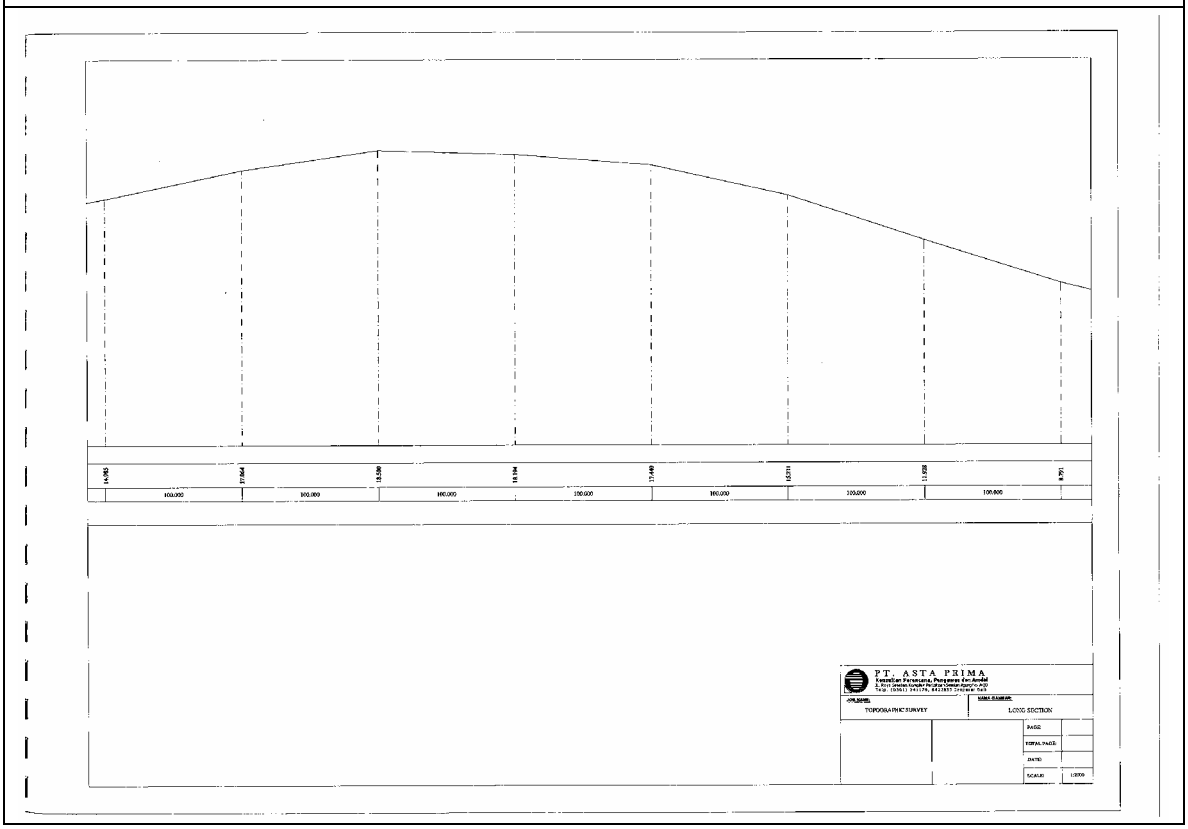
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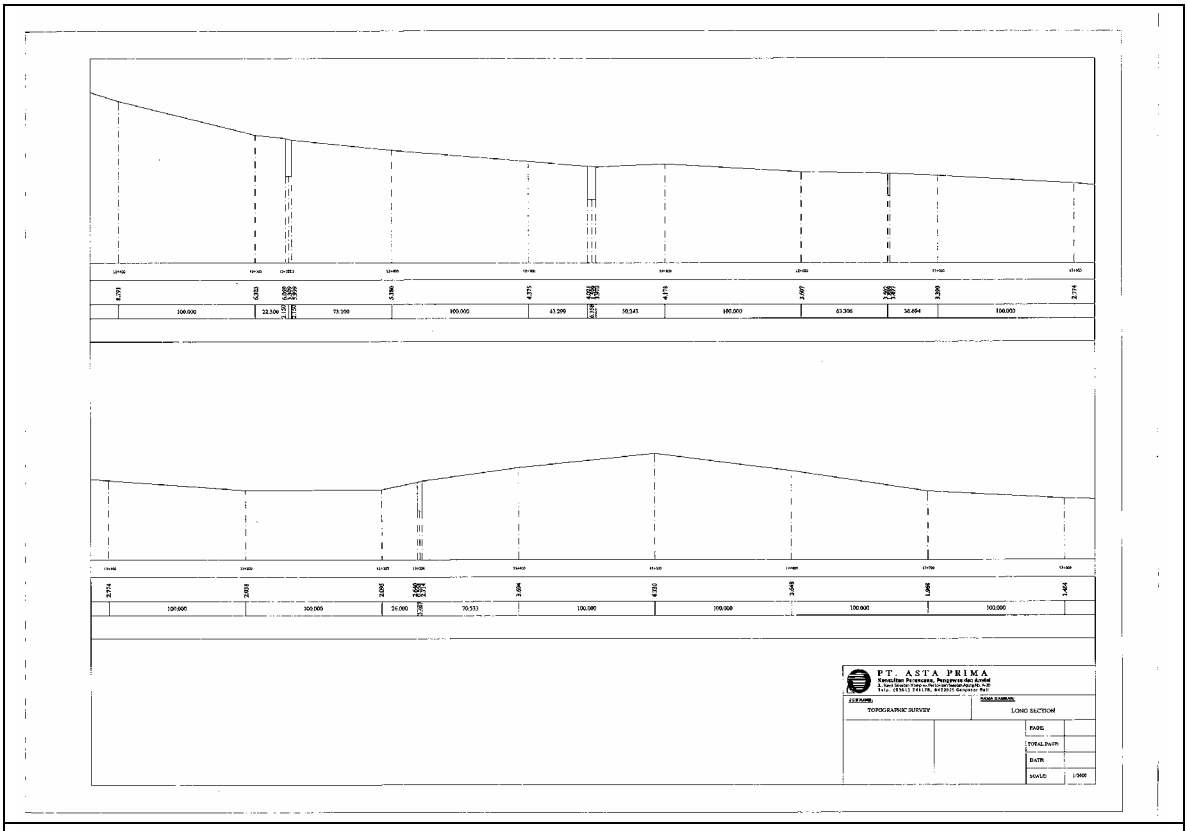
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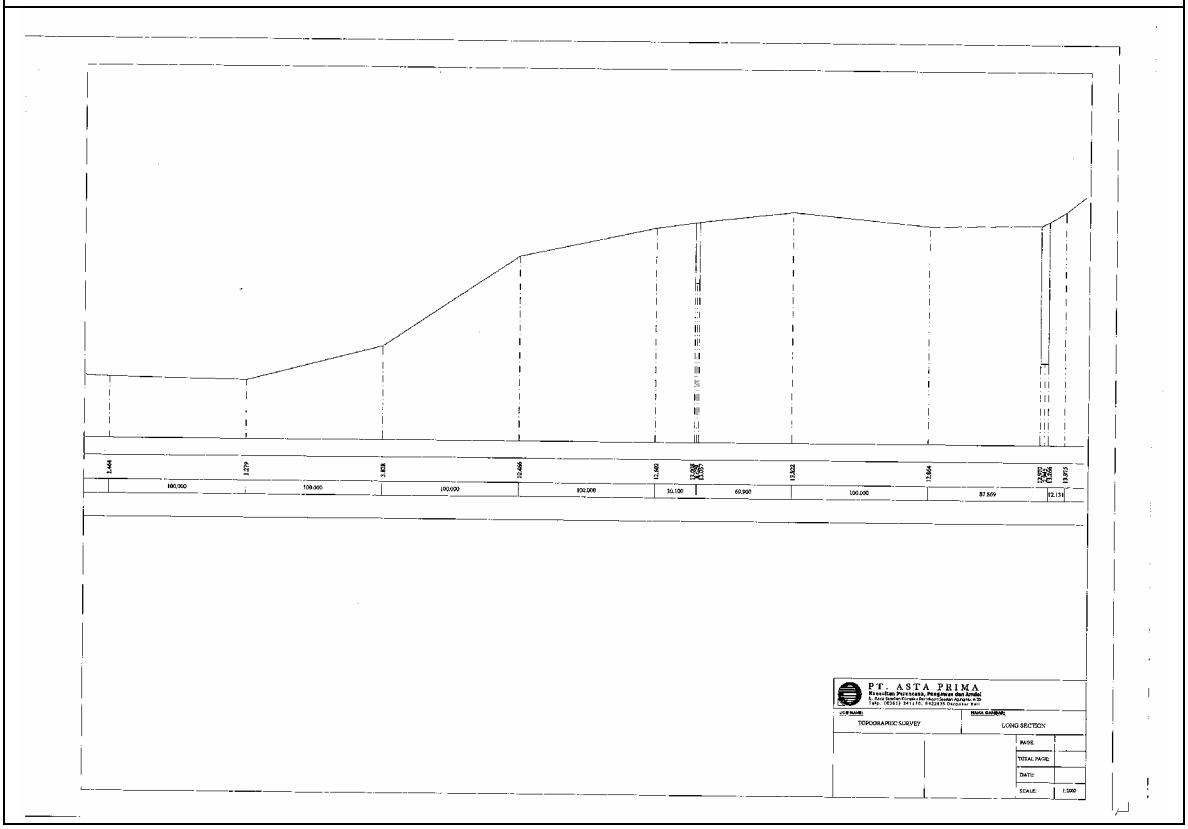
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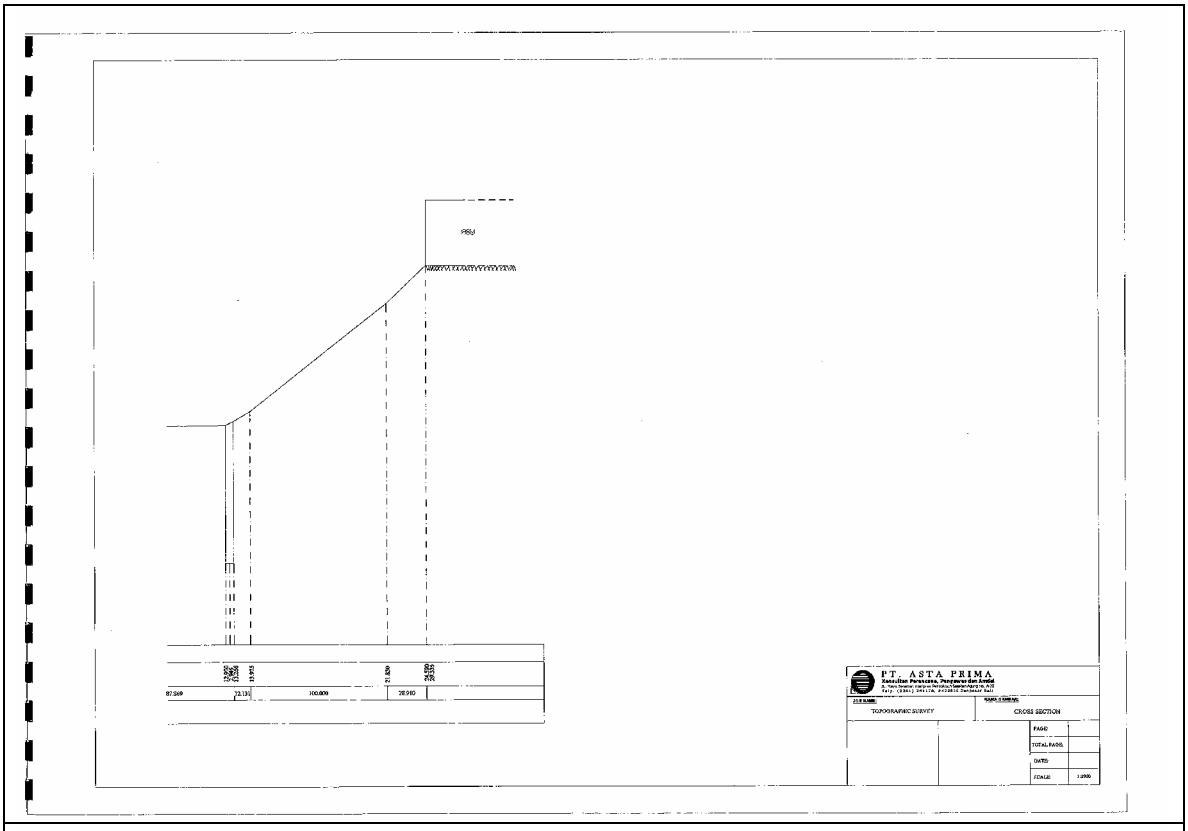
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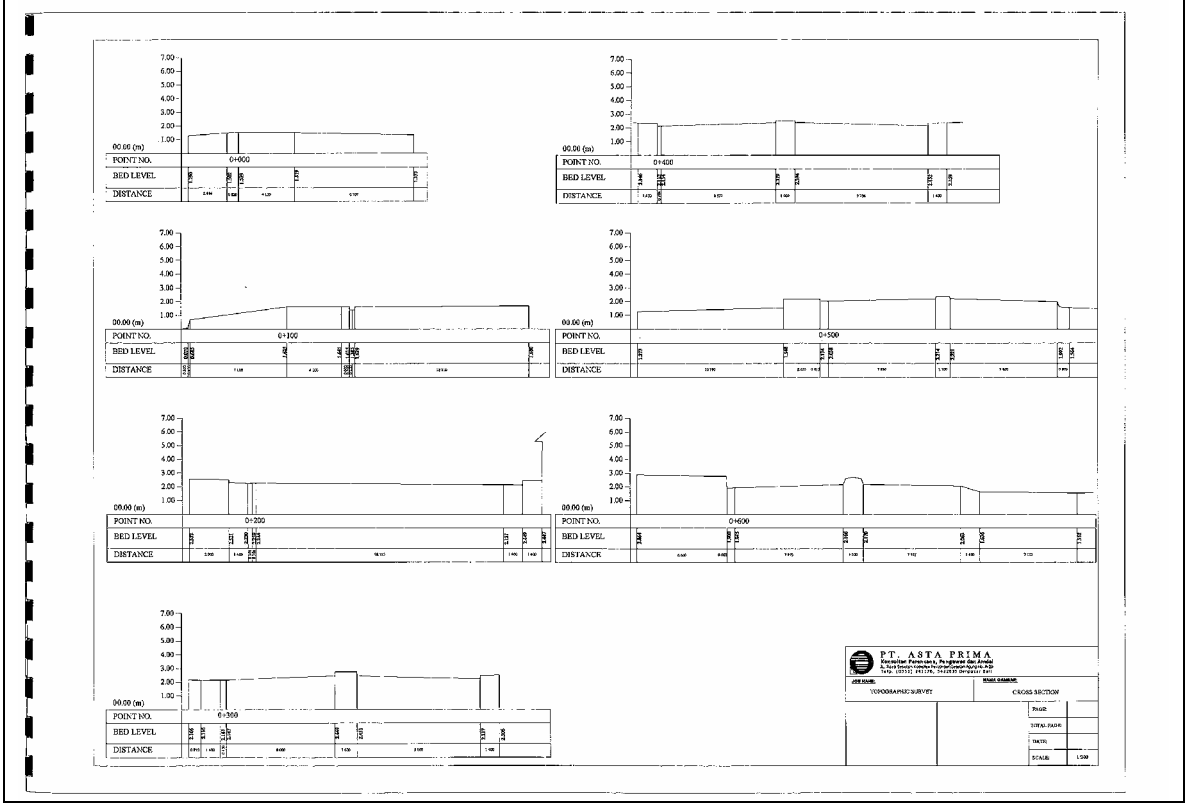
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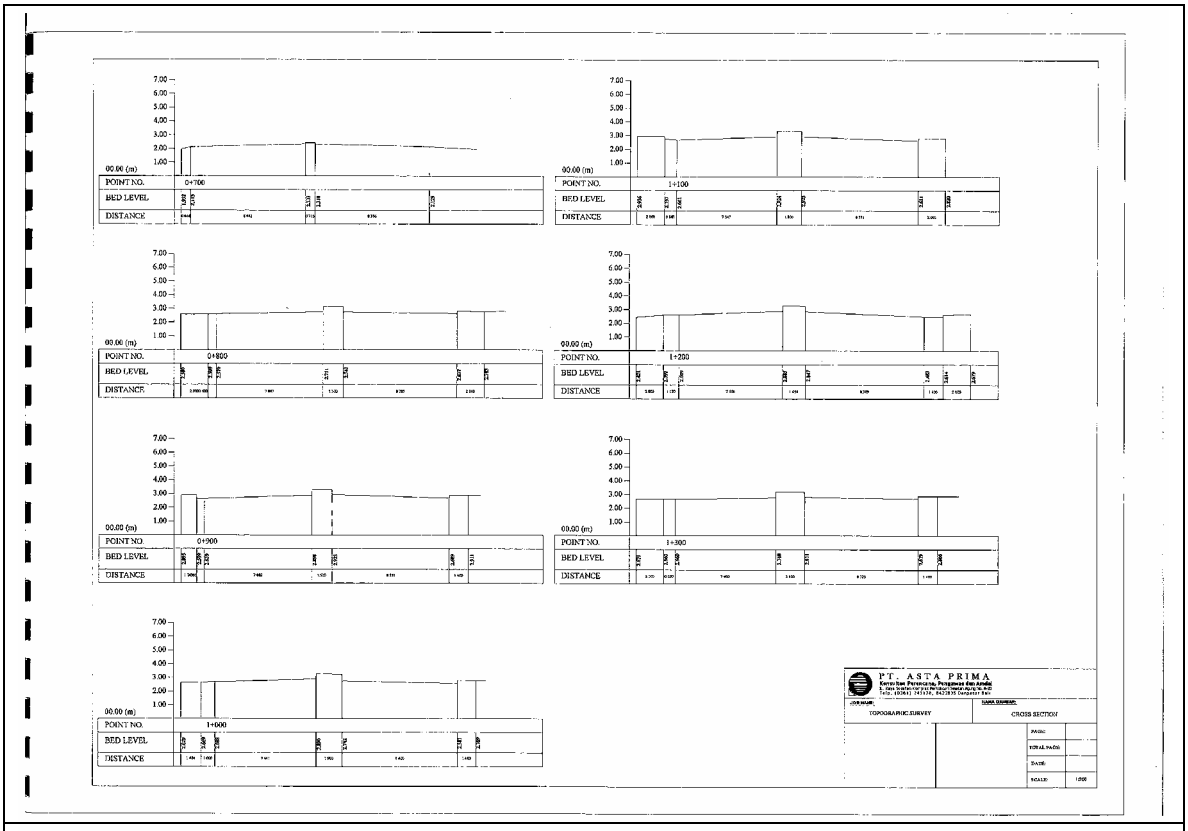
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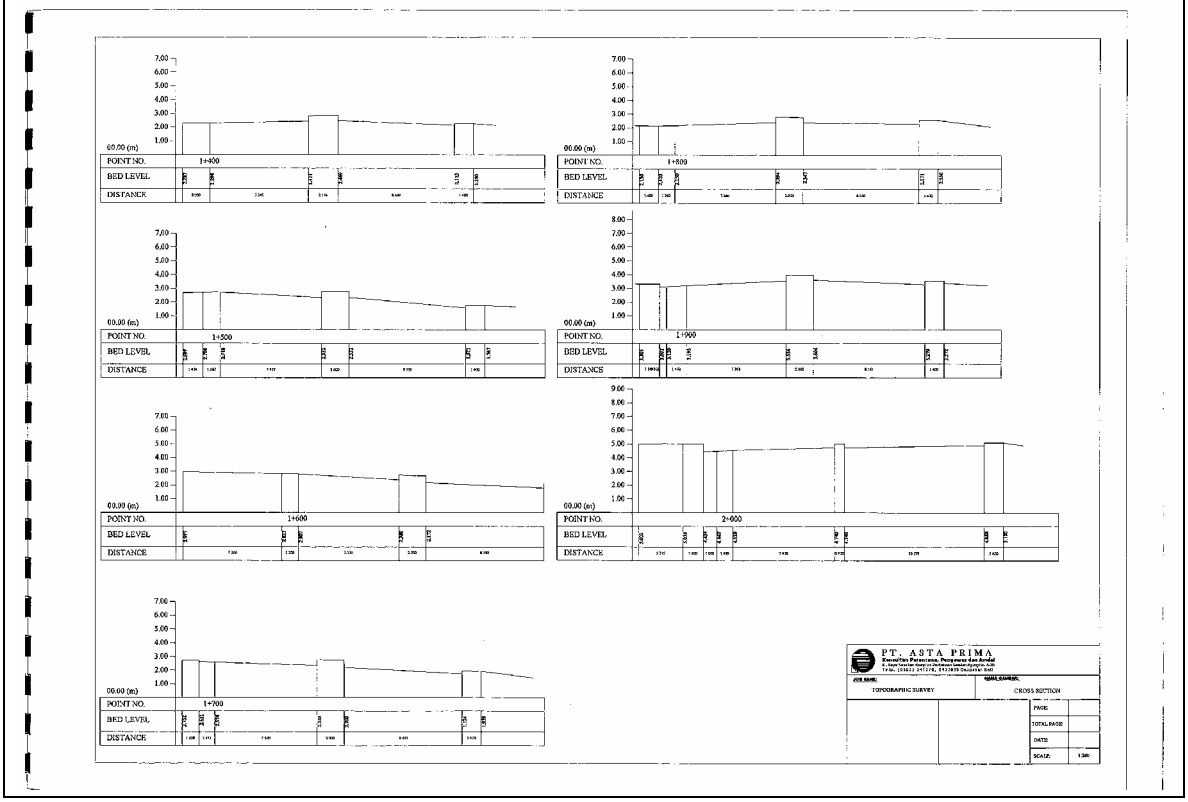
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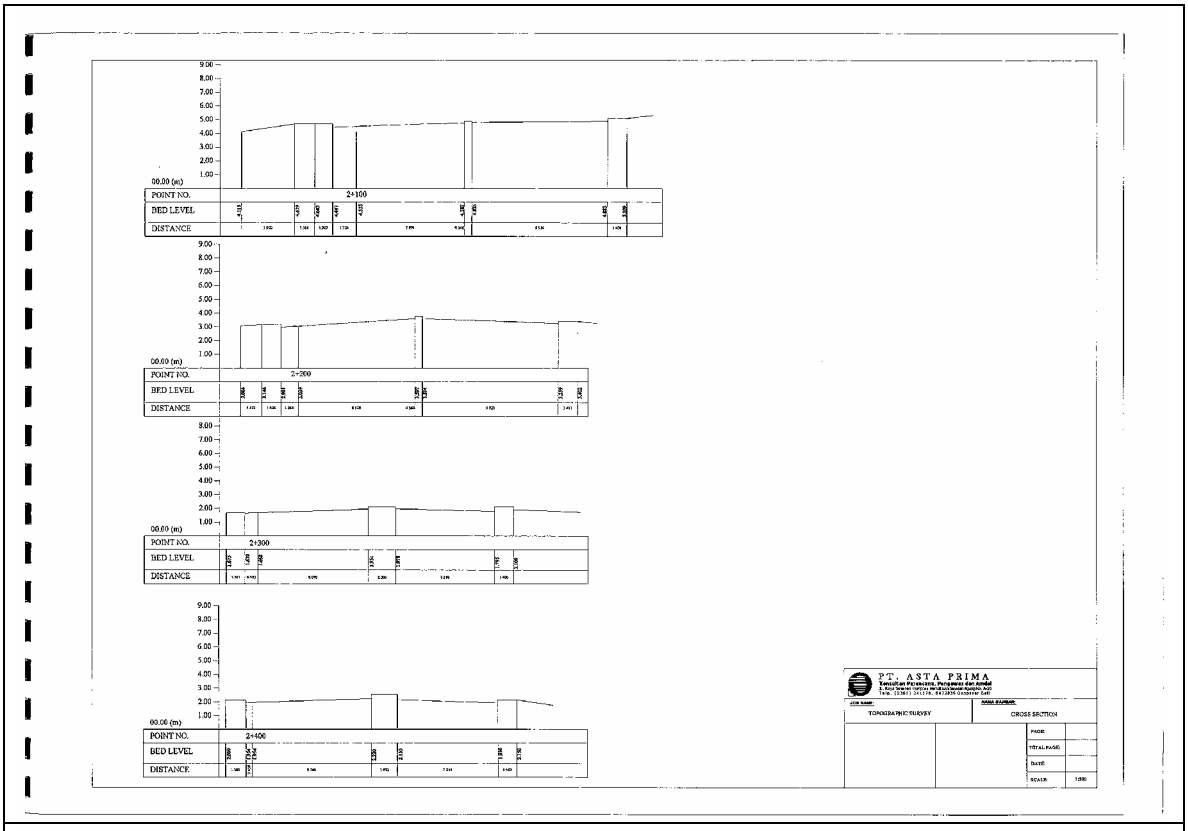
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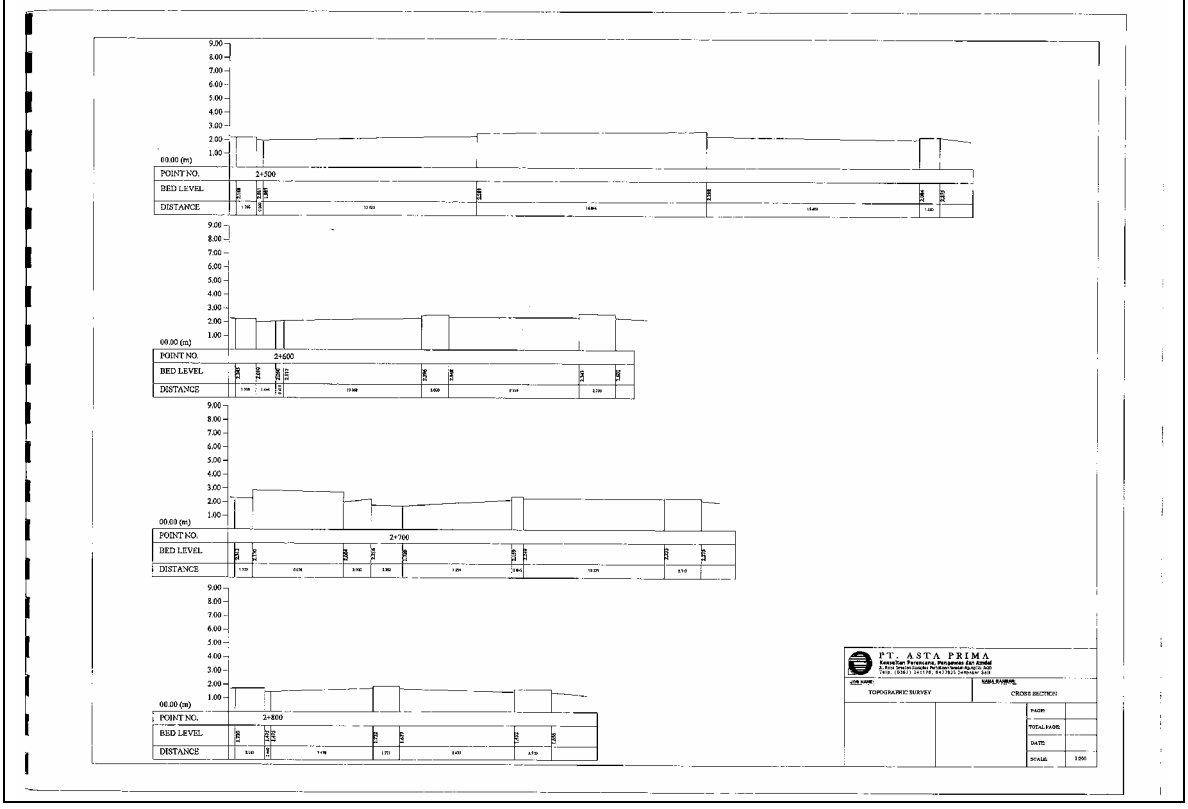
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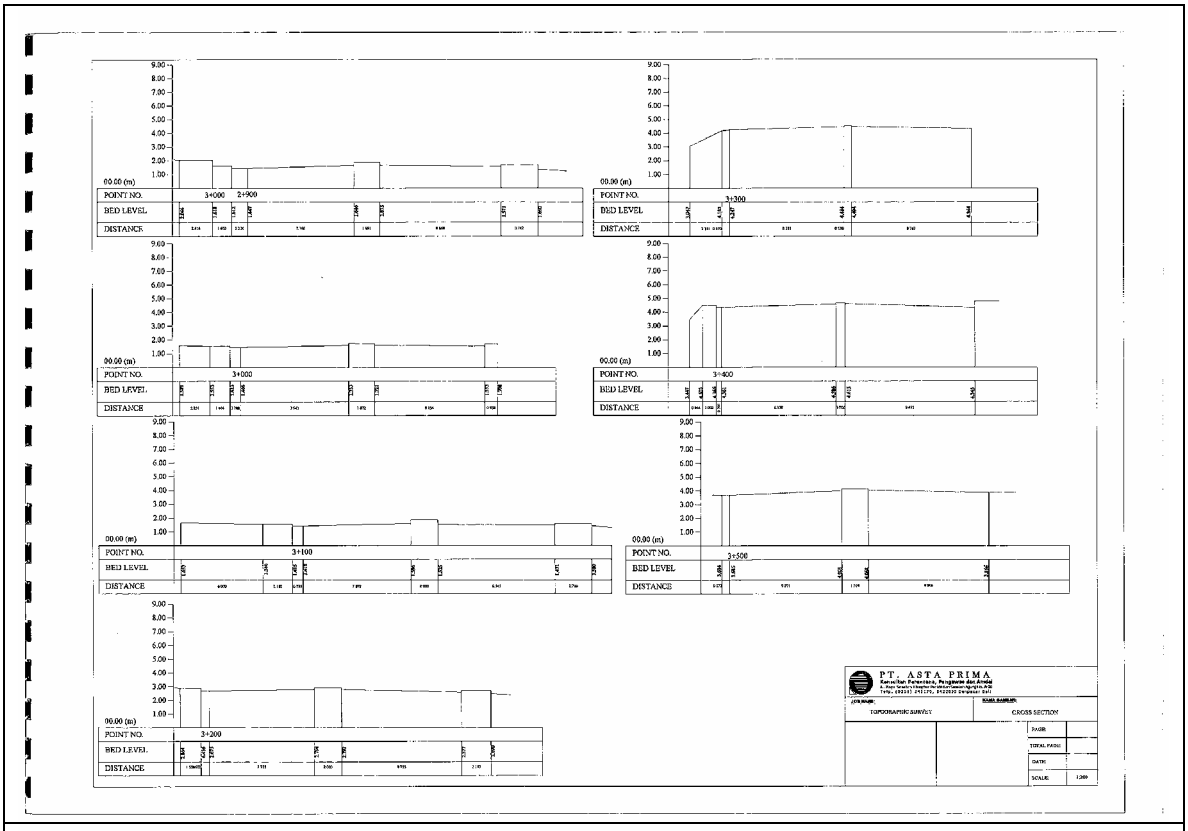
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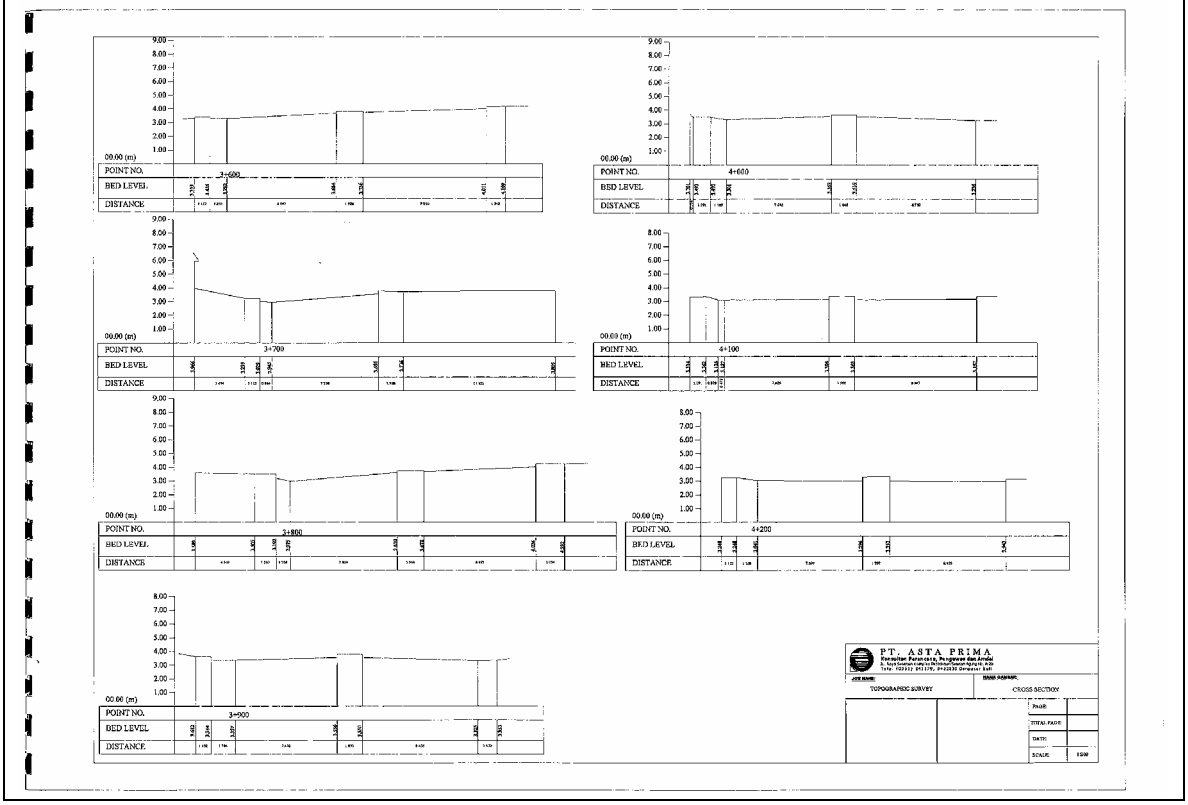
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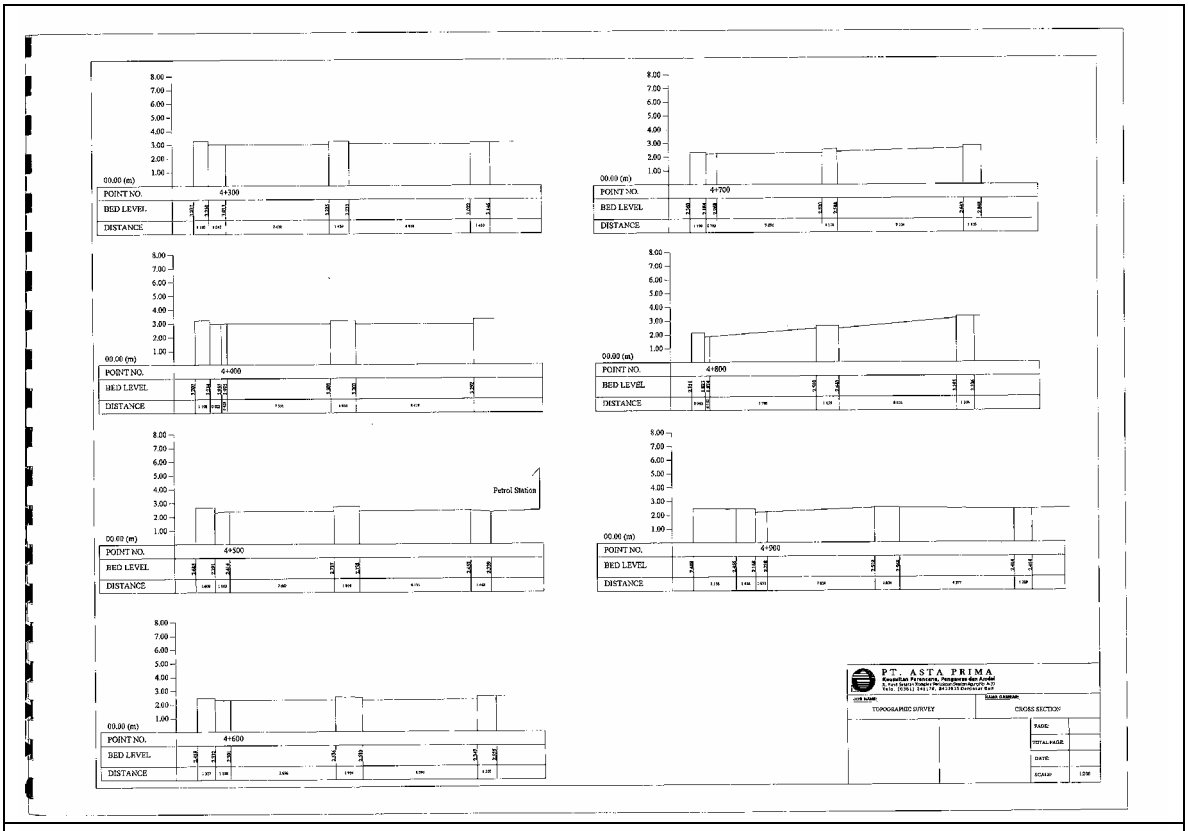
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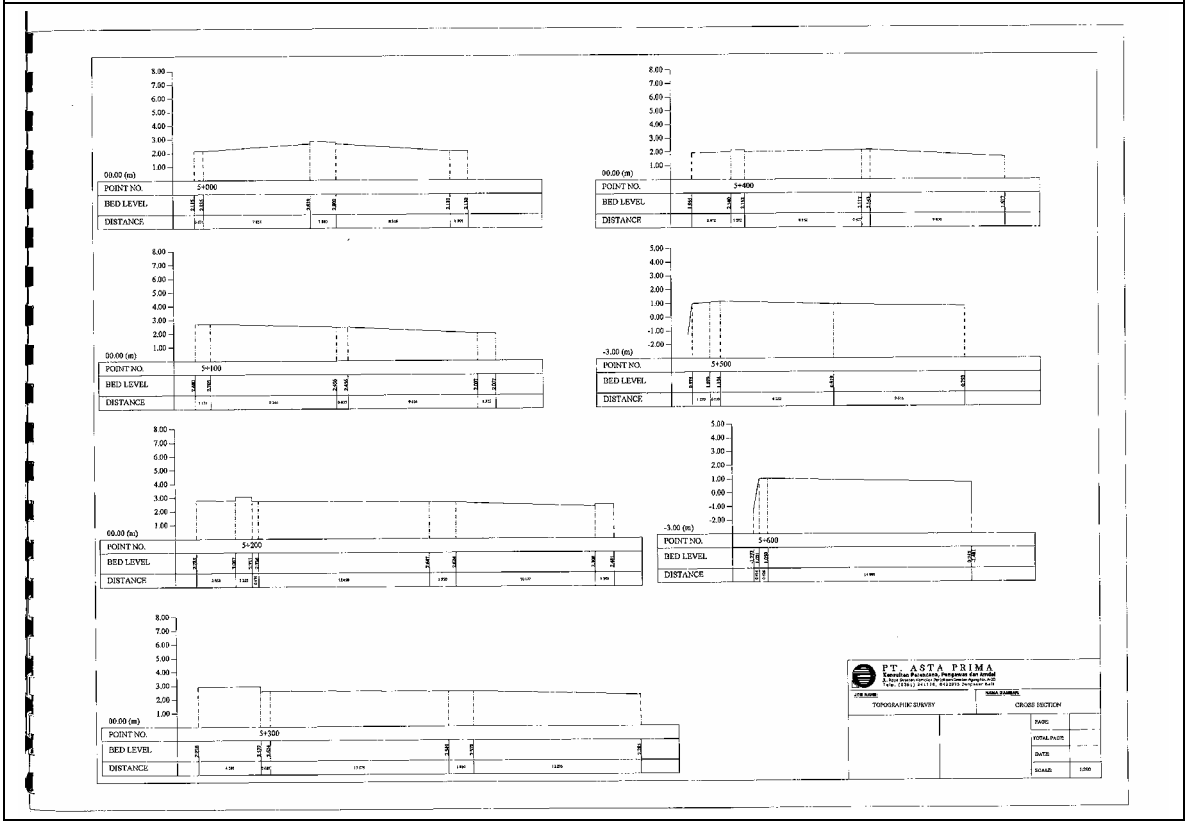
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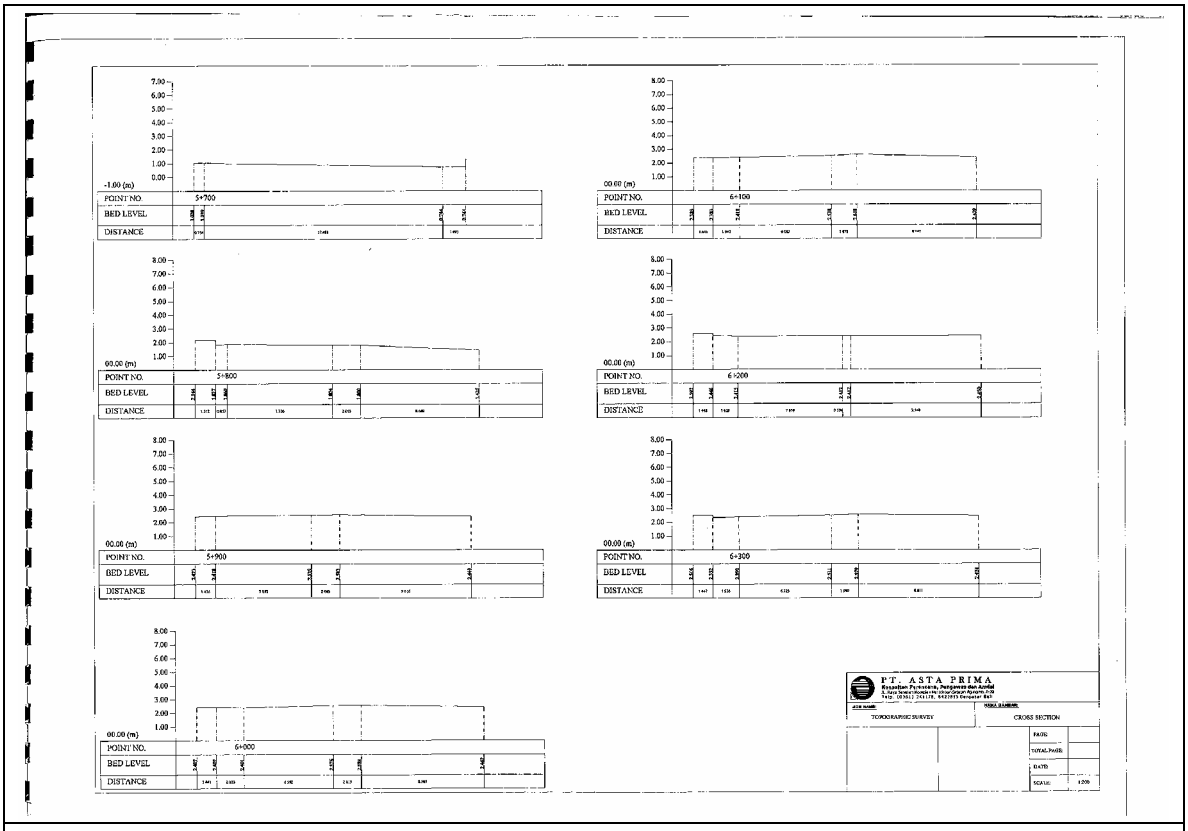
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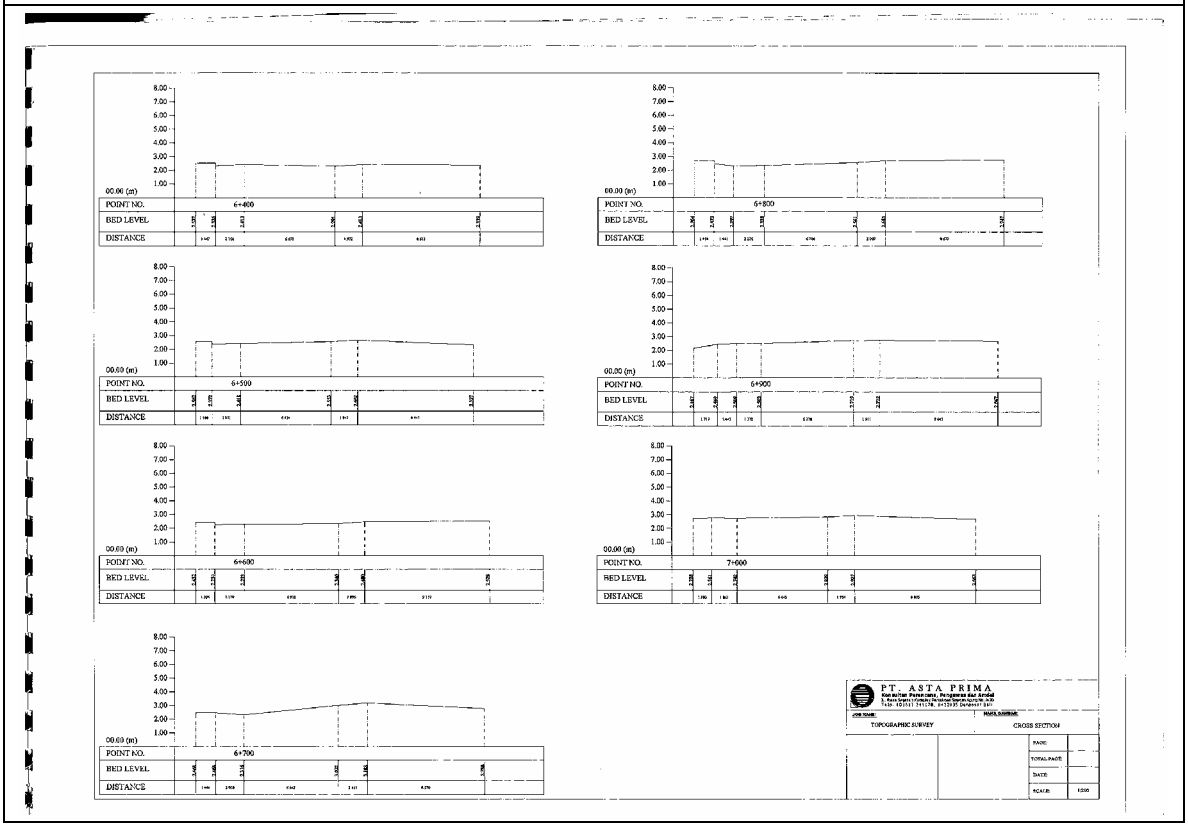
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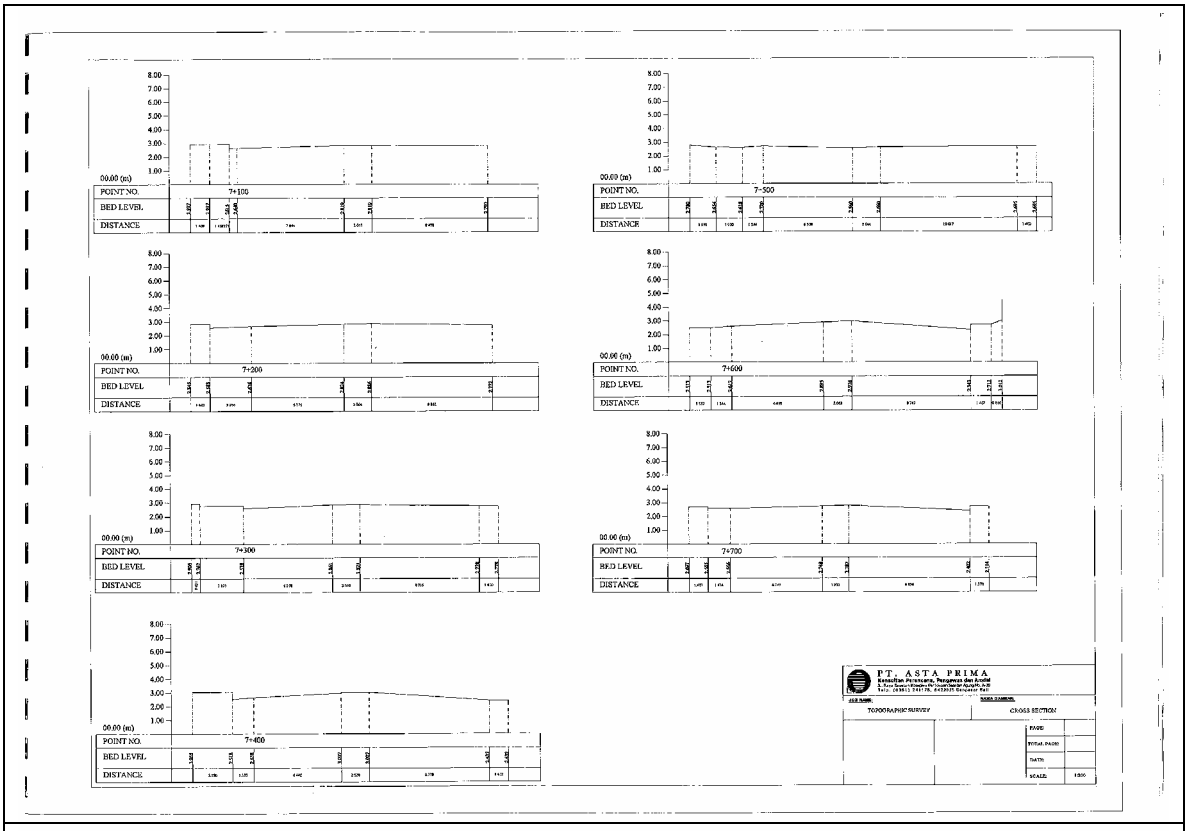
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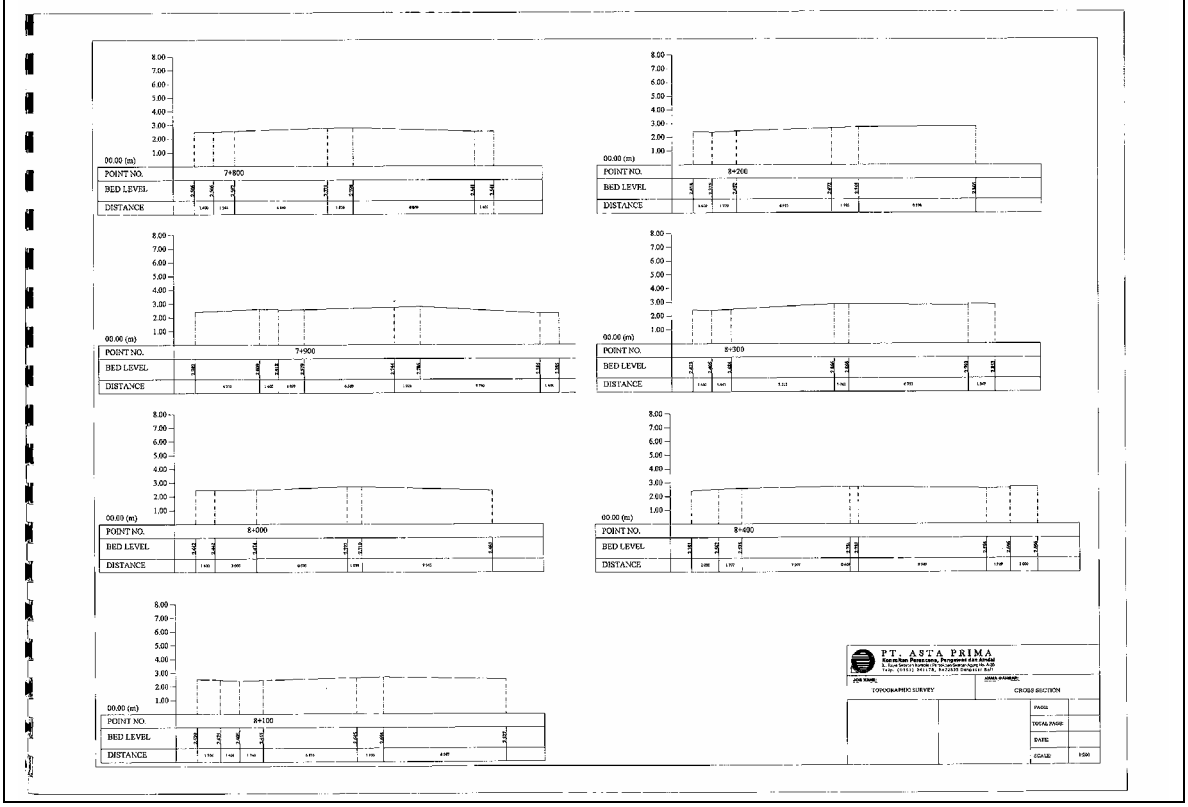
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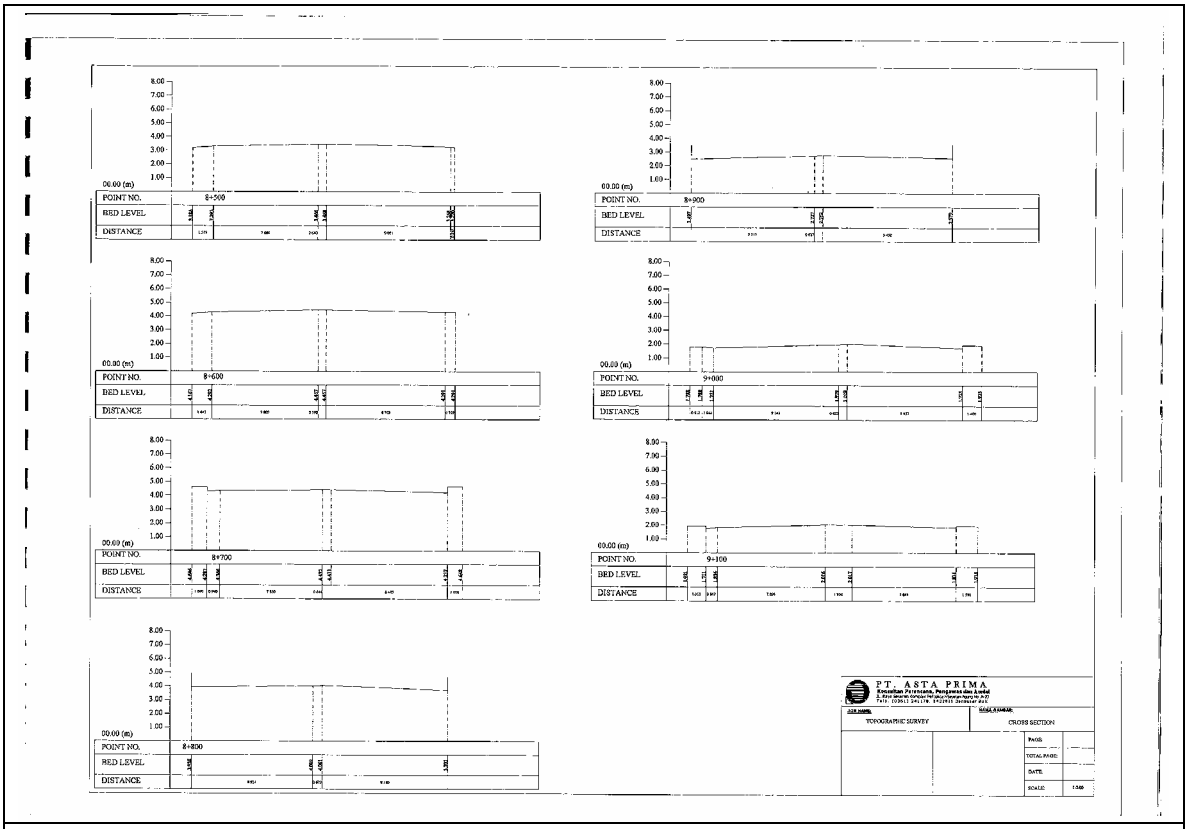
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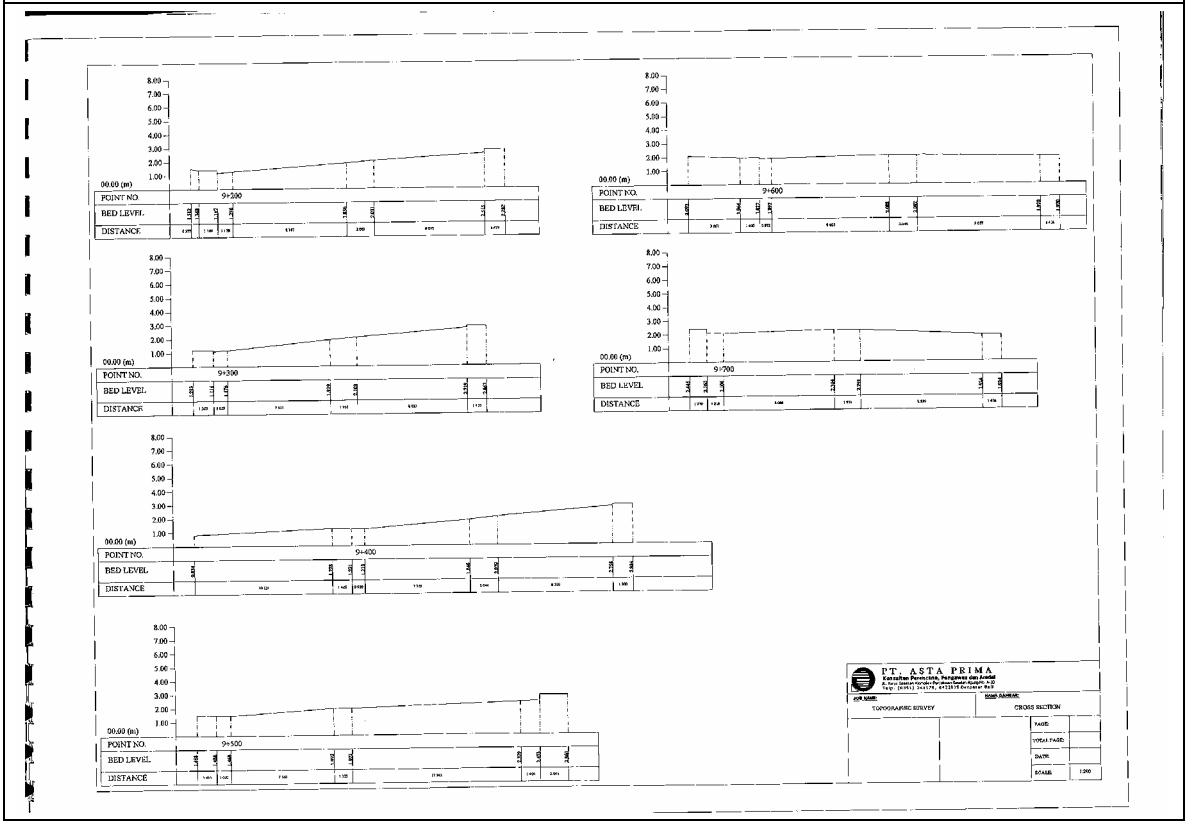
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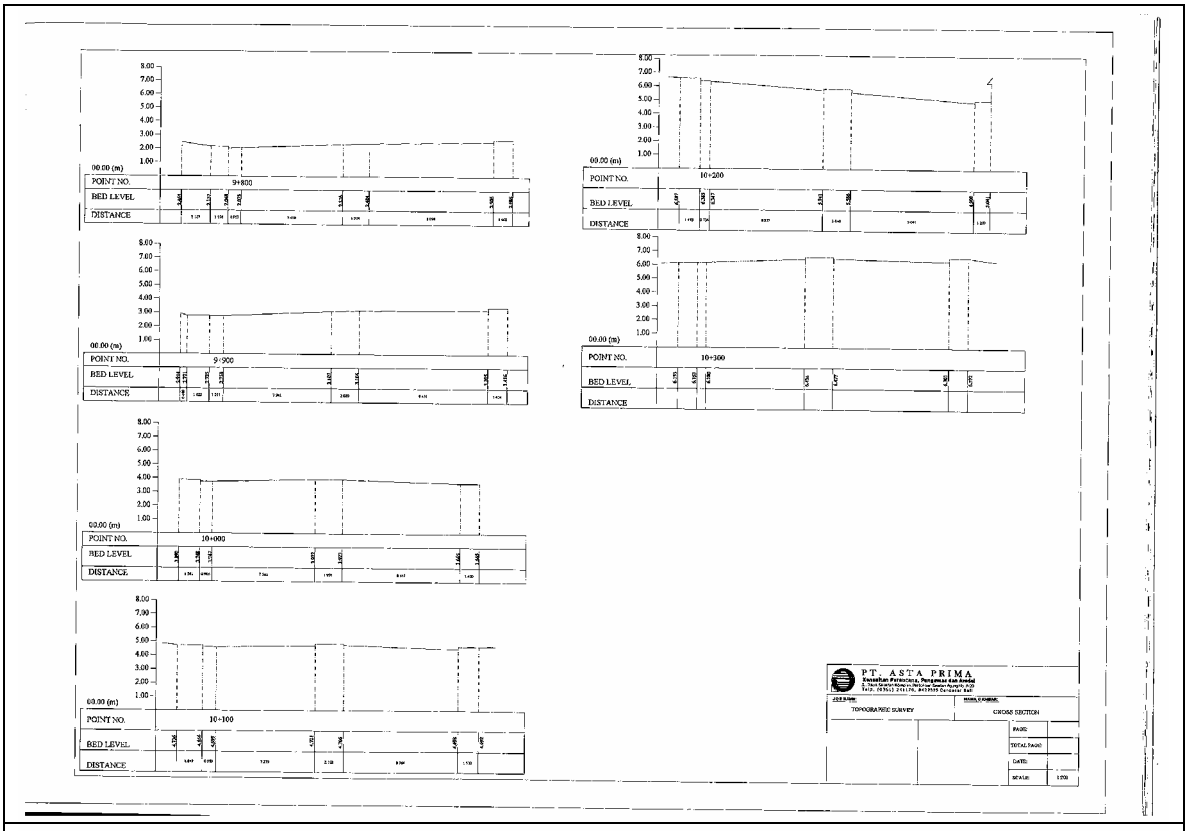
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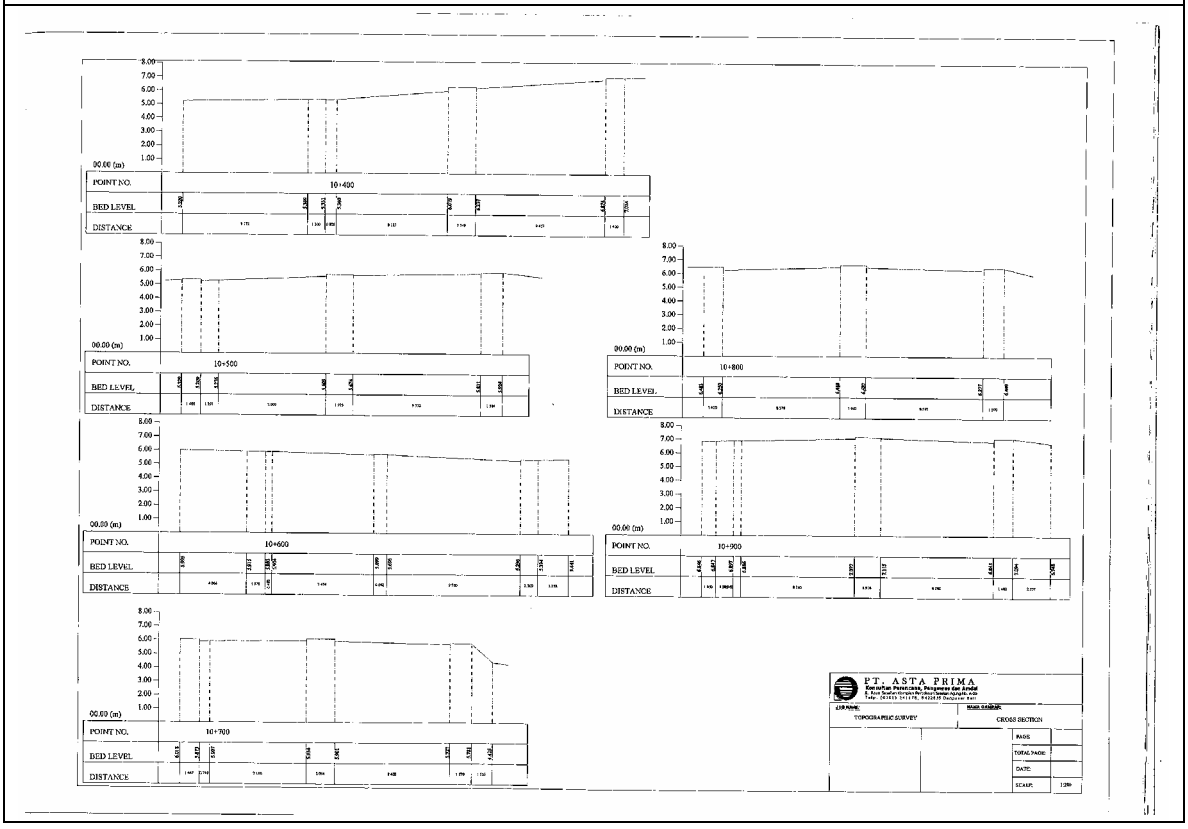
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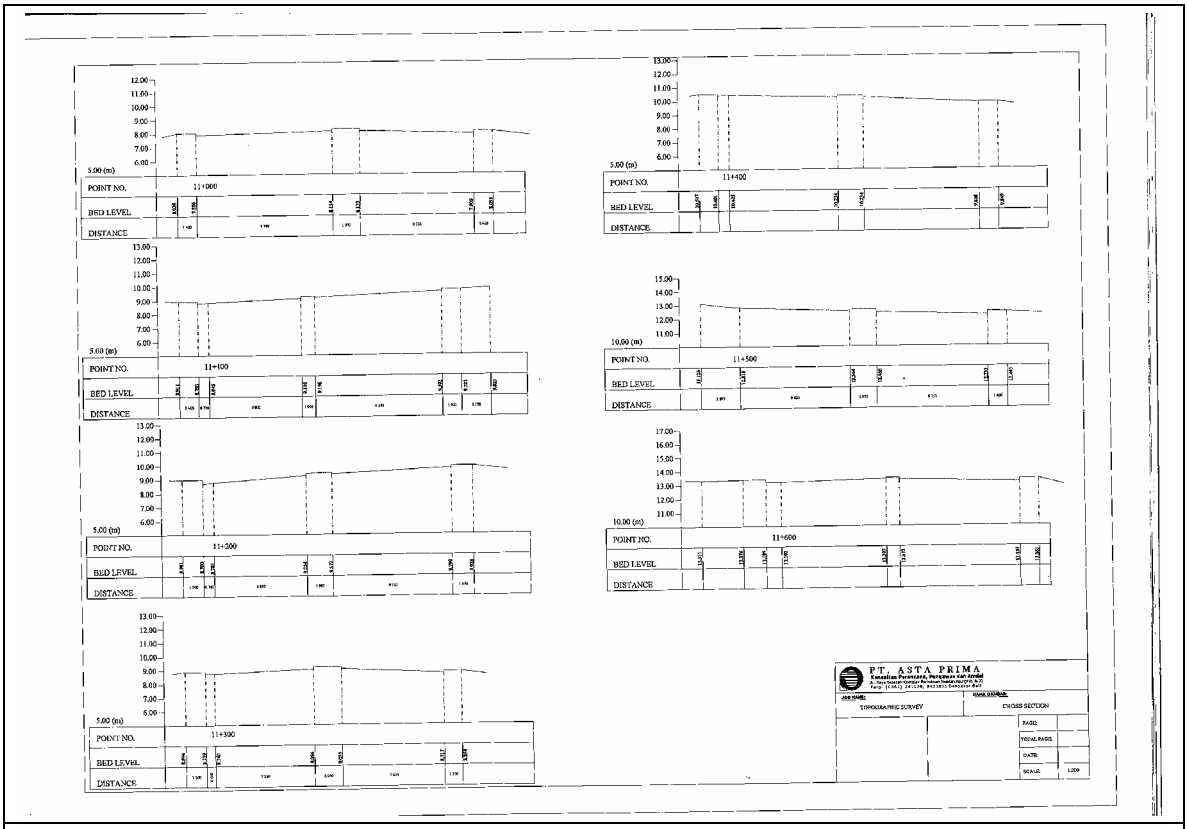
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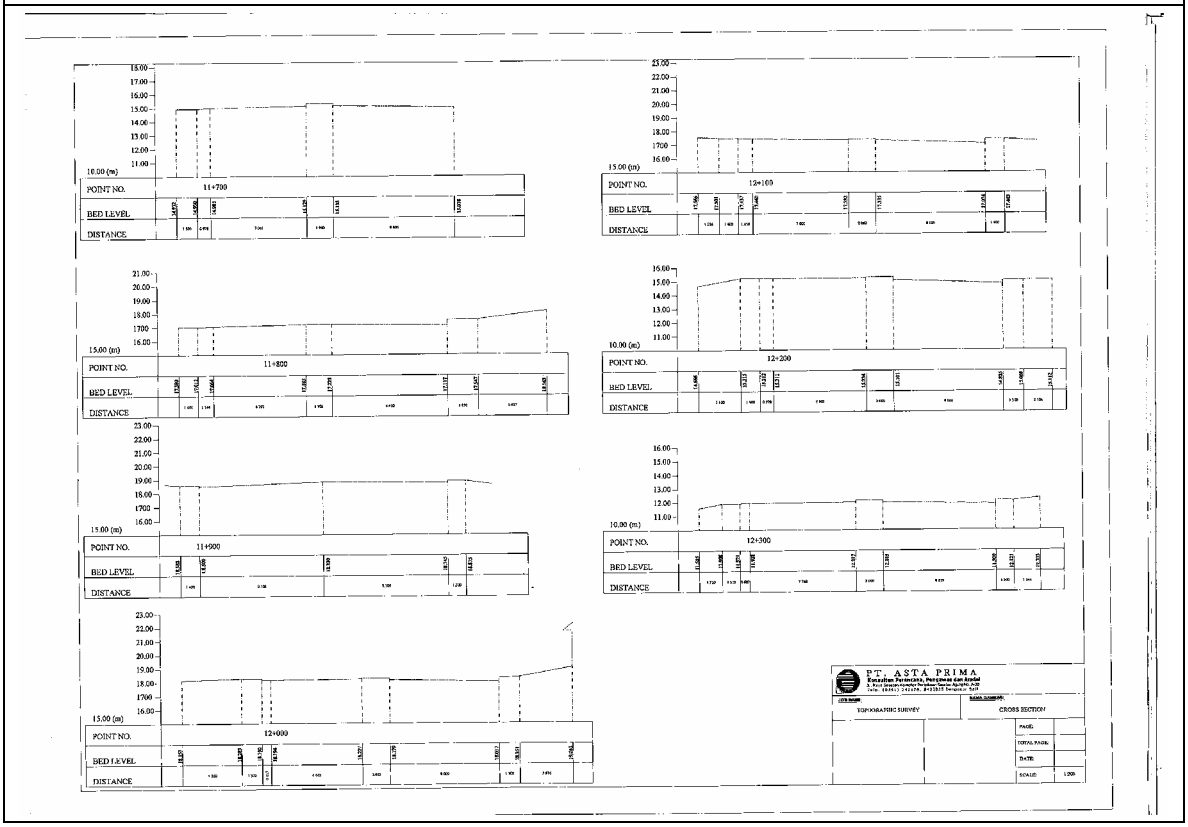
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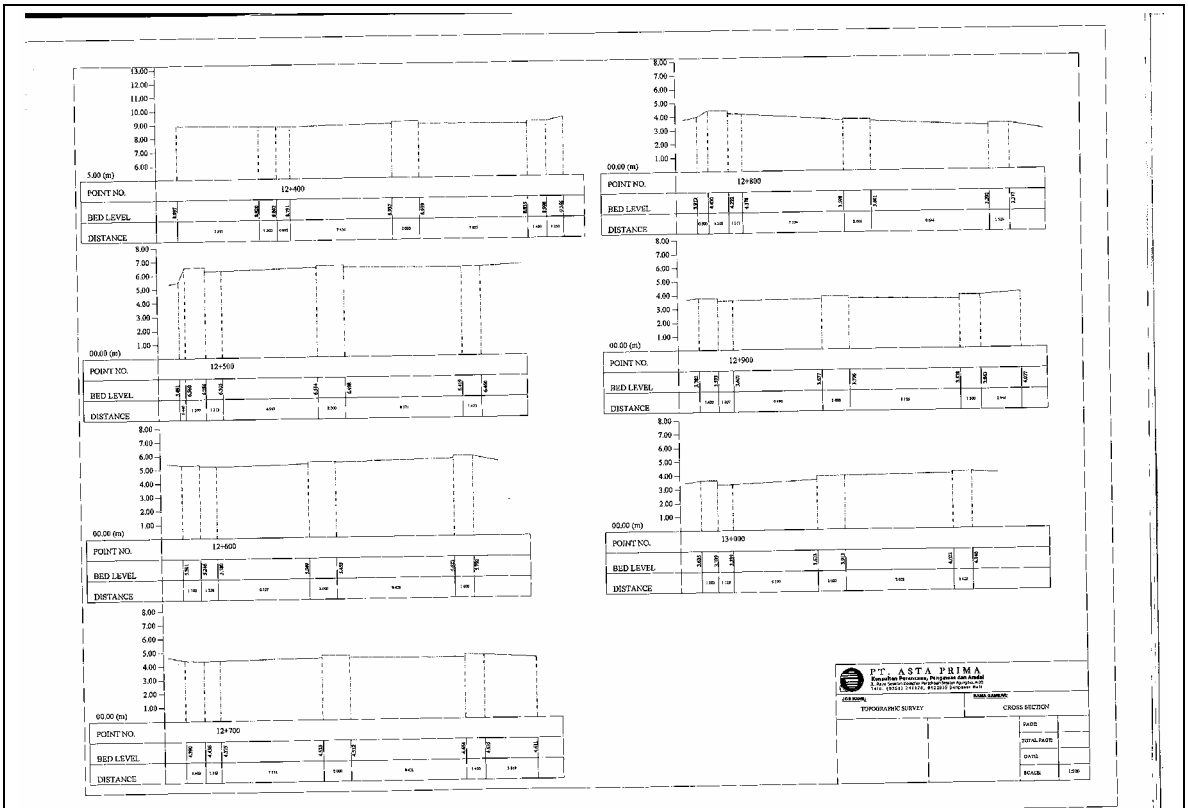
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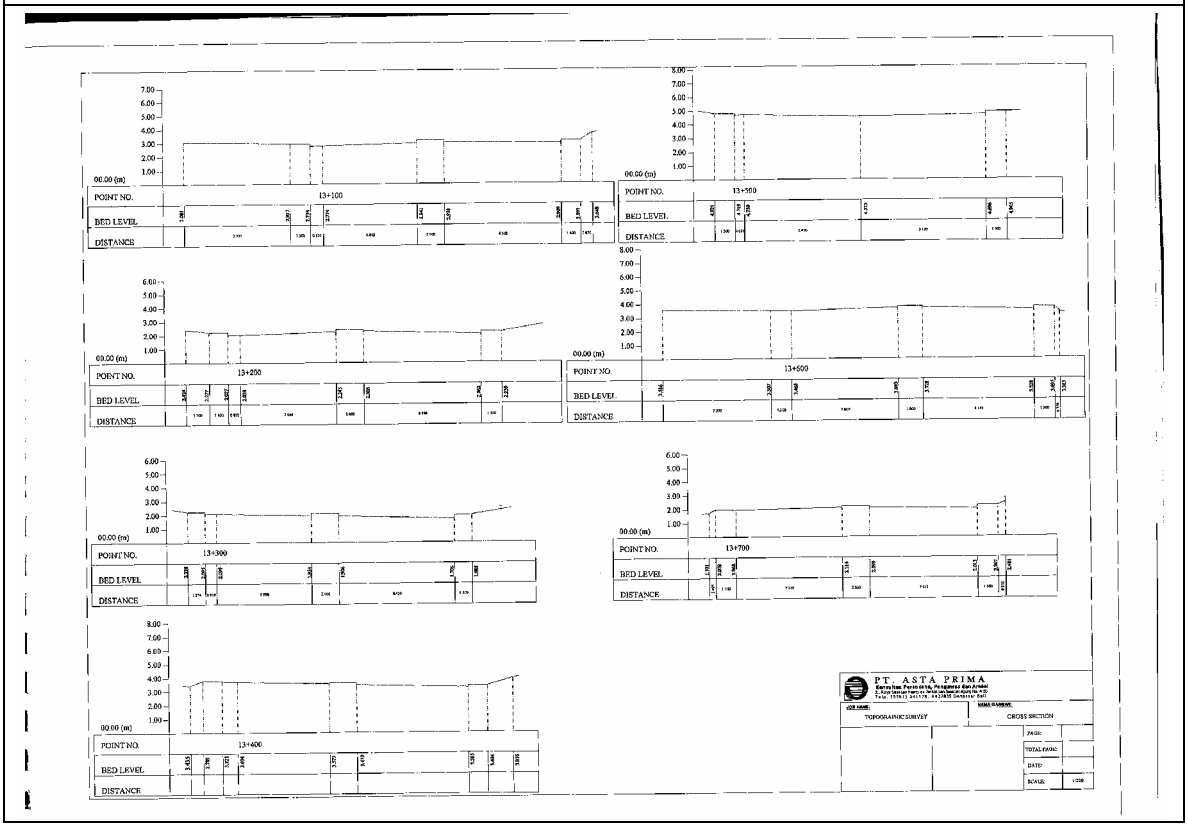
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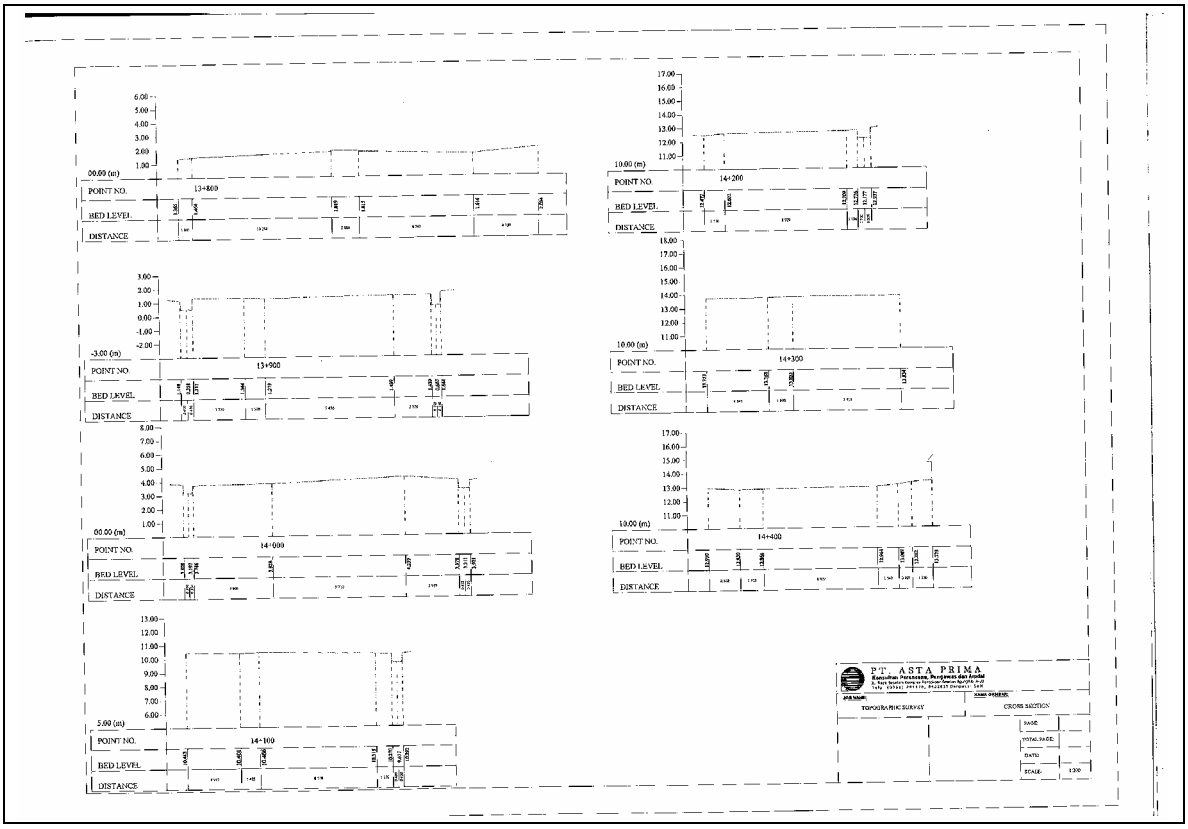
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CROSS SECTION

付属資料 4

土質調査

付属資料 4　　土質調査

4.a 調査実施仕様書

再生水プラント建設予定地（デンパサール下水処理場拡張用地）を対象に以下の仕様のボーリング調査を実施した。

ボーリング調査仕様

項目	仕様
ボーリング本数	3 本
深度	40m
総延長	120m

土質試験項目とサンプル数は以下の通りである。

土質試験項目とサンプル数

試験項目	仕様　／　試験項目
1. 標準貫入試験	1m 毎に実施
2. 試料サンプリング	1 ヶ所当たり 3 本
3. 室内試験	1) 単位体積重量
	2) 含水比
	3) 粒度試験
	4) 一軸圧縮試験

SECTION III

SPECIFICATIONS

3.1 PURPOSE

The work called for Geotechnical Investigation under this Contract (hereinafter referred to as the Work) will be conducted as a part of the JICA Preparatory Survey on Application of Wastewater Reclaiming in Southern Bali Water Supply System in the Republic of Indonesia. The survey results will be used by the JICA Study Team (hereinafter referred to as "the Engineer", and will serve as the basis for the preparation of preliminary designs of a reclamation plant.

3.2 GENERAL REQUIREMENTS

The Contractor shall comply with the following requirements in undertaking the Work.

(1) All measurements and results of the survey shall be in SI units.

(2) Locations of the sites for the Work shall be confirmed by the Contractor and shall be approved by the Engineer before the commencement of the survey works in field.

(3) Prior to the commencement of the Work, the Contractor shall submit an Initiation Report prepared in English describing:

- List of equipment to be used by the Contractor
- Methods with Standards to be used by the Contractor
- Work Schedule
- Staff Assignment Schedule

(4) The Contractor shall provide, and therefore shall include the associated costs in his proposal, all equipments, personnel, transportation and others required to complete the Work.

(5) The Contractor shall not commence the Work in field without receiving a written Notice to Proceed from the Engineer.

(6) Drawings and reports to be submitted by the Contractor shall, unless otherwise specifically directed by the Engineer, be as follows, including one set of files of compact disk:

- All drawings; One (1) sets of A 1 size and Two (2) sets of A3 size
- All reports; Two (2) sets of A4

(7) The progress of the Work shall be described in the form of a weekly report and submitted to the designated address of the Engineer by a facsimile at the end of each week throughout the tenure of this Contract.

(8) Accuracy of the survey and investigation shall be as directed by the Engineer.

3.3 SCOPE OF WORKS

The Work comprises the following schedules:

Schedule 3.3.1 : Boring
Schedule 3.3.2 : Standard Penetration Test and In-situ Permeability Test
Schedule 3.3.3 : Sampling and Laboratory Test

3.3.1 Boring

Three (3) nos. of boring in total will be conducted at the Suwung WWTP, as shown in Figure 1. And the actual location of boreholes shall be directed and confirmed by the Engineer, based on information of preliminary surveys of sites by the Contractor.

The maximum depth is approximately 40 meters at the proposed STP site and the total depth to dig is 120 m. When a bearing stratum is reached at less than specified depth, boring shall be stopped at 5 meters below the top of the stratum.

Method of boring shall be proposed by the Contractor for approval by the Engineer. The diameter of a borehole shall be sufficient to ensure that the boring can be completed to the scheduled depth and that samples of the specified diameter can be obtained.

Generally, water shall not be used to assist the advance of the borehole except in the case of dry coarse soils. Where the borehole penetrates below the water table and disturbance of the soil is likely, a positive hydrostatic pressure shall be maintained in the borehole.

The Contractor shall backfill boreholes in such a manner that no subsequent depression is formed at the ground surface due to settlement of the backfill. In some circumstances special infilling may be required by the Engineer. Unless otherwise instructed the special infilling shall be cement/bentonite (1:4) grout. Where artesian or other water conditions make normal backfilling impracticable, the Contractor shall consult with the Engineer a procedure for sealing the borehole.

3.3.2 Standard Penetration Test and In-situ Permeability Test

(1) Standard Penetration Test (SPT)
Standard penetration tests (SPT) shall be carried out every 1.0 m interval in accordance with ASTM D 1586-99 or equivalent standards. The sample from the split barrel sampler shall be retained as a small disturbed sample. Where a sample is not retained in the split barrel or when the cutting shoe is replaced by a solid cone, a disturbed sample shall be taken from the test zone. The water level and the depth of casing in the hole at the time of the test shall be recorded.

(2) In-situ Permeability Test
In-situ permeability test shall be conducted at each borehole in accordance with the ASTM D5126 or other equivalent standards.

3.3.3 Sampling and Laboratory Test

(1) Sampling

1) Disturbed Samples

One small disturbed sample shall be taken between each two successive SPTs. It shall weigh not less than 0.25 kg and shall be placed immediately in an airtight container, which it should fill. Samples shall be protected to ensure that their temperature does not fall below 5 °C. They shall also be protected from direct heat and sunlight.

Samples shall be examined and described by a geotechnical specialist in accordance with the American Standards, the Clause 6.4.3 of American Society for Testing and Materials (hereinafter referred to as ASTM) D420, clause 41 of British Standard (hereinafter referred to as BS) 5930 or equivalent standards.

2) Undisturbed Samples

At each borehole, undisturbed samples shall be taken as shown in Table 1, using open tube sampling equipment as described in the clause 2.2 of ASTM D1586, clause 19.4.4 of BS 5930 or equivalent standards. For predominantly cohesive soils, one undisturbed samples, by thin-walled tube sampling methods, shall be taken for laboratory tests in accordance with ASTM D1587 or equivalent standards.

Followings are major important points when the samples are taken:

Source: BLUPAL

Figure 1 Boring and Sampling Locations at the Suwung WWTP

Before an undisturbed sample is taken, the bottom of the hole shall be carefully cleared of loose materials and where a casing is being used the sample shall be taken below the bottom of the casing. Following a break in the work exceeding one hour, the borehole shall be advanced by 250 mm before undisturbed sampling is resumed.

Table 1 Undisturbed Sampling Events required for each borehole

Location	Boring Point	Number of samples	Sampling in the borehole
Sumung WWTP	No.1	4 (max.)	every 10 meters interval and the bottom
	No.2	4 (max.)	every 10 meters interval and the bottom
	No.3	4 (max.)	every 10 meters interval and the bottom
	Sub-total	12 (max.)	

Where an attempt to take an undisturbed sample is unsuccessful the hole shall be cleaned out for the full depth to which the sampling tube has penetrated and the recovered soil saved as a disturbed sample. A fresh attempt shall then be made from the level of the base of the unsuccessful attempt. Should this second attempt also prove unsuccessful the Contractor shall agree with the Engineer alternative means of sampling.

The samples shall be sealed as soon as possible on the same day to preserve their natural moisture content and in such a manner as to prevent the sealant from entering any voids in the sample.

The depths below ground level at which samples are taken shall be recorded. The level of the top of the sample and the length of sample obtained shall be recorded.

(2) Laboratory Test

Undisturbed samples shall be taken to a soils laboratory approved by the Engineer and shall be subjected to the following tests. Unit shall be based on SI unit.

- Specific gravity, ASTM D854-58 or BS test 6
- Water (moisture) content, ASTM D2216-71 or BS test 1(A)
- Density, ASTM D2937-71 or BS test 15(E) or 15(F)
- Particle size distribution, ASTM D421-58 and ASTM D422-63 or BS test 7
- Unconfined compressive strength, ASTM D2166-66 or BS test 20

Contractor shall prepare a schedule of tests for approval by the Engineer.

All preparation, testing and reporting shall be where applicable in accordance with the relevant American Standards, the ASTM. Where tests are not covered by the American Standards they shall be

performed in accordance with the procedures given in the following references.
British Standard, Head K. H., Manual of soil laboratory testing (vols. I-III), Pentech, London
relevant publications by the Transport and Road Research Laboratory (TRRL), and the International Journal of Rock Mechanics and Mining Sciences (IJRM).

Calibration of load-displacement or other measuring and testing equipment shall be carried out in accordance with the manufacturer's instructions. Evidence of recent calibrations shall be submitted to the Engineer.

3.4 Reporting

The report shall be prepared in English. The report shall be submitted in two (2) sections, the first being the factual report, and the second the interpretative report. Both sections of the report shall begin with a cover page showing the name of the Contract and the names of the Employer and Contractor. A draft copy of the factual report and the interpretative report shall be submitted to the Engineer for approval before submission of the final report.

The factual report shall contain the following information, where applicable

- a description of the work carried out
- exploratory hole logs
- laboratory test results
- plan with locations of exploratory holes
- site location plan

The plans shall be presented to a scale directed by the Engineer and shall include a north point.

The exploratory hole logs shall be presented to a vertical scale in the form as appropriate. The logs shall contain the following information

- Contract title and site location
- Contractor's and operator's name
- Borehole number and location
- Dates and time
- Ground level related to the agreed datum
- Diameters and depths of borehole and casings referred to the agreed datum
- Elevation of each stratum referred to the agreed datum
- The depth at which any water was added

- Records of groundwater
- A summary of groundwater observations
- Description of each stratum in accordance with ASTM D420
- Symbolic legend of strata in accordance with ASTM D420
- Depth of samples taken for laboratory tests

The interpretative report shall contain the following information

- a written appraisal of the ground and water conditions
- geotechnical analyses and recommendations, in particular, with respect to the depth and the type of the foundations for RC water retaining structures which weigh 10 to 15 ton/m^2.

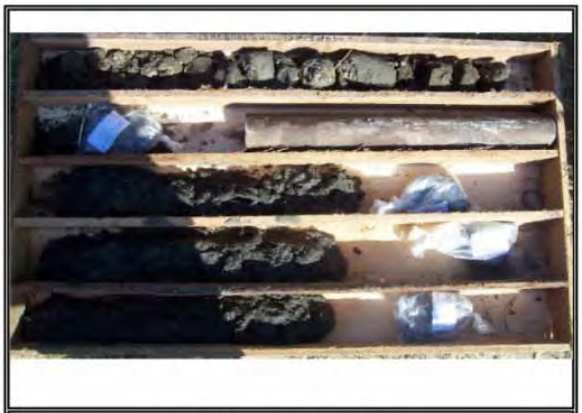
The Contractor shall supply the calculations and analyses on which his recommendations are based.

4.b 調査実施

PHOTO DOCUMENTATION (BH 1)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT

DRILLING AT BH-1



COREBOX 1 (0 - 5 M)

COREBOX 2 (5 - 10 M)

COREBOX 3 (10 - 15 M)

COREBOX 4 (15 - 20 M)

COREBOX 5 (20 - 25 M)

PHOTO DOCUMENTATION (BH 1)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT

COREBOX 6 (25 - 30 M)

COREBOX 7 (30 - 35 M)

COREBOX 8 (35 - 40 M)

PHOTO DOCUMENTATION (BH 2)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT

DRILLING AT BH-2

COREBOX 1 (0 - 5 M)

COREBOX 2 (5 - 10 M)

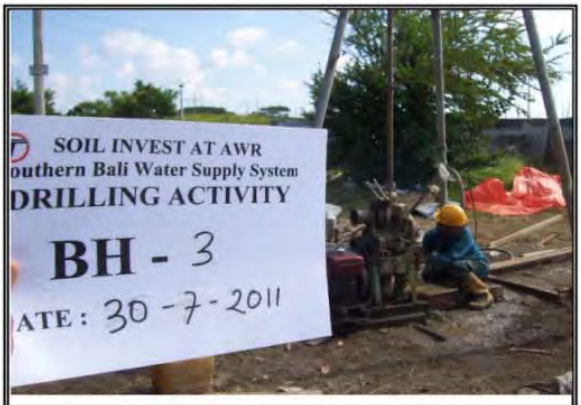
COREBOX 3 (10 - 15 M)

COREBOX 4 (15 - 20 M)

COREBOX 5 (20 - 25 M)

PHOTO DOCUMENTATION (BH 3)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT



DRILLING AT BH-3

COREBOX 1 (0 - 5 M)

COREBOX 2 (5 - 10 M)

COREBOX 3 (10 - 15 M)

COREBOX 4 (15 - 20 M)

COREBOX 5 (20 - 25 M)

PHOTO DOCUMENTATION (BH 3)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT

COREBOX 6 (25 - 30 M)

SPT ACTIVITY

PHOTO DOCUMENTATION (BH 4)

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
LOCATION : BALI
CLIENT : NIHON SUIDO CONSULTANT

DRILLING AT BH-4

COREBOX 1 (0 - 5 M)

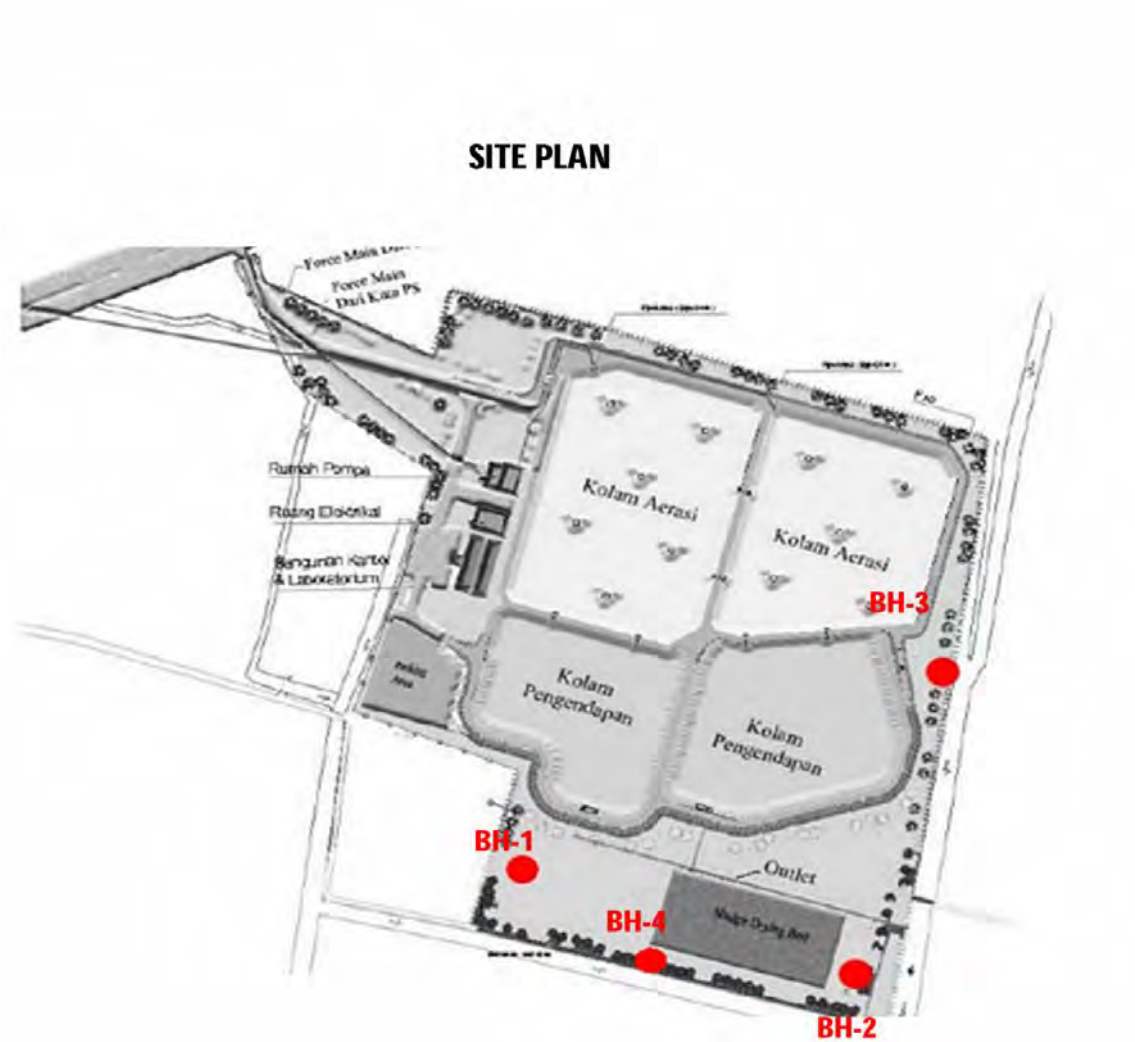
COREBOX 2 (5 - 10 M)

COREBOX 3 (10 - 15 M)

COREBOX 4 (15 - 20 M)

COREBOX 5 (20 - 25 M)

4.c 調査結果


SITE PLAN
Force Main
Dari Lift PS
Rumah Pompa
Ruang Elektrikal
Bangunan Kantor
& Laboratorium
Kolam Aerasi
Kolam Aerasi
Kolam
Pengendapan
Kolam
Pengendapan
BH-1
BH-2
BH-3
BH-4
Outlet

BOREHOLE LOGS

BORING NUMBER BH-01

PT. Tigenco Graha Persada
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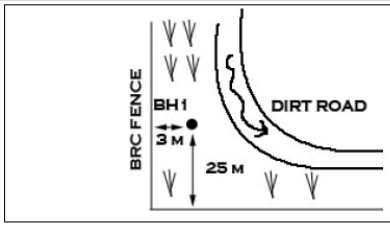

PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS
DATE STARTED 7/20/11 **COMPLETED** 7/24/11
X,Y,Z 302509.706 , 9035534.116 , 4.976 m
DRILLER Waluyo
GROUND WATER LEVELS, AVERAGE: 1.31
DRILLING METHOD Continuous Coring NQ Size - 76mm
LOGGED BY Harris **CHECKED BY** Andrianto
STATION

DATE	START	END	DATE	START	END
20/07/2011	0.60 m	0.60 m	21/07/2011	0.95 m	0.75 m
22/07/2011	0.70 m	2.80 m	23/07/2011	1.20 m	2.10 m
24/07/2011	1.20 m	2.20 m			

DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)	FINES CONTENT (%) / PL MC LL / SPT N VALUE
			0.0					
	4		silty CLAY with little fine sand, grey, high plasticity, very soft		SPT 1	1		1
					UD 1	1.45 1.5		1
2					SPT 2	2 2.45		1
	2				SPT 3	3 3.45		1
4					SPT 4	4 4.45		1
	0			9	SPT 5	5 5.45		1
6					SPT 6	6 6.45		1
	-2				SPT 7	7 7.45		1
8			8.0		SPT 8	8 8.45		1
	-4		grades, with coarse sand 9.0		SPT 9	9 9.45		2
10			fine SAND, dark grey to black, very loose		SPT 10	10 10.45	2-1-1/20 (2)	2
	-6		11.0		SPT 11	11 11.45	1-1-1/20 (2)	2
12			grades, coarse SAND, black	6	SPT 12	12 12.45	1-1-1/20 (2)	2
	-8		13.0		SPT 13	13 13.45	1-1-1/20 (2)	2
14			grades, fine SAND		SPT 14	14 14.45	1-1-1/20 (2)	2
	-10		15.0		SPT 15	15 15.45	1-1-1/20 (2)	2
16			ORGANIC CLAY, grey, very soft to soft, high plasticity		UD 2	15.5		2
	-12				SPT 16	16 16.45	1-1-1/20 (2)	2
18				5	SPT 17	17 17.45	1-1-1/20 (2)	2
	-14				SPT 18	18 18.45	1-1-1/20 (2)	2
20			20.0		SPT 19	19 19.45	1-1-1/20 (2)	2
					UD 3	19.5 20	1-1-1/20	

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

(Continued Next Page)

BORING NUMBER BH-01

PT. Tigenco Graha Persada
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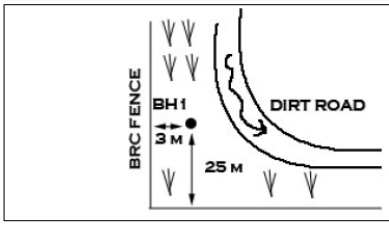
PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS



DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)	FINES CONTENT (%) / PL MC LL / SPT N VALUE
22	-16		silty CLAY with little fine sand, dark grey, high plasticity, very soft *(continued)*	3	SPT 20	20.45	(2)	2
					SPT 21	21.45	1-1-1/20 (2)	3
					SPT 22	22.45	1-1-2/20 (3)	4
	-18		23.0					
24			silty CLAY with little coarse sand, dark grey, soft to medium stiff, high plasticity		SPT 23	23.45	1-2-2/20 (4)	6
			24.0 grades, brownish to grey		SPT 24	24.45	5-7-9/20 (16)	31
	-20		25.0 grades, hard		SPT 25	25.45	10-14-17/20 (31)	16
26			26.0 silty CLAY with coral deposits, brown to gray, medium plasticiy		SPT 26	26.45	6-7-9/20 (16)	23
	-22		27.0 grades, with fine sand, high plasticity	7.5	SPT 27	27.45	8-8-15/20 (23)	24
28			28.0 grades, medium plasticity		SPT 28	28.45	8-8-16/20 (24)	28
	-24				SPT 29	29.45	10-12-16/20 (28)	30
30			30.0		SPT 30	30.45	10-12-18/20 (30)	17
			30.5 grades, very stiff to hard					
	-26		31.0 silty CLAY with LIMESTONE, light grey to white, high plasticity		SPT 31	31.45	6-6-11/20 (17)	20
32			grades, very stiff to hard		SPT 32	32.45	7-8-12/20 (20)	19
	-28				SPT 33	33.45	6-7-12/20 (19)	19
34					SPT 34	34.45	7-7-12/20 (19)	30
	-30				SPT 35	35.45	12-13-17/20 (30)	40
36			36.0	9.95	SPT 36	36.45	16-20-20/20 (40)	43
			grades, milky white		SPT 37	37.45	16-20-23/20 (43)	44
	-32				SPT 38	38.45	16-20-24/20 (44)	46
38					SPT 39	39.45	16-21-25/20 (46)	48
	-34				SPT 40	40.45	17-21-27/20 (48)	
40								

Bottom of borehole at 40.45 meters.

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-02

PAGE 1 OF 2

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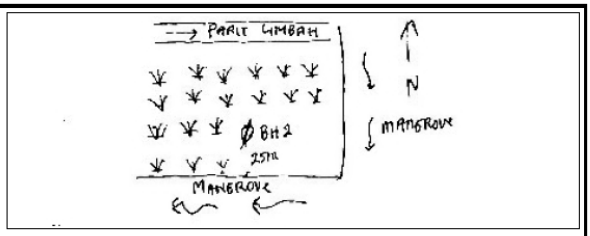

PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS

DATE STARTED 7/25/11 **COMPLETED** 7/28/11 **X,Y,Z** 302694.95 , 9035462.004 , 4.67 m
DRILLER Waluyo **GROUND WATER LEVELS, AVERAGE:** 1.605
DRILLING METHOD Continuous Coring NQ Size - 76mm
LOGGED BY Harris **CHECKED BY** Andrianto
STATION

DATE	START	END	DATE	START	END
25/07/2011	2.00 m	2.00 m	26/07/2011	1.30 m	1.70 m
27/07/2011	1.20 m	1.70 m	28/07/2011	1.20 m	1.70 m

DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)
			0.0				
	4		silty CLAY with SAND, dark grey to brown, very soft, high plasticity		SPT 1	1 / 1.45	
2					SPT 2	2 / 2.45	
	2				SPT 3	3 / 3.45	
4					SPT 4	4	
	0				UD 1	4.45 / 4.5	
				10.5	SPT 5	5 / 5.45	
6					SPT 6	6	
	-2				UD 2	6.45 / 6.5	
					SPT 7	7 / 7.45	
8					SPT 8	8	
	-4				UD 3	8.45 / 8.5	
					SPT 9	9 / 9.45	
10			10.0				
			10.5 grades, with coral deposits		SPT 10	10 / 10.45	3-4-4/20 (8)
	-6		11.0 coarse SAND with coral deposits	0.5			
			silty CLAY with coral deposits, dark gray, very stiff, medium plasticiy		SPT 11	11 / 11.45	5-7-9/20 (16)
12				2			
	-8		12.5		SPT 12	12 / 12.45	5-7-12/20 (19)
			13.0 grades, with limestone, brownish white				
			CORALS, white, hard	1	SPT 13	13 / 13.05	
14			14.0				
	-10		silty CLAY with corals, white, very stiff, low plasticity	1	SPT 14	14 / 14.45	9-10-10/20 (20)
			15.0				
			15.5 LIMESTONE, light grey to white, very stiff, non plastic	0.5	SPT 15	15 / 15.45	9-10-12/20 (22)
16			16.0 silty CLAY with fine sand, light grey mottled light brown, very stiff, high plasticity		SPT 16	16 / 16.45	9-12-14/20 (26)
	-12		grades, with limestone, light grey to white	2.5	SPT 17	17 / 17.45	11-12-15/20 (27)
18			18.0				
	-14		LIMESTONE, light grey to white, very stiff to hard, medium plastic		SPT 18	18 / 18.45	11-15-15/20 (30)
					SPT 19	19 / 19.45	9-11-14/20 (25)
20					SPT 20		9-12-14/20

FINES CONTENT (%) 20 40 60 80
PL MC LL
SPT N VALUE 10 20 30 40

(Continued Next Page)

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-02

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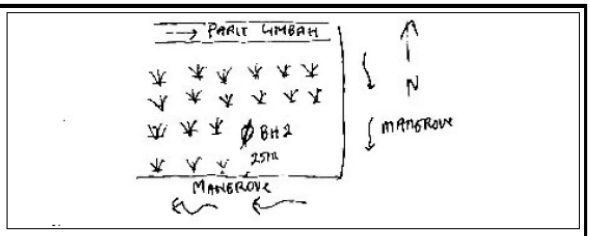
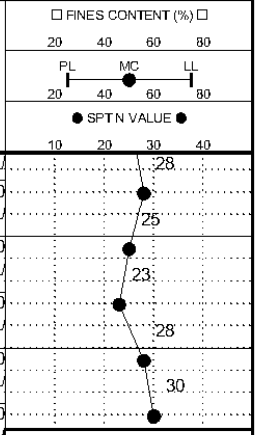
PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS



DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)
22	-18		LIMESTONE, light grey to white, very stiff to hard, medium plastic *(continued)*	7.45	20	20.45	(26)
					SPT 21	21.45	10-14-14/20 (28)
					SPT 22	22.45	10-12-13/20 (25)
					SPT 23	23.45	10-10-13/20 (23)
24	-20				SPT 24	24.45	12-14-14/20 (28)
					SPT 25	25.45	12-14-16/20 (30)

Bottom of borehole at 25.45 meters.



GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-03

PAGE 1 OF 2

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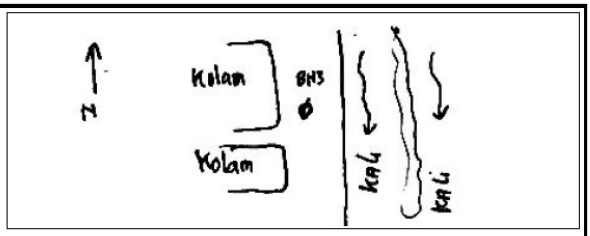

PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS

DATE STARTED 7/30/11 **COMPLETED** 8/2/11 **X,Y,Z** 302762.208 , 9035677.517 , 5.086 m
DRILLER Waluyo **GROUND WATER LEVELS, AVERAGE:** 1.875
DRILLING METHOD Continuous Coring NQ Size - 76mm
LOGGED BY Harris **CHECKED BY** Andrianto
STATION

DATE	START	END	DATE	START	END
30/07/2011	2.80 m	2.80 m	31/07/2011	1.20 m	1.90 m
01/08/2011	1.50 m	1.20 m	02/08/2011	1.30 m	2.30 m

DEPTH (m)	ELEV (m)	LITHOLOGY DESCRIPTION	LAYER THICK (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)	N VALUE
0.0							
		silty CLAY with limestone, dark brown, mottled white, medium plasticity	1				
1.0							
2	4	coarse to fine SAND, black, loose	2	SPT 1	1.45	2-2-3/20 (5)	5
				SPT 2	2.45	1-1-1/20 (2)	2
3.0	2			UD 1	2.5		
3.5		silty CLAY with little fine sand, dark grey, very soft to soft, high plasticity	0.5	SPT 3	3.45	1-1-1/20 (2)	2
4		CORALS, fine sand, white, dark grey dots, soft	2.5	SPT 4	4.45	1-1-2/20 (3)	3
	0			SPT 5	5.45	1-1-2/20 (3)	3
6.0							1
6		silty CLAY with corals, grey, very soft, high plasticity	3	SPT 6	6.45	1/45 (1)	1
	-2			SPT 7	7.45	1/45 (1)	1
8				SPT 8	8.45	1/45 (1)	1
9.0	-4			UD 2	8.5		
9.5		fine SAND with corals, very loose	0.5	SPT 9	9.45	1/45 (1)	1
10.0		CORALS, white, light grey spots	6				
10		grades, with shell, very loose		SPT 10	10.45	1-1-2/20 (3)	3
	-6			SPT 11	11.45	1-1-2/20 (3)	3
12				SPT 12	12.45	1-1-2/20 (3)	3
	-8			SPT 13	13.45	1-2-2/20 (4)	4
14				SPT 14	14.45	1-2-2/20 (4)	4
	-10			SPT 15	15.45	2-2-2/20 (4)	4
15.5							
16		silty CLAY with coarse SAND, brownish grey mottled grey, medium plasticity	0.5	SPT 16	16.45	8-11-13/20 (24)	24
	-12	coarse SAND, brownish white, medium dense	1.5	SPT 17	17.45	10-13-15/20 (28)	28
17.5							
18		CORALS, dark grey to white	0.5				30
18.5		coarse SAND, brownish white, medium dense	0.5	SPT 18	18.45	10-14-16/20 (30)	30
19.0		silty CLAY with fine SAND mix with corals, white, light grey dots, high plasticity	0.5				6
	-14	coarse SAND with corals, brownish grey, loose, low plasticity	1.5	SPT 19	19.45	3-3-3/20 (6)	7
20							
20.5				SPT 20		3-3-4/20	

FINES CONTENT (%) 20 40 60 80
PL MC LL
SPT N VALUE 10 20 30 40

(Continued Next Page)

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-03

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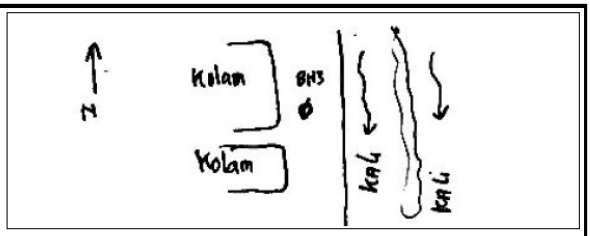
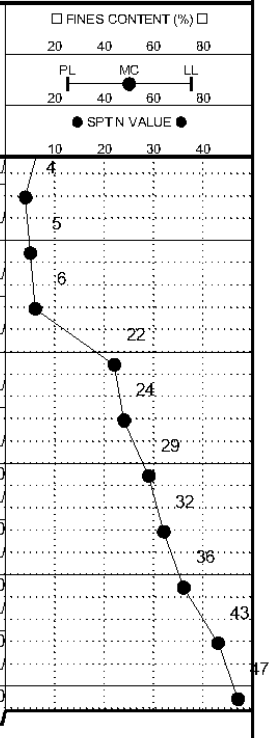
Telephone: (62) 21 86600710

PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS



DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)
			21.0 CORALS mix with limestone, dark grey mottled white	0.5	20	20.45	(7)
	-16		21.5 fine SAND, with some limestone, white, light grey dots, very loose, low plasticity	0.5	SPT 21	21 / 21.45	3-2-2/20 (4)
22			LIMESTONE, white, light grey dots, medium plasticity		SPT 22	22 / 22.45	2-2-3/20 (5)
	-18				SPT 23	23 / 23.45	2-2-4/20 (6)
24					SPT 24	24 / 24.45	7-10-12/20 (22)
	-20				SPT 25	25 / 25.45	7-10-14/20 (24)
			25.5 grades, white, brownish white dots	8.95	SPT 26	26 / 26.45	10-12-17/20 (29)
26	-22				SPT 27	27 / 27.45	10-15-17/20 (32)
					SPT 28	28 / 28.45	12-15-21/20 (36)
28	-24				SPT 29	29 / 29.45	12-18-25/20 (43)
30					SPT 30	30 / 30.45	14-20-27/20 (47)



Bottom of borehole at 30.45 meters.

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-04

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Jl. Pahlawan Revolusi 100BJakarta Timur 14340
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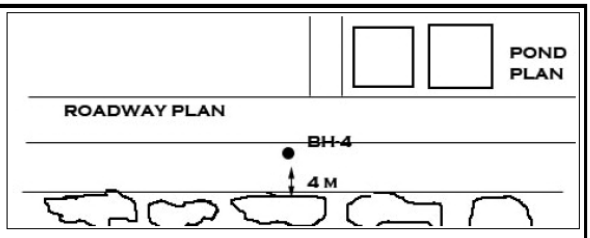


PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS

DATE STARTED 8/4/11 **COMPLETED** 8/5/11 **X,Y,Z** 302601.196 , 9035490.905 , 4.569 m
DRILLER Waluyo **GROUND WATER LEVELS, AVERAGE:** 1.9
DRILLING METHOD Continuous Coring NQ Size - 76mm
LOGGED BY Harris **CHECKED BY** Andrianto
STATION

DATE	START	END	DATE	START	END
04/08/2011	1.70 m	1.70 m	05/08/2011	1.50 m	2.70 m

DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)
			0.0				
	4		silty CLAY, dark brown, high plasticity	1			
			1.0				
2			silty CLAY with fine sand, dark grey, very soft to soft, medium to high plasticity		SPT 1	1 / 1.45	1-1-1/20 (2)
	2				SPT 2	2	1-1-1/20 (2)
					UD 1	2.45 / 2.5	
4				5	SPT 3	3 / 3.45	1/45 (1)
	0				SPT 4	4	1/45 (1)
					UD 2	4.45 / 4.5	
6			6.0		SPT 5	5 / 5.45	1/45 (1)
	-2		fine SAND, black, very loose		SPT 6	6 / 6.45	1-1-2/20 (3)
8				2	SPT 7	7 / 7.45	1/45 (1)
			8.0				
	-4		silty CLAY, dark grey, very soft to soft, high plasticity		SPT 8	8 / 8.45	1/45 (1)
					UD 3	8.5 / 9	
10					SPT 9	9.45	1-1-1/20 (2)
	-6				SPT 10	10 / 10.45	1-1-1/20 (2)
12					SPT 11	11 / 11.45	1-1-1/20 (2)
					UD 4	11.5	
	-8			8	SPT 12	12 / 12.45	1-1-1/20 (2)
14					SPT 13	13 / 13.45	1-1-1/20 (2)
	-10				SPT 14	14 / 14.45	1-1-1/20 (2)
16			16.0		SPT 15	15 / 15.45	1-1-1/20 (2)
	-12		silty CLAY with coarse SAND, dark grey, very soft to soft, high plasticity		SPT 16	16 / 16.45	1-1-1/20 (2)
				2	SPT 17	17 / 17.45	1-1-1/20 (2)
18			18.0				
	-14		18.5 fine SAND, dark grey, very loose	0.5	SPT 18	18 / 18.45	1-1-1/20 (2)
			silty CLAY with fine sand, dark grey, soft, high plasticity	1			
			19.5		SPT 19	19 / 19.45	1-1-2/20 (3)
20			LIMESTONE, light grey to white, dotted white, low medium plasticity		SPT 20		10-14-17/20

FINES CONTENT (%) 20 40 60 80
PL MC LL 20 40 60 80
SPT N VALUE 10 20 30 40

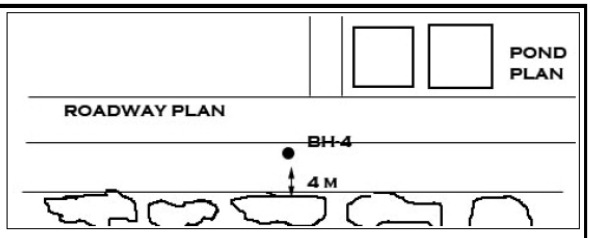
(Continued Next Page)

GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

BORING NUMBER BH-04

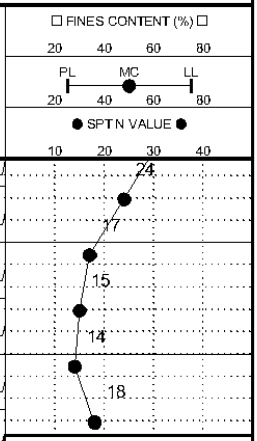
PT. Tigenco Graha Persada
Jl. Pahlawan Revolusi 100BJakarta Timur 14340
Telephone: (62) 21 86600710

PROJECT Wastewater Reclaiming in Southern Bali Water Supply System
LOCATION IPAL SUWUNG
CLIENT NIHON SUIDO CONSULTANTS



DEPTH SCALE (m)	ELEVATION SCALE (m)	GRAPHIC LOG	LITHOLOGY DESCRIPTION	LAYER THICKNESS (M)	SAMPLE TYPE NUMBER	SAMPLE DEPTH (M)	BLOW COUNTS (N VALUE)
22	-18		LIMESTONE, light grey to white, dotted white, low medium plasticity *(continued)*	5.95		20.45	(31)
					SPT 21	21.45	9-12-12/20 (24)
					SPT 22	22.45	7-7-10/20 (17)
24					SPT 23	23.45	7-7-8/20 (15)
	-20				SPT 24	24.45	7-7-7/20 (14)
					SPT 25	25.45	8-9-9/20 (18)

Bottom of borehole at 25.45 meters.



GEOTECH BH PLOTS NISSUICON-DENPASAR.GPJ TIGENCO-RAILWAY.GDT 9/12/11

LAB TEST RESULTS

- Specific Gravity Test
- Moisture Content Test
- Density Test
- Sieve Analysis
- Hydrometer Analysis
- Unconfined Compression Test
- Atterberg Limits

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	28-Jul-2011
	Tested By	Benny	Checked By	M. Iqbal, ST

INDEX PROPERTIES

Location : Bali

Bore Hole No		BH - 01		BH - 01		BH - 01		BH - 02	
Depth	meter	1.50 - 2.00		15.50 - 16.00		19.50 - 20.00		4.50 - 5.00	
Sample Type		UDS		UDS		UDS		UDS	
SPECIFIC GRAVITY TEST (ASTM D - 854)									
Pycnometer No.		T15	T14	T6	T16	T8	T29	T28	T13
Wt. Of dry Soil (A)	g	17.91	17.67	14.18	14.22	14.00	14.21	16.02	15.45
Temperature (T)	^{0}C	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Wt. Pycnometer + Water + Soil (B)	g	169.55	158.46	163.98	156.79	163.57	169.52	172.62	161.23
Wt Pycnometer + Water at T ^{0}C (C)	g	158.47	147.52	155.24	147.95	154.90	160.65	162.69	151.65
A+(C-B)	g	6.83	6.73	5.44	5.38	5.33	5.34	6.09	5.87
Specific Gravity (Gs)		2.618	2.621	2.602	2.639	2.622	2.657	2.626	2.628
SPECIFIC GRAVITY Average (Gs)		**2.619**		**2.620**		**2.639**		**2.627**	
MOISTURE CONTENT TEST (BS 1377 : 1975)									
No. Container		R.1	D.60	R.12	D.55	F.36	D.3	E.33	E.6
Wt. Container + Wet Soil	g	163.80	30.05	144.56	46.52	141.09	46.81	34.40	33.47
Wt. Container + Dry Soil	g	116.34	21.86	87.44	27.51	84.12	27.51	20.87	20.42
Wt. Container	g	17.58	5.05	19.71	4.88	17.43	4.85	5.16	5.27
Wt. Water	g	47.46	8.19	57.12	19.01	56.97	19.30	13.53	13.05
Wt. Dry Soil	g	98.76	16.81	67.73	22.63	66.69	22.66	15.71	15.15
Moisture Content (w)	%	48.06	48.72	84.33	84.00	85.43	85.17	86.12	86.14
MOISTURE CONTENT Average (w)	%	**48.39**		**84.17**		**85.30**		**86.13**	
DENSITY TEST (BS 1377 : 1975)									
No. Ring		A		A		A		A	
Wt. Ring + Wet Soil	g	75.95		71.75		70.55		71.27	
Wt. Ring	g	43.38		43.38		43.38		43.38	
Vol. Wet Soil (= Vol. Ring)	cm^3	19.24		19.24		19.24		19.24	
BULK DENSITY (γm)	Mg/m^3	**1.693**		**1.475**		**1.412**		**1.450**	

DRY DENSITY (γd)	Mg/m^3	**1.141**	**0.801**	**0.762**	**0.779**
VOID RATIO (e)		**1.296**	**2.273**	**2.463**	**2.373**
POROSITY (n)		**0.564**	**0.694**	**0.711**	**0.704**
DEGREE OF SATURATION (Sr)	%	**97.792**	**97.038**	**91.396**	**95.347**

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	28-Jul-2011
	Tested By	Benny	Checked By	M. Iqbal, ST

INDEX PROPERTIES

Location : Bali

Bore Hole No		BH - 02		BH - 02		BH - 03		BH - 03	
Depth	meter	6.50 - 7.00		8.50 - 9.00		2.50 - 3.00		8.50 - 9.00	
Sample Type		UDS		UDS		UDS		UDS	
SPECIFIC GRAVITY TEST (ASTM D - 854)									
Pycnometer No.		T12	T18	T15	T11	T11	T27	T21	T26
Wt. Of dry Soil (A)	g	16.35	15.54	14.91	14.64	16.34	16.00	16.71	16.23
Temperature (T)	^{0}C	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Wt. Pycnometer + Water + Soil (B)	g	165.90	161.12	167.68	161.13	162.28	155.87	155.96	162.10
Wt Pycnometer + Water at T ^{0}C (C)	g	155.82	151.51	158.47	152.07	152.18	145.94	145.54	151.99
A+(C-B)	g	6.27	5.93	5.70	5.58	6.24	6.07	6.29	6.12
Specific Gravity (Gs)		2.603	2.616	2.611	2.619	2.614	2.631	2.652	2.647
SPECIFIC GRAVITY Average (Gs)		**2.610**		**2.615**		**2.623**		**2.650**	
MOISTURE CONTENT TEST (BS 1377 : 1975)									
No. Container		E.31	E.23	E.15	E.21	E.15	E.21	E.31	E.23
Wt. Container + Wet Soil	g	31.56	31.24	30.39	30.40	30.01	30.03	30.49	30.40
Wt. Container + Dry Soil	g	20.93	20.86	20.03	19.79	21.66	21.37	21.81	21.82
Wt. Container	g	5.04	5.49	5.41	5.32	5.32	5.41	5.01	5.49
Wt. Water	g	10.63	10.38	10.36	10.61	8.35	8.66	8.68	8.58
Wt. Dry Soil	g	15.89	15.37	14.62	14.47	16.34	15.96	16.80	16.33
Moisture Content (w)	%	66.90	67.53	70.86	73.32	51.10	54.26	51.67	52.54
MOISTURE CONTENT Average (w)	%	**67.22**		**72.09**		**52.68**		**52.10**	
DENSITY TEST (BS 1377 : 1975)									
No. Ring		A		A		A		A	
Wt. Ring + Wet Soil	g	72.70		74.12		75.11		79.33	
Wt. Ring	g	43.38		43.38		43.38		43.38	
Vol. Wet Soil (= Vol. Ring)	cm^3	19.24		19.24		19.24		19.24	
BULK DENSITY (γm)	Mg/m^3	**1.524**		**1.598**		**1.649**		**1.869**	

DRY DENSITY (γd)	Mg/m^3	**0.911**	**0.928**	**1.080**	**1.228**
VOID RATIO (e)		**1.864**	**1.817**	**1.428**	**1.157**
POROSITY (n)		**0.651**	**0.645**	**0.588**	**0.536**
DEGREE OF SATURATION (Sr)	%	**94.128**	**100.000**	**96.746**	**100.000**

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	28-Jul-2011
	Tested By	Benny	Checked By	M. Iqbal, ST

INDEX PROPERTIES

Location : Bali

Bore Hole No		BH - 04		BH - 04		BH - 04		BH - 04	
Depth	meter	2.50 - 3.00		4.50 - 5.00		8.50 - 9.00		11.50 - 12.00	
Sample Type		UDS		UDS		UDS		UDS	
SPECIFIC GRAVITY TEST (ASTM D - 854)									
Pycnometer No.		T14	T15	T23	T31	T22	T20	T29	T16
Wt. Of dry Soil (A)	g	18.68	19.24	19.50	25.33	16.71	16.23	16.34	16.00
Temperature (T)	^{0}C	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
Wt. Pycnometer + Water + Soil (B)	g	158.99	165.84	166.19	162.71	166.30	169.03	170.74	157.78
Wt Pycnometer + Water at T ^{0}C (C)	g	147.51	154.00	154.12	146.96	155.93	159.00	160.65	147.86
A+(C-B)	g	7.20	7.40	7.43	9.58	6.34	6.20	6.25	6.08
Specific Gravity (Gs)		2.590	2.596	2.620	2.640	2.631	2.613	2.610	2.627
SPECIFIC GRAVITY Average (Gs)		**2.593**		**2.630**		**2.622**		**2.619**	
MOISTURE CONTENT TEST (BS 1377 : 1975)									
No. Container		E.20	E.15	E.25	E.19	F.11	F.10	E.34	E.8
Wt. Container + Wet Soil	g	33.01	33.21	35.57	34.58	31.59	32.41	30.25	30.37
Wt. Container + Dry Soil	g	24.13	24.55	24.90	24.48	21.91	22.81	18.27	18.57
Wt. Container	g	5.41	5.32	5.44	5.16	5.08	5.21	5.30	5.30
Wt. Water	g	8.88	8.66	10.67	10.10	9.68	9.60	11.98	11.80
Wt. Dry Soil	g	18.72	19.23	19.46	19.32	16.83	17.60	12.97	13.27
Moisture Content (w)	%	47.44	45.03	54.83	52.28	57.52	54.55	92.37	88.92
MOISTURE CONTENT Average (w)	%	**46.23**		**53.55**		**56.03**		**90.64**	
DENSITY TEST (BS 1377 : 1975)									
No. Ring		A		A		A		A	
Wt. Ring + Wet Soil	g	76.17		73.62		73.23		71.23	
Wt. Ring	g	43.38		43.38		43.38		43.38	
Vol. Wet Soil (= Vol. Ring)	cm^3	19.24		19.24		19.24		19.24	
BULK DENSITY (γm)	Mg/m^3	**1.704**		**1.572**		**1.551**		**1.448**	

DRY DENSITY (γd)	Mg/m^3	**1.165**	**1.024**	**0.994**	**0.759**
VOID RATIO (e)		**1.225**	**1.569**	**1.637**	**2.449**
POROSITY (n)		**0.551**	**0.611**	**0.621**	**0.710**
DEGREE OF SATURATION (Sr)	%	**97.878**	**89.747**	**89.743**	**96.929**

	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	28-Jul-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 01 Sample Type : UDS
Depth : 1.50 - 2.00 m Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 43.36 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.810	1.87	1.87	98.13
8	2.380	1.170	2.70	4.57	95.43
20	0.840	2.250	5.19	9.76	90.24
40	0.420	3.300	7.61	17.37	82.63
80	0.177	6.260	14.44	31.80	68.20
100	0.149	1.570	3.62	35.42	64.58
200	0.074	4.000	9.23	44.65	55.35
Pan		19.36	44.65	89.30	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.595 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	24.0	22.0	138.77	22.2	0.0608	52.13
	1	23.0	21.0	140.33	21.2	0.0432	49.78
	2	22.0	20.0	141.89	20.2	0.0307	47.44
	5	20.0	18.0	145.01	18.2	0.0197	42.75
	15	17.0	15.0	149.69	15.2	0.0115	35.71
	30	15.0	13.0	152.81	13.2	0.0082	31.02
	60	14.0	12.0	154.37	12.2	0.0059	28.67
	240	12.5	10.5	156.71	10.7	0.0029	25.16
	1440	11.0	9.0	159.05	9.2	0.0012	21.64

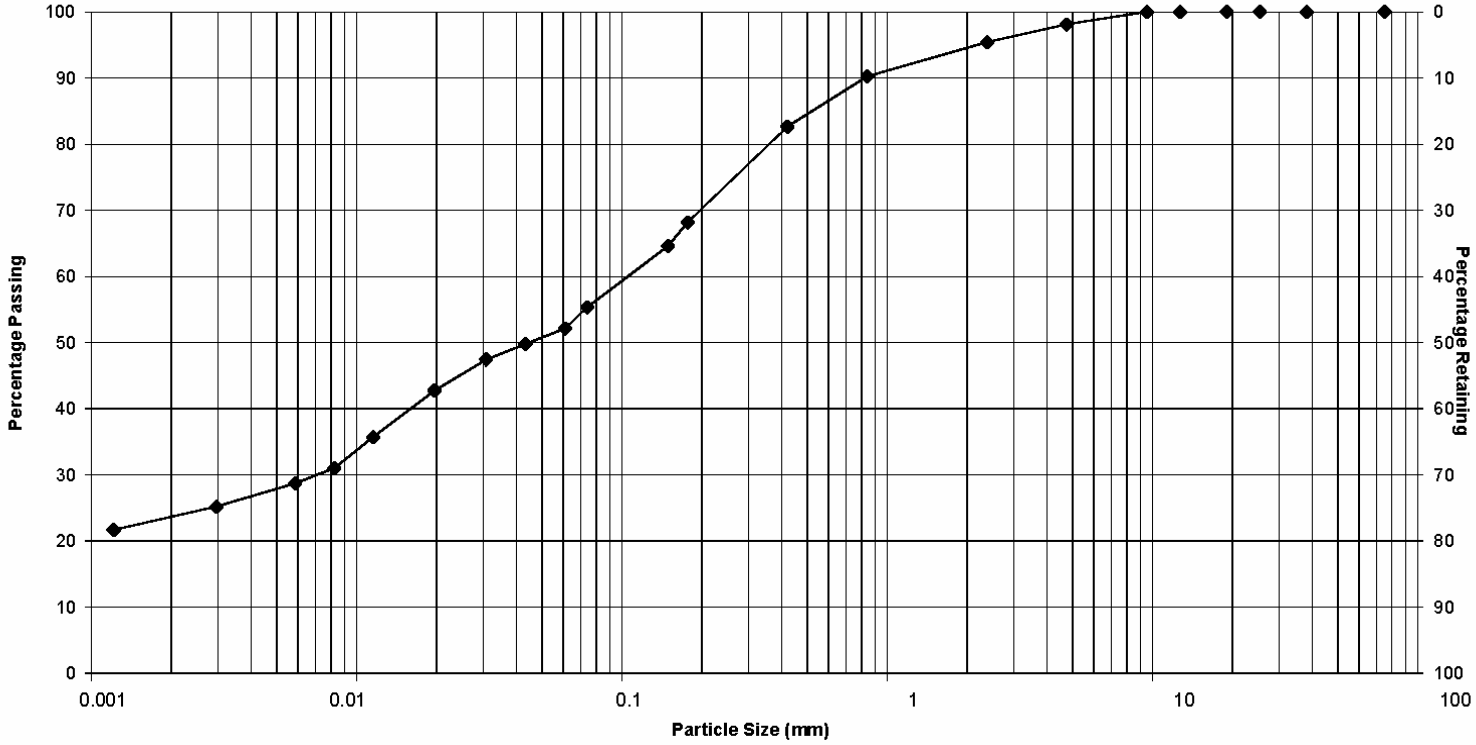
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan
Date	: 28-Jul-11

Hole No. : BH - 01
Depth : 1.50 - 2.00 m

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
27.86%	27.67%	42.59%			1.88%	0.00%

	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	28-Jul-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 01 Sample Type : UDS
Depth : 15.50 - 16.00 m Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 29.32 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.000	0.00	0.00	100.00
8	2.380	0.000	0.00	0.00	100.00
20	0.840	0.000	0.00	0.00	100.00
40	0.420	0.380	1.30	1.30	98.70
80	0.177	0.370	1.26	2.56	97.44
100	0.149	0.080	0.27	2.83	97.17
200	0.074	0.490	1.67	4.50	95.50
Pan		1.32	4.50	9.00	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.595 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	28.0	26.0	132.53	26.2	0.0594	90.96
	1	27.5	25.5	133.31	25.7	0.0422	89.22
	2	26.0	24.0	135.65	24.2	0.0301	84.02
	5	24.0	22.0	138.77	22.2	0.0192	77.09
	15	21.0	19.0	143.45	19.2	0.0113	66.68
	30	20.0	18.0	145.01	18.2	0.0080	63.21
	60	19.0	17.0	146.57	17.2	0.0057	59.75
	240	17.0	15.0	149.69	15.2	0.0029	52.81
	1440	14.0	12.0	154.37	12.2	0.0012	42.41

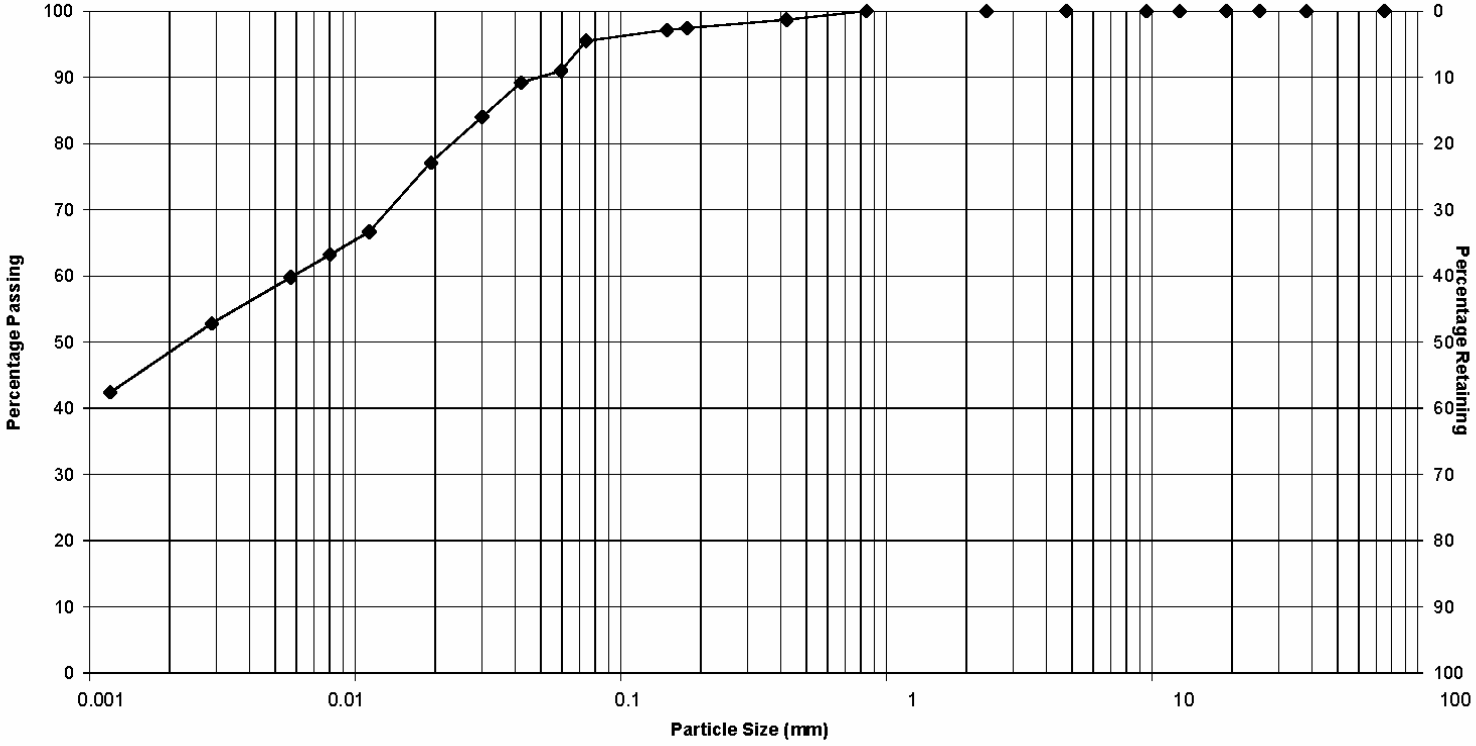
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan
Date	: 28-Jul-11

Hole No. : BH - 01
Depth : 15.50 - 16.00 m

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
58.40%	37.13%	4.47%			0.00%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	28-Jul-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 01 Sample Type : UDS
Depth : 19.50 - 20.00 m Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 33.95 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.000	0.00	0.00	100.00
8	2.380	0.420	1.24	1.24	98.76
20	0.840	0.780	2.30	3.53	96.47
40	0.420	0.350	1.03	4.57	95.43
80	0.177	0.340	1.00	5.57	94.43
100	0.149	0.060	0.18	5.74	94.26
200	0.074	1.000	2.95	8.69	91.31
Pan		2.95	8.69	17.38	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.595 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	31.0	29.0	127.85	29.2	0.0584	87.54
	1	30.0	28.0	129.41	28.2	0.0415	84.54
	2	29.0	27.0	130.97	27.2	0.0295	81.55
	5	27.0	25.0	134.09	25.2	0.0189	75.56
	15	25.0	23.0	137.21	23.2	0.0110	69.57
	30	23.0	21.0	140.33	21.2	0.0079	63.58
	60	21.0	19.0	143.45	19.2	0.0056	57.59
	240	18.0	16.0	148.13	16.2	0.0029	48.60
	1440	15.0	13.0	152.81	13.2	0.0012	39.62

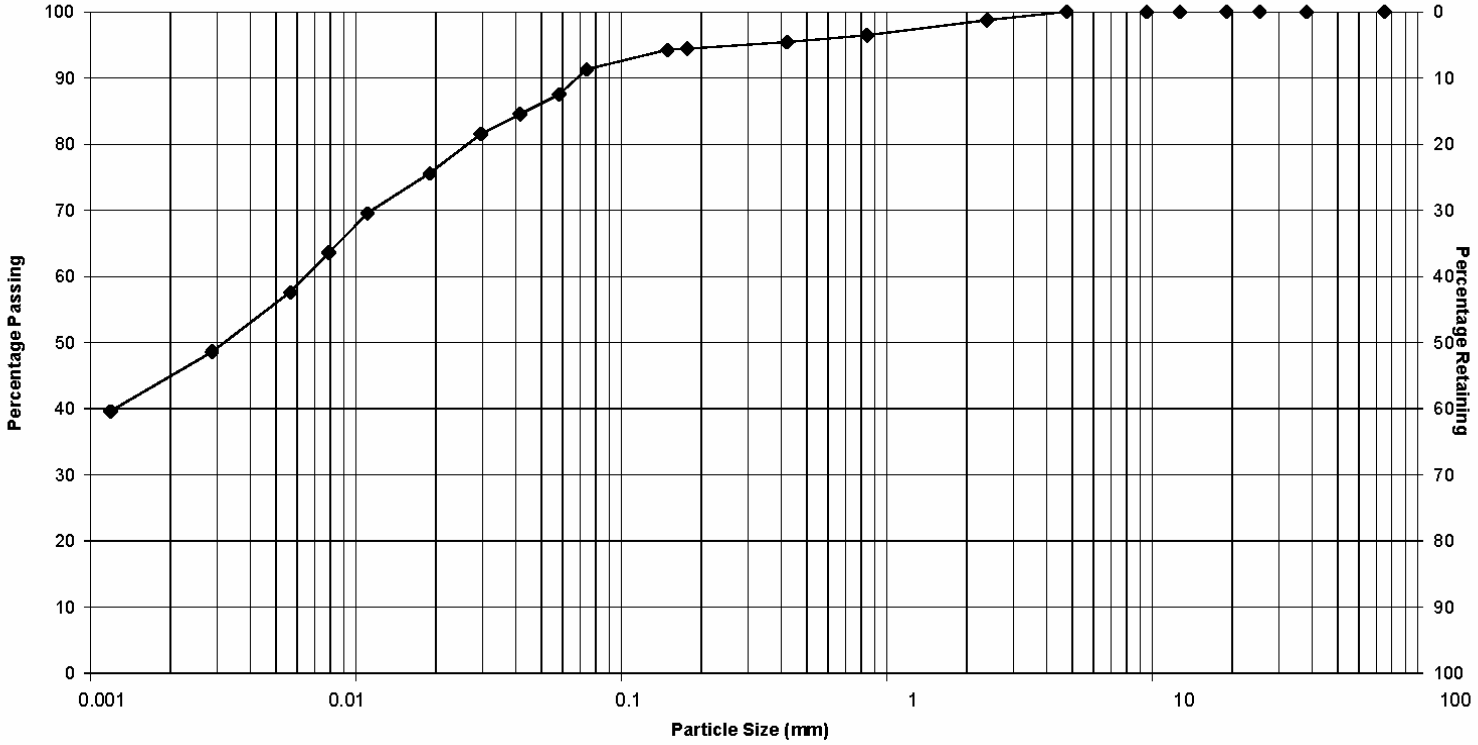
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	:	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM	
Client	:	NIHON SUIDOI CONSULTANT	
Location	:	Bali	
Tested by	:	Ria Irmawan	Date : 28-Jul-11

Hole No. : BH - 01
Depth : 19.50 - 20.00 m

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
55.98%	35.39%	8.63%			0.00%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 02
Depth : 4.50 - 5.00
Sample Type : UDS
Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 34.51 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.000	0.00	0.00	100.00
8	2.380	0.000	0.00	0.00	100.00
20	0.840	0.020	0.06	0.06	99.94
40	0.420	0.040	0.12	0.17	99.83
80	0.177	0.450	1.30	1.48	98.52
100	0.149	0.440	1.27	2.75	97.25
200	0.074	4.560	13.21	15.97	84.03
Pan		5.51	15.97	31.93	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g
Specific Gravity (Gs) : 2.623
Meniscus Correction,c : -2.00
Viscosity of water : 0.8711
Tube No. : 1
Hydrometer No. : A1
Temperature Correction, mt : 1.01
Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	29.0	27.0	130.97	27.2	0.0586	79.69
	1	27.0	25.0	134.09	25.2	0.0419	73.84
	2	26.0	24.0	135.65	24.2	0.0298	70.91
	5	25.0	23.0	137.21	23.2	0.0190	67.98
	15	22.0	20.0	141.89	20.2	0.0111	59.20
	30	20.0	18.0	145.01	18.2	0.0080	53.35
	60	18.0	16.0	148.13	16.2	0.0057	47.50
	240	16.0	14.0	151.25	14.2	0.0029	41.64
	1440	13.0	11.0	155.93	11.2	0.0012	32.86

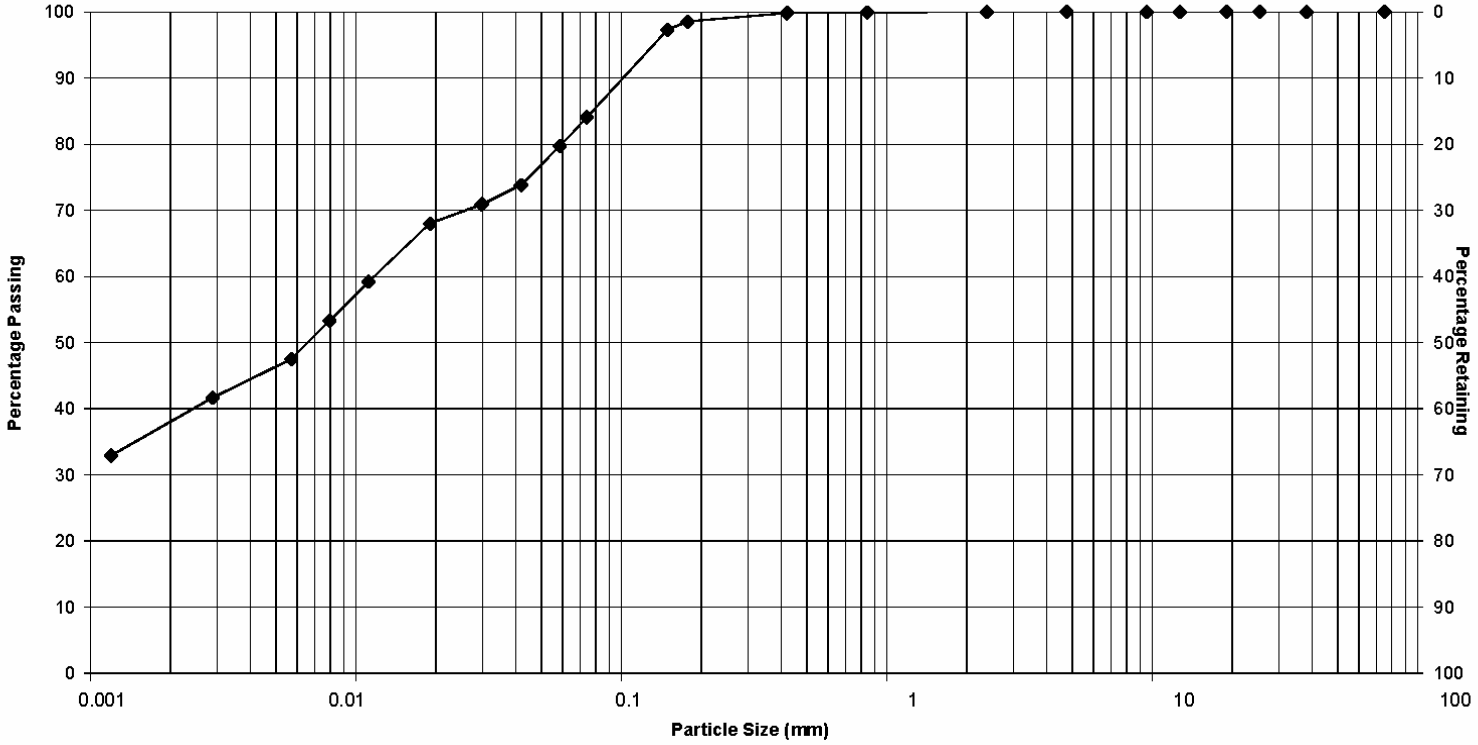
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan — Date : 2-Aug-11

Hole No. : BH - 02
Depth : 4.50 - 5.00

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
46.39%	37.90%	15.71%			0.00%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 02 Sample Type : UDS
Depth : 6.50 - 7.00 m Sample Description : clayey SAND

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 39.69 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.000	0.00	0.00	100.00
8	2.380	0.260	0.66	0.66	99.34
20	0.840	1.290	3.25	3.91	96.09
40	0.420	3.380	8.52	12.42	87.58
80	0.177	8.480	21.37	33.79	66.21
100	0.149	2.330	5.87	39.66	60.34
200	0.074	5.950	14.99	54.65	45.35
Pan		21.69	54.65	109.30	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.653 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	18.0	16.0	148.13	16.2	0.0617	41.01
	1	17.0	15.0	149.69	15.2	0.0439	38.48
	2	16.0	14.0	151.25	14.2	0.0312	35.96
	5	14.0	12.0	154.37	12.2	0.0199	30.90
	15	14.0	12.0	154.37	12.2	0.0115	30.90
	30	13.0	11.0	155.93	11.2	0.0082	28.38
	60	12.0	10.0	157.49	10.2	0.0058	25.85
	240	11.0	9.0	159.05	9.2	0.0029	23.32
	1440	10.0	8.0	160.61	8.2	0.0012	20.79

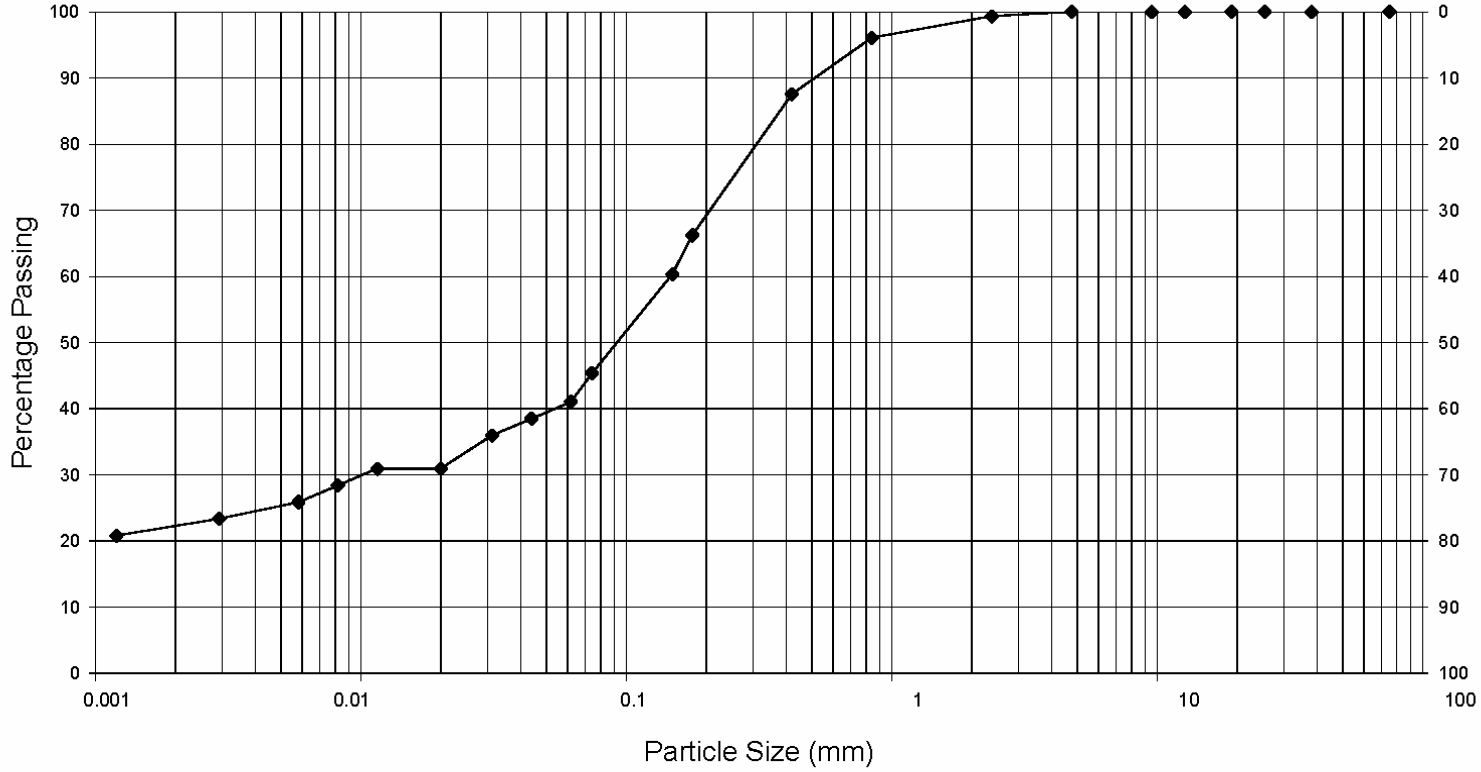
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan
Date	: 2-Aug-11

Hole No. : BH - 02
Depth : 6.50 - 7.00 m

Sample Type : UDS
Sample Description : clayey SAND



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
25.30%	20.34%	54.36%			0.00%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 02 Sample Type : UDS
Depth : 8.50 - 9.00 m Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 33.98 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.090	0.26	0.26	99.74
8	2.380	0.470	1.38	1.65	98.35
20	0.840	1.200	3.53	5.18	94.82
40	0.420	1.450	4.27	9.45	90.55
80	0.177	2.310	6.80	16.24	83.76
100	0.149	0.580	1.71	17.95	82.05
200	0.074	2.880	8.48	26.43	73.57
Pan		8.98	26.43	52.85	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.653 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	25.0	23.0	137.21	23.2	0.0594	68.57
	1	24.0	22.0	138.77	22.2	0.0422	65.62
	2	22.0	20.0	141.89	20.2	0.0302	59.71
	5	20.0	18.0	145.01	18.2	0.0193	53.81
	15	18.0	16.0	148.13	16.2	0.0113	47.90
	30	17.0	15.0	149.69	15.2	0.0080	44.95
	60	16.0	14.0	151.25	14.2	0.0057	42.00
	240	14.0	12.0	154.37	12.2	0.0029	36.10
	1440	12.0	10.0	157.49	10.2	0.0012	30.19

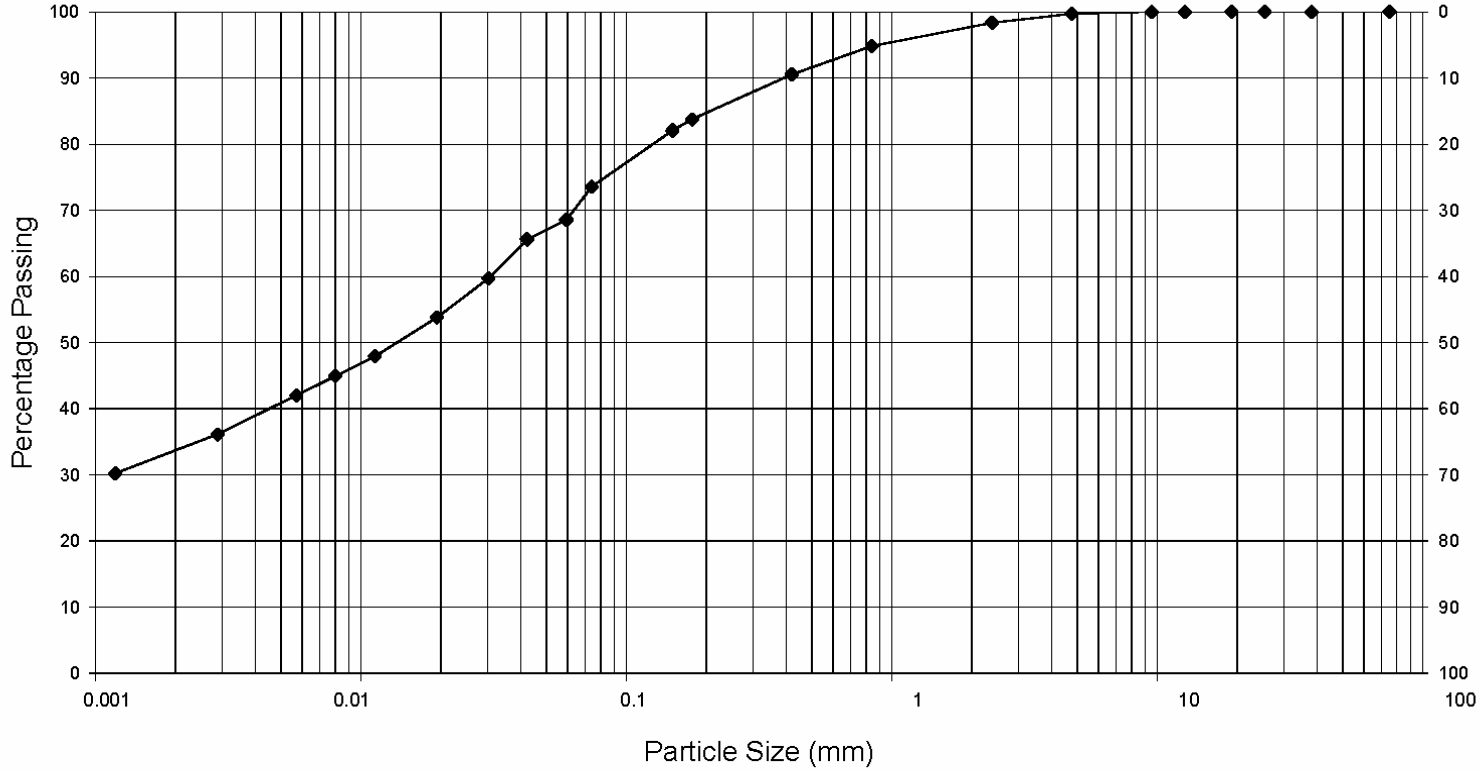
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan
Date	: 2-Aug-11

Hole No. : BH - 02
Depth : 8.50 - 9.00 m

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
40.88%	32.86%	25.99%			0.27%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	3-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 03 Sample Type : UDS
Depth : 2.50 - 3.00 m Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 39.33 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	1.900	4.83	4.83	95.17
8	2.380	1.120	2.85	7.68	92.32
20	0.840	2.720	6.92	14.59	85.41
40	0.420	3.450	8.77	23.37	76.63
80	0.177	5.750	14.62	37.99	62.01
100	0.149	1.350	3.43	41.42	58.58
200	0.074	3.040	7.73	49.15	50.85
Pan		19.33	49.15	98.30	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.653 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	20.0	18.0	145.01	18.2	0.0611	46.49
	1	19.0	17.0	146.57	17.2	0.0434	43.94
	2	18.0	16.0	148.13	16.2	0.0309	41.39
	5	16.0	14.0	151.25	14.2	0.0197	36.29
	15	15.0	13.0	152.81	13.2	0.0114	33.74
	30	14.0	12.0	154.37	12.2	0.0081	31.19
	60	13.0	11.0	155.93	11.2	0.0058	28.63
	240	12.0	10.0	157.49	10.2	0.0029	26.08
	1440	10.0	8.0	160.61	8.2	0.0012	20.98

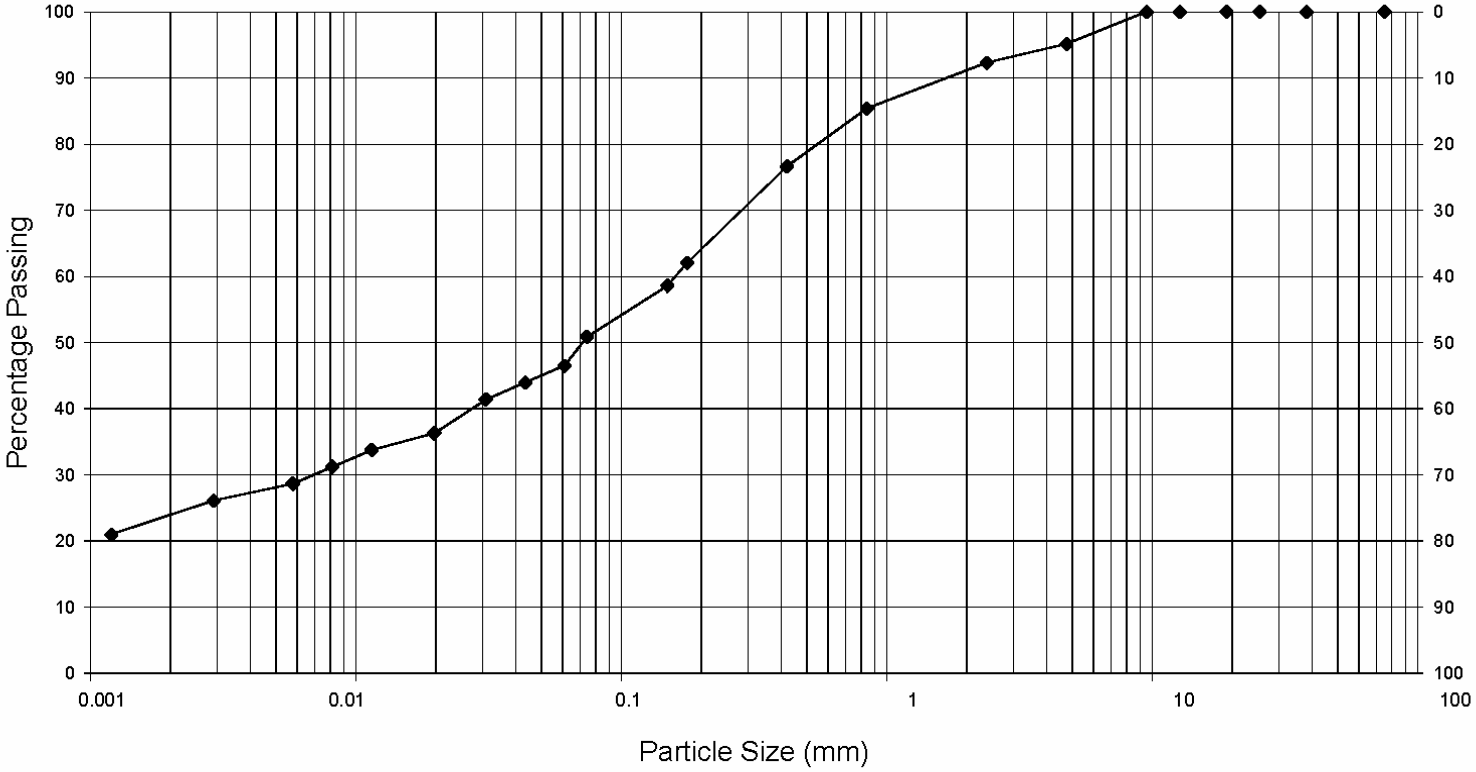
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan
Date	: 3-Aug-11

Hole No. : BH - 03
Depth : 2.50 - 3.00 m

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
28.10%	22.90%	44.16%			4.84%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	3-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 03 Sample Type : UDS
Depth : 8.50 - 9.00 m Sample Description : silty SAND

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 40.14 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	5.060	12.61	12.61	87.39
8	2.380	4.130	10.29	22.89	77.11
20	0.840	3.920	9.77	32.66	67.34
40	0.420	3.140	7.82	40.48	59.52
80	0.177	4.000	9.97	50.45	49.55
100	0.149	1.810	4.51	54.96	45.04
200	0.074	5.080	12.66	67.61	32.39
Pan		27.14	67.61	135.23	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.653 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

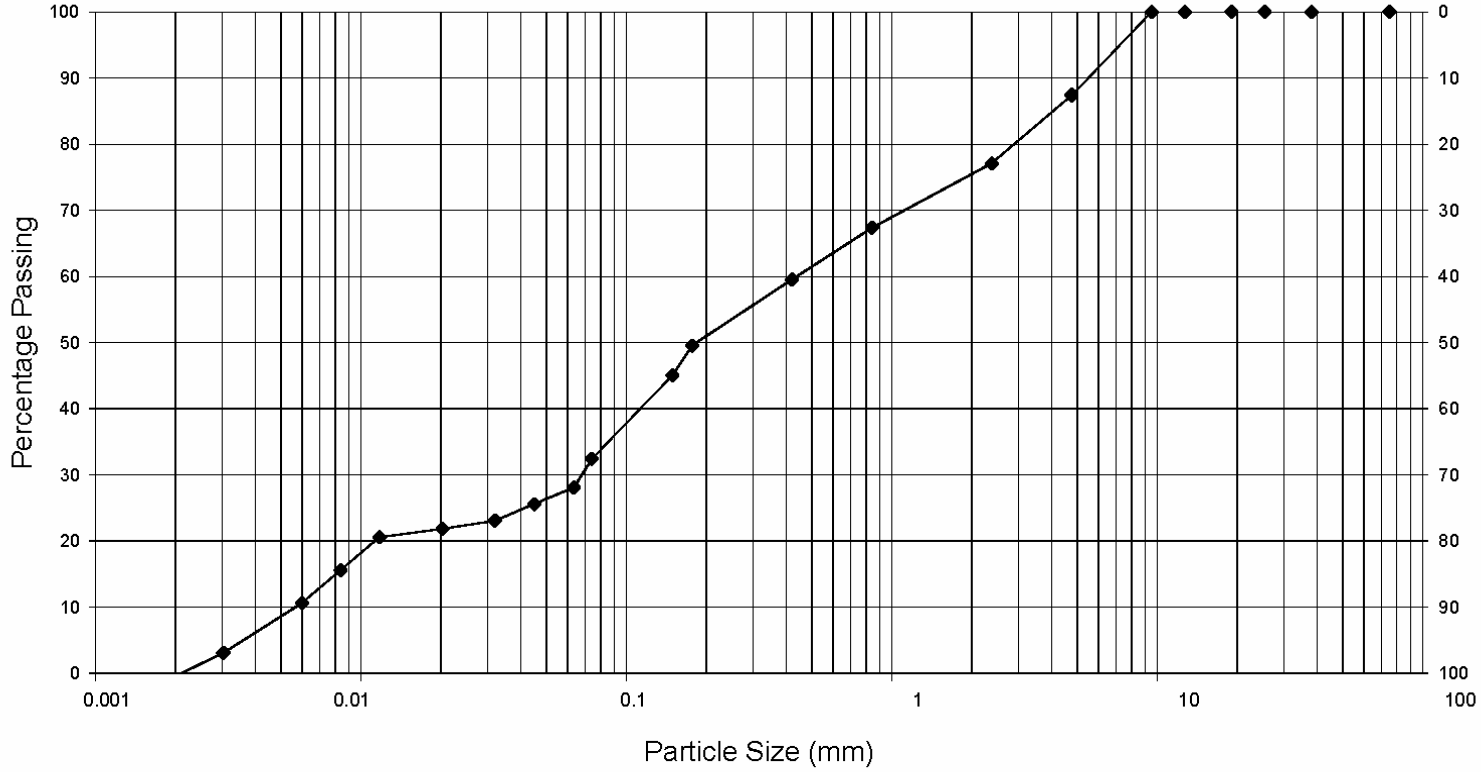
Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	13.0	11.0	155.93	11.2	0.0633	28.06
	1	12.0	10.0	157.49	10.2	0.0450	25.56
	2	11.0	9.0	159.05	9.2	0.0320	23.06
	5	10.5	8.5	159.83	8.7	0.0203	21.81
	15	10.0	8.0	160.61	8.2	0.0117	20.56
	30	8.0	6.0	163.73	6.2	0.0084	15.56
	60	6.0	4.0	166.85	4.2	0.0060	10.56
	240	3.0	1.0	171.53	1.2	0.0030	3.07
	1440	0.0	-2.0	176.21	-1.8	0.0013	-4.43

NOTES :

	PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)	Project : **SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM** Client : NIHON SUIDOI CONSULTANT Location : Bali Tested by : Ria Irmawan Date : 3-Aug-11

Hole No. : BH - 03
Depth : 8.50 - 9.00 m

Sample Type : UDS
Sample Description : silty SAND



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
8.59%	24.04%	54.73%			12.64%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 04
Depth : 2.50 - 3.00
Sample Type : UDS
Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 43.04 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	2.040	4.74	4.74	95.26
8	2.380	0.560	1.30	6.04	93.96
20	0.840	2.110	4.90	10.94	89.06
40	0.420	3.380	7.85	18.80	81.20
80	0.177	5.600	13.01	31.81	68.19
100	0.149	1.290	3.00	34.80	65.20
200	0.074	3.560	8.27	43.08	56.92
Pan		18.54	43.08	86.15	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g
Specific Gravity (Gs) : 2.653
Meniscus Correction,c : -2.00
Viscosity of water : 0.8711
Tube No. : 1
Hydrometer No. : A1
Temperature Correction, mt : 1.01
Dispersant Correction, x : 4

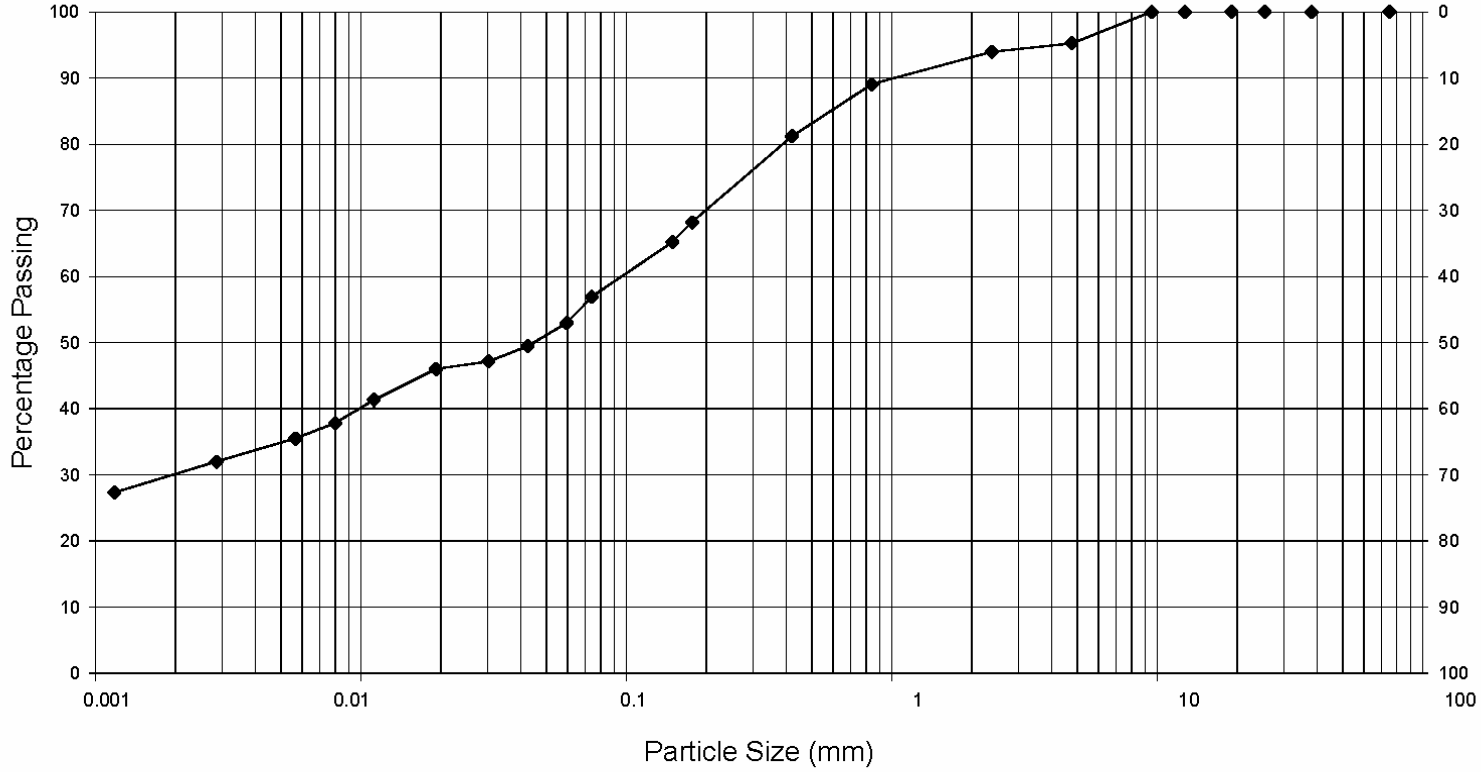
Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	24.5	22.5	137.99	22.7	0.0596	52.97
	1	23.0	21.0	140.33	21.2	0.0425	49.47
	2	22.0	20.0	141.89	20.2	0.0302	47.14
	5	21.5	19.5	142.67	19.7	0.0192	45.98
	15	19.5	17.5	145.79	17.7	0.0112	41.32
	30	18.0	16.0	148.13	16.2	0.0080	37.82
	60	17.0	15.0	149.69	15.2	0.0057	35.49
	240	15.5	13.5	152.03	13.7	0.0029	31.99
	1440	13.5	11.5	155.15	11.7	0.0012	27.33

NOTES :

	PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)	Project : **SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**
		Client : NIHON SUIDOI CONSULTANT
		Location : Bali
		Tested by : Ria Irmawan — Date : 11-Aug-11

Hole No. : BH - 04
Depth : 2.50 - 3.00

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
34.85%	22.23%	38.18%			4.74%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 04
Depth : 4.50 - 5.00
Sample Type : UDS
Sample Description : clayey SAND

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 41.60 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.130	0.31	0.31	99.69
8	2.380	0.120	0.29	0.60	99.40
20	0.840	1.180	2.84	3.44	96.56
40	0.420	3.780	9.09	12.52	87.48
80	0.177	8.580	20.63	33.15	66.85
100	0.149	3.320	7.98	41.13	58.87
200	0.074	5.490	13.20	54.33	45.67
Pan		22.60	54.33	108.65	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g
Specific Gravity (Gs) : 2.653
Meniscus Correction,c : -2.00
Viscosity of water : 0.8711
Tube No. : 1
Hydrometer No. : A1
Temperature Correction, mt : 1.01
Dispersant Correction, x : 4

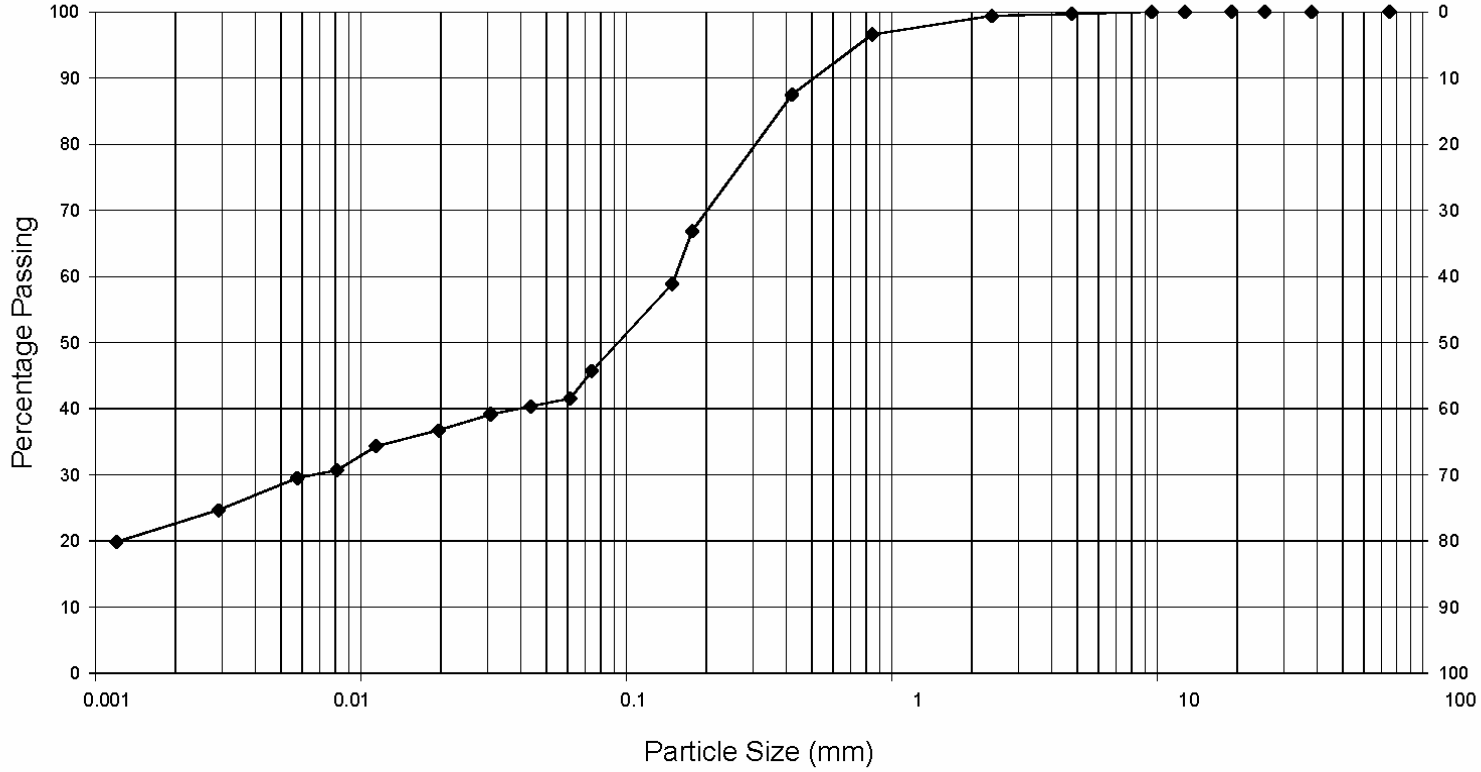
Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	19.0	17.0	146.57	17.2	0.0614	41.54
	1	18.5	16.5	147.35	16.7	0.0435	40.33
	2	18.0	16.0	148.13	16.2	0.0309	39.13
	5	17.0	15.0	149.69	15.2	0.0196	36.72
	15	16.0	14.0	151.25	14.2	0.0114	34.31
	30	14.5	12.5	153.59	12.7	0.0081	30.69
	60	14.0	12.0	154.37	12.2	0.0058	29.48
	240	12.0	10.0	157.49	10.2	0.0029	24.66
	1440	10.0	8.0	160.61	8.2	0.0012	19.84

NOTES :

	PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)	Project : **SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**
		Client : NIHON SUIDOI CONSULTANT
		Location : Bali
		Tested by : Ria Irmawan — Date : 11-Aug-11

Hole No. : BH - 04
Depth : 4.50 - 5.00

Sample Type : UDS
Sample Description : clayey SAND



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
28.49%	17.44%	53.76%			0.31%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 04
Depth : 8.50 - 9.00
Sample Type : UDS
Sample Description : clayey SAND

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 38.45 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.670	1.74	1.74	98.26
8	2.380	1.220	3.17	4.92	95.08
20	0.840	2.240	5.83	10.74	89.26
40	0.420	7.750	20.16	30.90	69.10
80	0.177	5.750	14.95	45.85	54.15
100	0.149	1.650	4.29	50.14	49.86
200	0.074	2.170	5.64	55.79	44.21
Pan		21.45	55.79	111.57	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g
Specific Gravity (Gs) : 2.653
Meniscus Correction,c : -2.00
Viscosity of water : 0.8711
Tube No. : 1
Hydrometer No. : A1
Temperature Correction, mt : 1.01
Dispersant Correction, x : 4

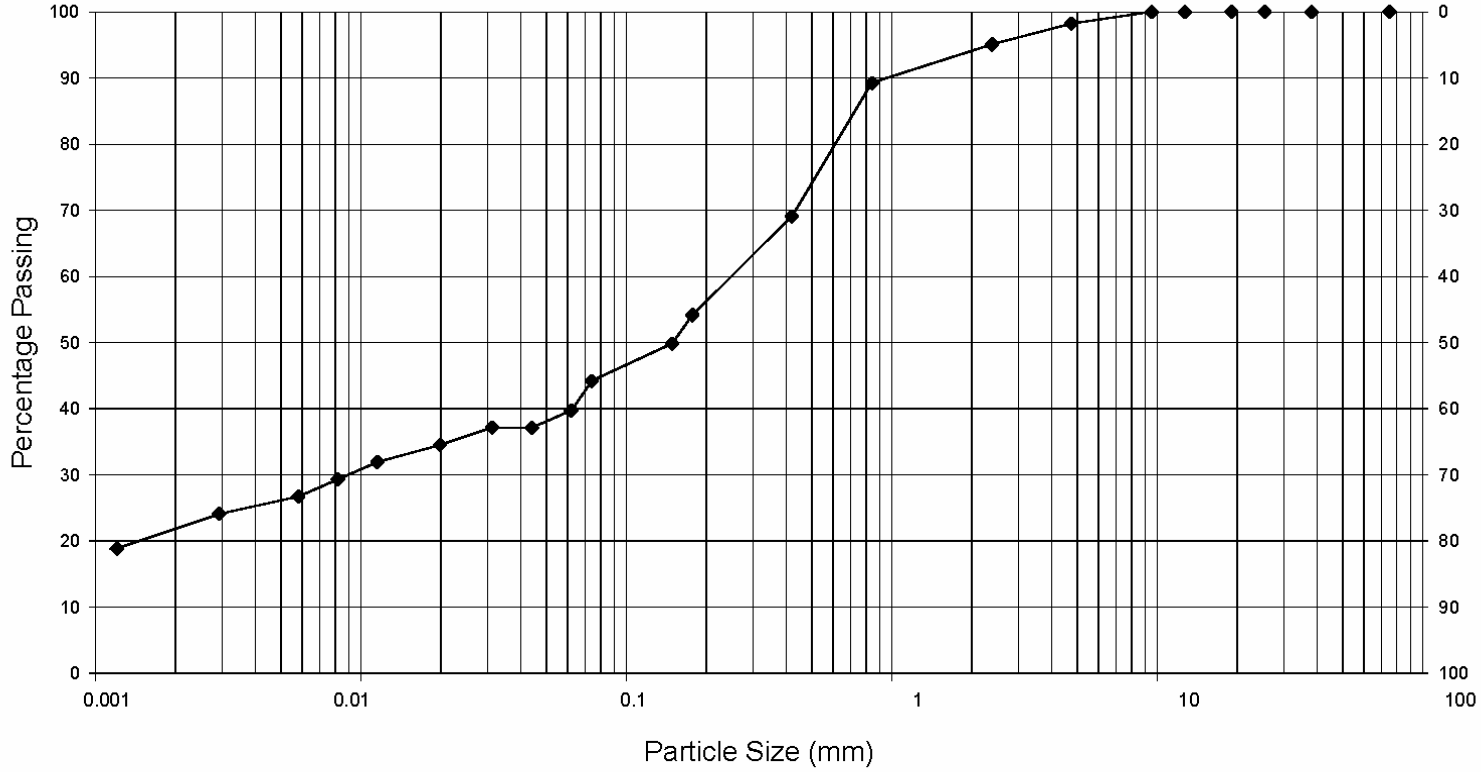
Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	17.0	15.0	149.69	15.2	0.0620	39.73
	1	16.0	14.0	151.25	14.2	0.0441	37.12
	2	16.0	14.0	151.25	14.2	0.0312	37.12
	5	15.0	13.0	152.81	13.2	0.0198	34.51
	15	14.0	12.0	154.37	12.2	0.0115	31.90
	30	13.0	11.0	155.93	11.2	0.0082	29.29
	60	12.0	10.0	157.49	10.2	0.0058	26.68
	240	11.0	9.0	159.05	9.2	0.0029	24.07
	1440	9.0	7.0	162.17	7.2	0.0012	18.85

NOTES :

	PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)	Project : **SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**
		Client : NIHON SUIDOI CONSULTANT
		Location : Bali
		Tested by : Ria Irmawan — Date : 11-Aug-11

Hole No. : BH - 04
Depth : 8.50 - 9.00

Sample Type : UDS
Sample Description : clayey SAND



CLAY	SILT	FINE	MEDIUM	COARSE	GRAVEL	COBBLES
		SAND				
26.11%	18.21%	53.93%			1.75%	0.00%

	Project	**SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM**		
	Client	NIHON SUIDOI CONSULTANT		
	Location	Bali	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

PARTICLE SIZE DISTRIBUTION ANALYSIS

Hole No. : BH - 04 Sample Type : UDS
Depth : 11.50 - 12.00 Sample Description : silty CLAY

SIEVE ANALYSIS (ASTM D 422)

Initial weight of dry soil : 34.52 g

Sieve No.	Sieve Opening mm	Wt. Soil Retained	Percent Retained %	Cumulative Percent Retained %	Percent Finer %
3"	101.600	0.000	0.00	0.00	100.00
2"	75.000	0.000	0.00	0.00	100.00
1 1/2"	38.100	0.000	0.00	0.00	100.00
1"	25.400	0.000	0.00	0.00	100.00
3/4"	19.050	0.000	0.00	0.00	100.00
1/2"	12.700	0.000	0.00	0.00	100.00
3/8"	9.525	0.000	0.00	0.00	100.00
4	4.760	0.000	0.00	0.00	100.00
8	2.380	0.000	0.00	0.00	100.00
20	0.840	0.020	0.06	0.06	99.94
40	0.420	0.250	0.72	0.78	99.22
80	0.177	0.580	1.68	2.46	97.54
100	0.149	0.660	1.91	4.37	95.63
200	0.074	5.010	14.51	18.89	81.11
Pan		6.52	18.89	37.78	

HYDROMETER ANALYSIS (BS 1377 : 1975)

Weight of soil : 60.00 g Tube No. : 1
Specific Gravity (Gs) : 2.653 Hydrometer No. : A1
Meniscus Correction,c : -2.00 Temperature Correction, mt : 1.01
Viscosity of water : 0.8711 Dispersant Correction, x : 4

Time	Elapsed Time t min	Hydrometer reading R'h	TRUE Reading Rh	Effective depth HR mm	Fully Corrected Reading	Particle Diameter D mm	Percentage Finer Than D K %
	0	0.0	0.0	0.000	0.0	0.0000	0.00
	0.5	28.0	26.0	132.53	26.2	0.0584	76.21
	1	27.5	25.5	133.31	25.7	0.0414	74.76
	2	27.0	25.0	134.09	25.2	0.0294	73.31
	5	26.0	24.0	135.65	24.2	0.0187	70.40
	15	24.0	22.0	138.77	22.2	0.0109	64.59
	30	22.0	20.0	141.89	20.2	0.0078	58.78
	60	20.5	18.5	144.23	18.7	0.0056	54.42
	240	18.0	16.0	148.13	16.2	0.0028	47.15
	1440	15.0	13.0	152.81	13.2	0.0012	38.44

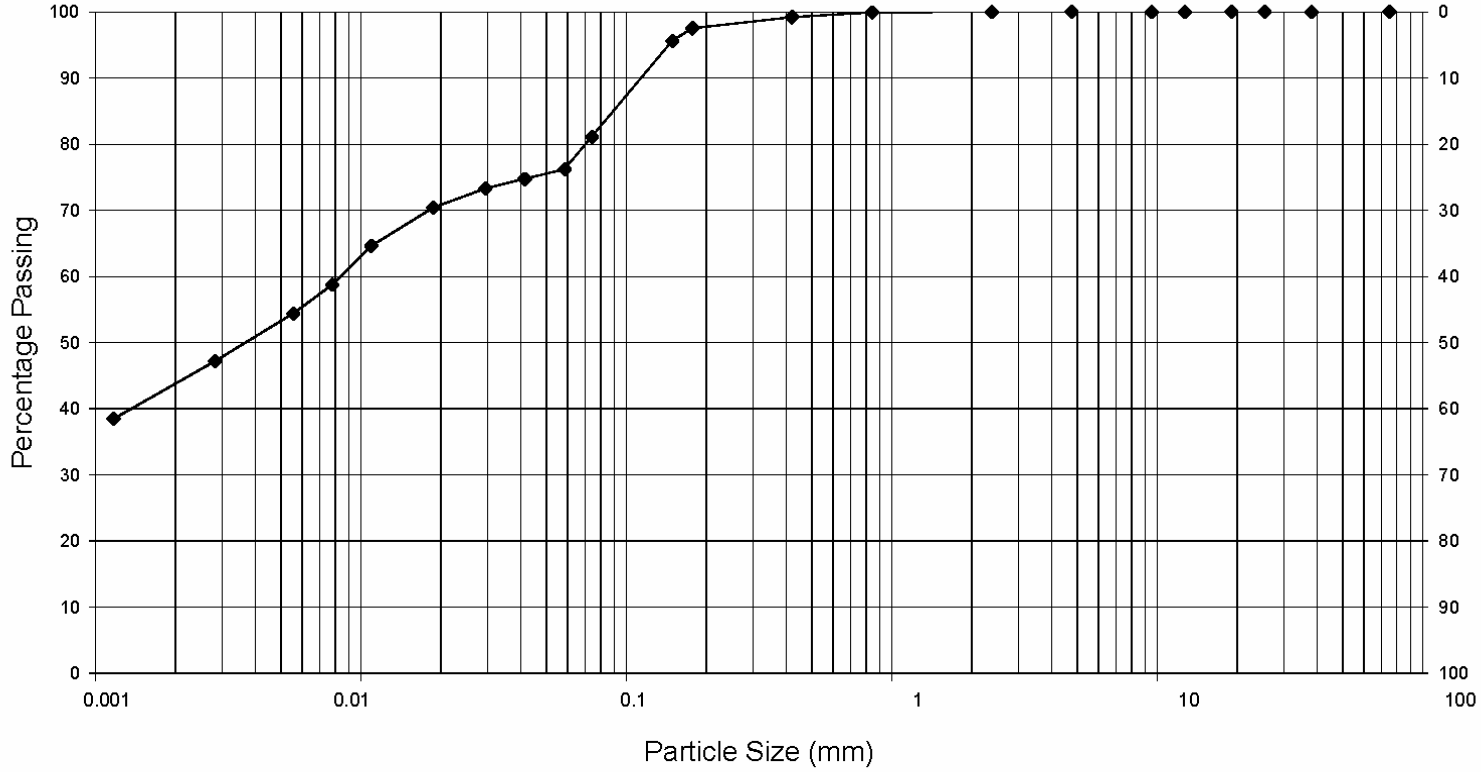
NOTES :

PARTICLE SIZE DISTRIBUTION ANALYSIS (ASTM D 422)

Project	: SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM
Client	: NIHON SUIDOI CONSULTANT
Location	: Bali
Tested by	: Ria Irmawan — Date : 11-Aug-11

Hole No. : BH - 04
Depth : 11.50 - 12.00

Sample Type : UDS
Sample Description : silty CLAY



CLAY	SILT	SAND: FINE	SAND: MEDIUM	SAND: COARSE	GRAVEL	COBBLES
53.28%	28.11%	18.61%			0.00%	0.00%

	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	28-Jul-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 1
Depth : 1.50 - 2.00

Sample type : UDS
Soil description :
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	144.23		
Density	Mg/m3	1.673		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	1.5	0.001	1137.11	0.011
40	0.40	0.53	3.0	0.002	1140.12	0.021
60	0.60	0.79	4.0	0.003	1143.14	0.028
80	0.80	1.05	5.5	0.004	1146.18	0.038
100	1.00	1.32	7.0	0.006	1149.24	0.049
120	1.20	1.58	8.0	0.006	1152.31	0.056
140	1.40	1.84	9.0	0.007	1155.40	0.062
160	1.60	2.11	10.0	0.008	1158.50	0.069
180	1.80	2.37	11.5	0.009	1161.63	0.079
200	2.00	2.63	12.5	0.010	1164.77	0.086
220	2.20	2.89	13.0	0.010	1167.92	0.089
240	2.40	3.16	14.0	0.011	1171.10	0.096
260	2.60	3.42	15.0	0.012	1174.29	0.102
280	2.80	3.68	15.5	0.012	1177.50	0.105
300	3.00	3.95	16.0	0.013	1180.72	0.108
320	3.20	4.21	17.0	0.014	1183.97	0.115
340	3.40	4.47	17.5	0.014	1187.23	0.118
360	3.60	4.74	18.0	0.014	1190.51	0.121
380	3.80	5.00	18.5	0.015	1193.81	0.124
400	4.00	5.26	19.0	0.015	1197.12	0.127
420	4.20	5.53	19.5	0.016	1200.46	0.130
440	4.40	5.79	20.5	0.016	1203.81	0.136
460	4.60	6.05	21.0	0.017	1207.18	0.139
480	4.80	6.32	20.0	0.016	1210.57	0.132
500	5.00	6.58	19.5	0.016	1213.98	0.129
520	5.20	6.84	19.0	0.015	1217.41	0.125
540	5.40	7.11	18.0	0.014	1220.86	0.118
560	5.60	7.37	17.0	0.014	1224.33	0.111
580	5.80	7.63	16.0	0.013	1227.82	0.104
600	6.00	7.89	15.0	0.012	1231.32	0.097

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH1(1.5)

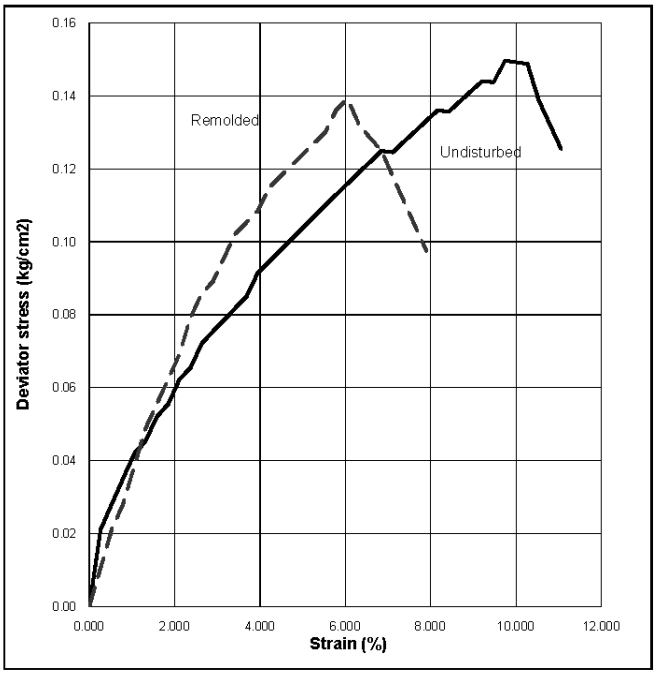
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	7/28/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 1
Depth : 1.50 - 2.00

Sample type : UDS
Soil description :

TEST RESULT

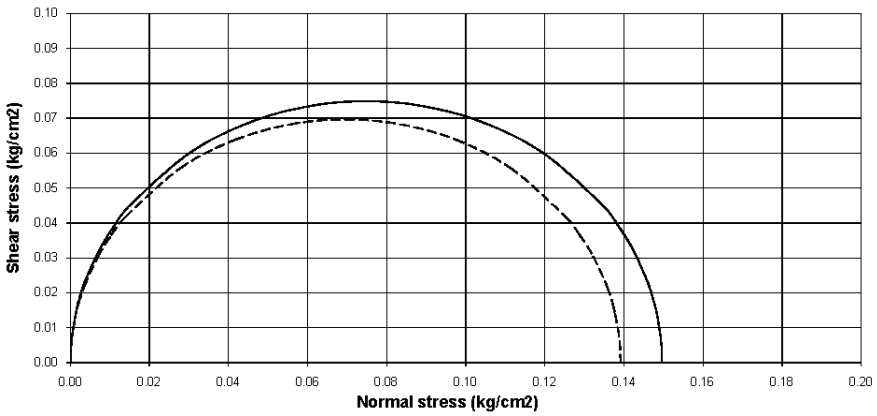


Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.150	9.737
Remolded	0.139	6.053
Sensitivity	1.075	

Mode of failure

Undisturb ☐ Remolded ☐

MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	28-Jul-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 1
Depth : 15.50 - 16.00

Sample type : UDS
Soil description :
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	122.08		
Density	Mg/m3	1.416		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	1.0	0.001	1137.11	0.007
40	0.40	0.53	2.0	0.002	1140.12	0.014
60	0.60	0.79	3.0	0.002	1143.14	0.021
80	0.80	1.05	4.0	0.003	1146.18	0.028
100	1.00	1.32	5.5	0.004	1149.24	0.038
120	1.20	1.58	6.5	0.005	1152.31	0.045
140	1.40	1.84	8.0	0.006	1155.40	0.055
160	1.60	2.11	9.0	0.007	1158.50	0.062
180	1.80	2.37	10.0	0.008	1161.63	0.069
200	2.00	2.63	11.0	0.009	1164.77	0.076
220	2.20	2.89	12.0	0.010	1167.92	0.082
240	2.40	3.16	12.5	0.010	1171.10	0.085
260	2.60	3.42	13.5	0.011	1174.29	0.092
280	2.80	3.68	14.0	0.011	1177.50	0.095
300	3.00	3.95	14.5	0.012	1180.72	0.098
320	3.20	4.21	15.0	0.012	1183.97	0.101
340	3.40	4.47	15.5	0.012	1187.23	0.104
360	3.60	4.74	16.0	0.013	1190.51	0.108
380	3.80	5.00	16.5	0.013	1193.81	0.111
400	4.00	5.26	17.0	0.014	1197.12	0.114
420	4.20	5.53	17.5	0.014	1200.46	0.117
440	4.40	5.79	18.0	0.014	1203.81	0.120
460	4.60	6.05	18.0	0.014	1207.18	0.119
480	4.80	6.32	18.0	0.014	1210.57	0.119
500	5.00	6.58	18.5	0.015	1213.98	0.122
520	5.20	6.84	19.0	0.015	1217.41	0.125
540	5.40	7.11	18.0	0.014	1220.86	0.118
560	5.60	7.37	17.5	0.014	1224.33	0.114
580	5.80	7.63	16.0	0.013	1227.82	0.104
600	6.00	7.89	15.0	0.012	1231.32	0.097
620	6.20	8.16	14.0	0.011	1234.85	0.091
640	6.40	8.42	13.0	0.010	1238.40	0.084

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH1(15.5)

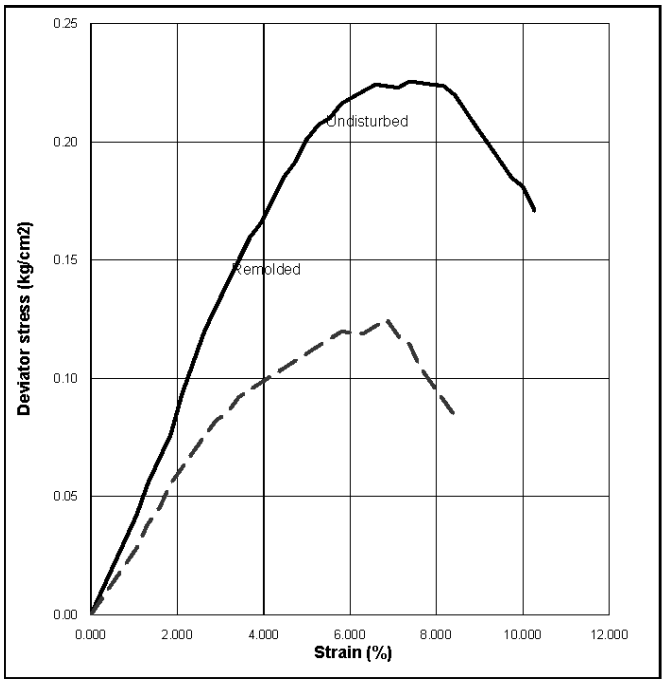
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	7/28/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 1
Depth : 15.50 - 16.00

Sample type : UDS
Soil description :

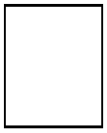
TEST RESULT



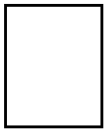
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.225	7.632
Remolded	0.125	6.842
Sensitivity	1.806	

Mode of failure

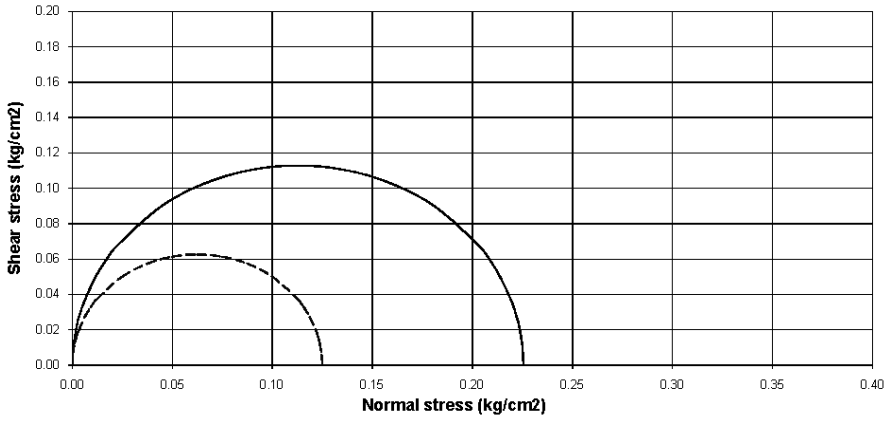
Undisturb



Remolded



MOHR CIRCLES



Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
Client		Date	28-Jul-11
Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

UNDISTURBED

Location : Bali
Boring no : BH - 01
Depth : 19.50 - 20.00 m

Sample type : UDS
Soil description :
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	129.66		
Density	Mg/m3	1.504		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

UNDISTURBED

Deformation gauge reading x 0.01mm	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0.000	0	0	1134.11	0.000
20	0.20	0.26	2.0	0.002	1137.11	0.014
40	0.40	0.53	2.5	0.002	1140.12	0.018
60	0.60	0.79	3.0	0.002	1143.14	0.021
80	0.80	1.05	3.0	0.002	1146.18	0.021
100	1.00	1.32	3.5	0.003	1149.24	0.024
120	1.20	1.58	4.0	0.003	1152.31	0.028
140	1.40	1.84	4.0	0.003	1155.40	0.028
160	1.60	2.11	4.5	0.004	1158.50	0.031
180	1.80	2.37	5.0	0.004	1161.63	0.034
200	2.00	2.63	5.0	0.004	1164.77	0.034
220	2.20	2.89	5.5	0.004	1167.92	0.038
240	2.40	3.16	6.0	0.005	1171.10	0.041
260	2.60	3.42	6.5	0.005	1174.29	0.044
300	3.00	3.95	7.0	0.006	1180.72	0.047
320	3.20	4.21	7.5	0.006	1183.97	0.051
340	3.40	4.47	8.0	0.006	1187.23	0.054
360	3.60	4.74	8.0	0.006	1190.51	0.054
380	3.80	5.00	8.5	0.007	1193.81	0.057
400	4.00	5.26	9.0	0.007	1197.12	0.060
420	4.20	5.53	9.5	0.008	1200.46	0.063
440	4.40	5.79	10.0	0.008	1203.81	0.066
460	4.60	6.05	10.0	0.008	1207.18	0.066
480	4.80	6.32	10.0	0.008	1210.57	0.066
500	5.00	6.58	11.0	0.009	1213.98	0.072
520	5.20	6.84	11.5	0.009	1217.41	0.076
540	5.40	7.11	12.0	0.010	1220.86	0.079
560	5.60	7.37	12.0	0.010	1224.33	0.078
580	5.80	7.63	12.0	0.010	1227.82	0.078
600	6.00	7.89	13.0	0.010	1231.32	0.084
620	6.20	8.16	13.0	0.010	1234.85	0.084
640	6.40	8.42	13.5	0.011	1238.40	0.087
660	6.60	8.68	13.5	0.011	1241.97	0.087
680	6.80	8.95	14.0	0.011	1245.56	0.090
700	7.00	9.21	14.0	0.011	1249.17	0.090
720	7.20	9.47	14.0	0.011	1252.80	0.089
740	7.40	9.74	15.0	0.012	1256.45	0.096
760	7.60	10.00	15.0	0.012	1260.13	0.095
780	7.80	10.26	15.5	0.012	1263.82	0.098
800	8.00	10.53	16.0	0.013	1267.54	0.101
820	8.20	10.79	16.0	0.013	1271.28	0.101
840	8.40	11.05	16.5	0.013	1275.04	0.104
860	8.60	11.32	16.5	0.013	1278.82	0.103
880	8.80	11.58	16.5	0.013	1282.63	0.103
900	9.00	11.84	17.0	0.014	1286.46	0.106
920	9.20	12.11	17.0	0.014	1290.31	0.105
940	9.40	12.37	17.0	0.014	1294.19	0.105
960	9.60	12.63	17.0	0.014	1298.08	0.105
980	9.80	12.89	17.5	0.014	1302.01	0.108
1000	10.00	13.16	18.0	0.014	1305.95	0.110
1020	10.20	13.42	18.0	0.014	1309.92	0.110
1040	10.40	13.68	18.0	0.014	1313.91	0.110
1060	10.60	13.95	18.0	0.014	1317.93	0.109
1080	10.80	14.21	18.0	0.014	1321.97	0.109
1100	11.00	14.47	18.0	0.014	1326.04	0.109

_AB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH1(19.5)

Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
Client	o	Date	28-Jul-11
Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 01
Depth : 19.50 - 20.00 m

Sample type : UDS
Soil description :
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	147.09		
Density	Mg/m3	1.707		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	2.0	0.002	1146.18	0.014
100	1.00	1.32	2.5	0.002	1149.24	0.017
120	1.20	1.58	3.0	0.002	1152.31	0.021
140	1.40	1.84	3.5	0.003	1155.40	0.024
160	1.60	2.11	4.0	0.003	1158.50	0.028
180	1.80	2.37	4.0	0.003	1161.63	0.028
200	2.00	2.63	4.5	0.004	1164.77	0.031
220	2.20	2.89	5.0	0.004	1167.92	0.034
240	2.40	3.16	5.5	0.004	1171.10	0.038
260	2.60	3.42	6.0	0.005	1174.29	0.041
280	2.80	3.68	6.5	0.005	1177.50	0.044
300	3.00	3.95	7.0	0.006	1180.72	0.047
320	3.20	4.21	7.5	0.006	1183.97	0.051
340	3.40	4.47	8.0	0.006	1187.23	0.054
360	3.60	4.74	8.5	0.007	1190.51	0.057
380	3.80	5.00	8.5	0.007	1193.81	0.057
400	4.00	5.26	9.0	0.007	1197.12	0.060
420	4.20	5.53	9.0	0.007	1200.46	0.060
440	4.40	5.79	8.5	0.007	1203.81	0.056
460	4.60	6.05	8.0	0.006	1207.18	0.053
480	4.80	6.32	7.5	0.006	1210.57	0.050
500	5.00	6.58	7.0	0.006	1213.98	0.046
520	5.20	6.84	6.5	0.005	1217.41	0.043
540	5.40	7.11	6.0	0.005	1220.86	0.039
560	5.60	7.37	5.5	0.004	1224.33	0.036
580	5.80	7.63	5.0	0.004	1227.82	0.033

_AB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH1(19.5)

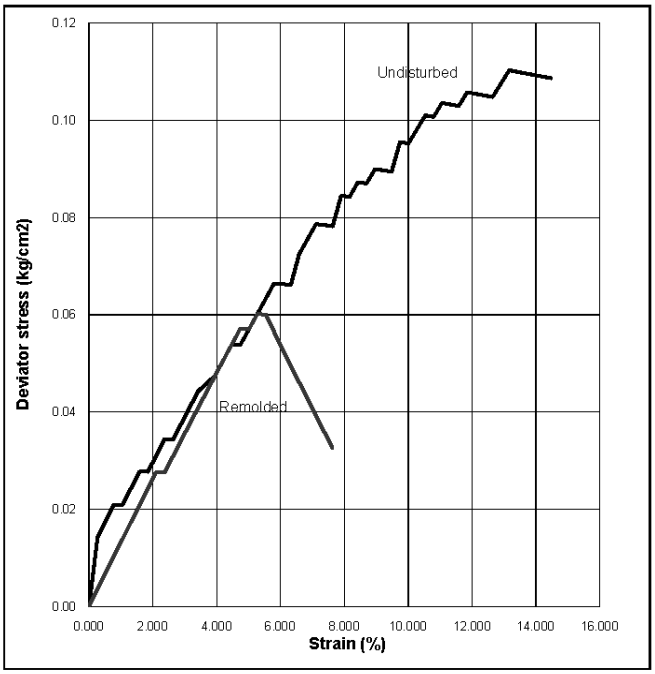
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	28-Jul-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 01
Depth : 19.50 - 20.00 m

Sample type : UDS
Soil description :

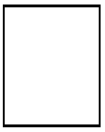
TEST RESULT



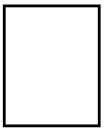
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.084	8.158
Remolded	0.060	5.526
Sensitivity	1.404	

Mode of failure

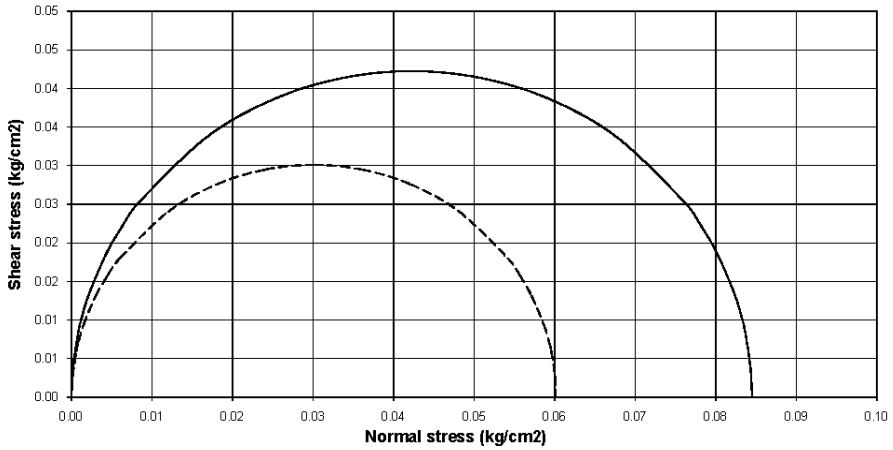
Undisturb



Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
			Date	2-Aug-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 02
Depth : 4.50 - 5.00

Sample type : UDS
Soil description :
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	115.82		
Density	Mg/m3	1.344		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.0	0.001	1143.14	0.007
80	0.80	1.05	1.0	0.001	1146.18	0.007
100	1.00	1.32	1.5	0.001	1149.24	0.010
120	1.20	1.58	2.0	0.002	1152.31	0.014
140	1.40	1.84	2.0	0.002	1155.40	0.014
160	1.60	2.11	2.0	0.002	1158.50	0.014
180	1.80	2.37	2.5	0.002	1161.63	0.017
200	2.00	2.63	2.5	0.002	1164.77	0.017
220	2.20	2.89	2.5	0.002	1167.92	0.017
240	2.40	3.16	2.5	0.002	1171.10	0.017
260	2.60	3.42	2.5	0.002	1174.29	0.017

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH2(4.5)

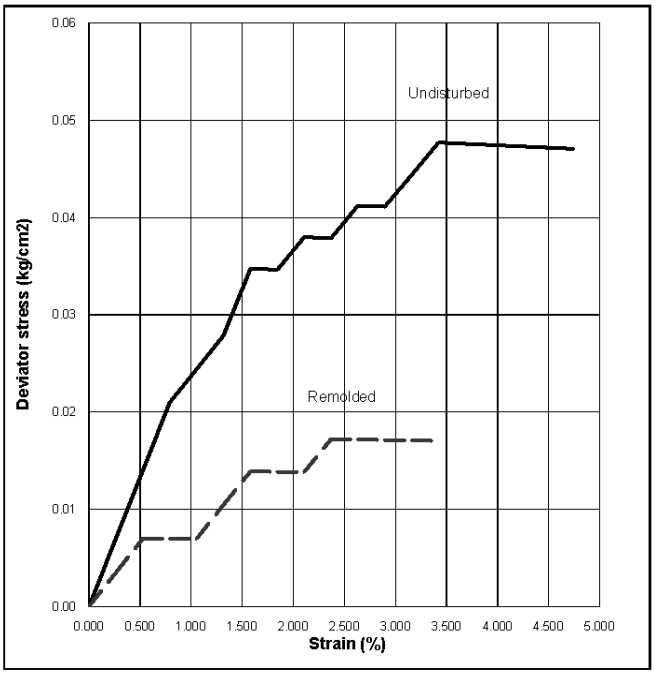
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/2/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 02
Depth : 4.50 - 5.00

Sample type : UDS
Soil description : 0

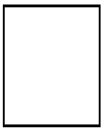
TEST RESULT



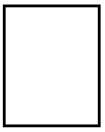
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.048	3.684
Remolded	0.017	3.421
Sensitivity	2.770	

Mode of failure

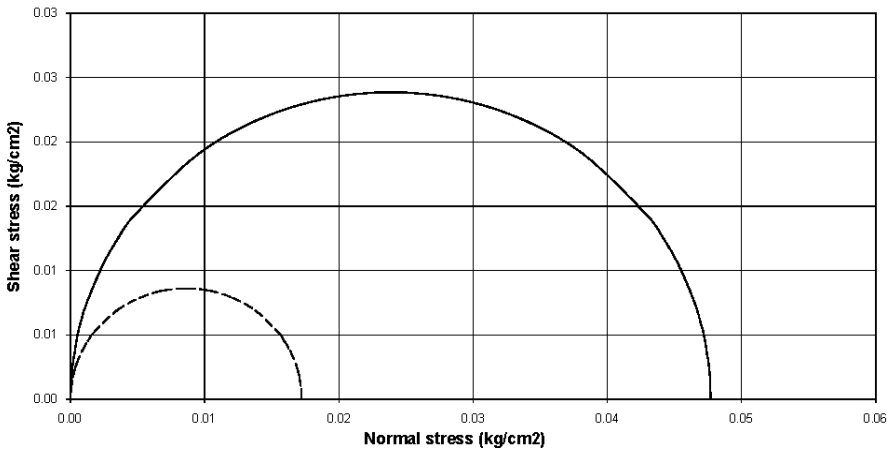
Undisturb



Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	2-Aug-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 02
Depth : 6.50 - 7.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	126.97		
Density	Mg/m3	1.473		

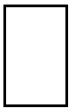
Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	2.0	0.002	1146.18	0.014
100	1.00	1.32	2.0	0.002	1149.24	0.014
120	1.20	1.58	3.0	0.002	1152.31	0.021
140	1.40	1.84	3.5	0.003	1155.40	0.024
160	1.60	2.11	3.5	0.003	1158.50	0.024
180	1.80	2.37	4.0	0.003	1161.63	0.028
200	2.00	2.63	4.5	0.004	1164.77	0.031
220	2.20	2.89	5.0	0.004	1167.92	0.034
240	2.40	3.16	5.5	0.004	1171.10	0.038
260	2.60	3.42	5.5	0.004	1174.29	0.037
280	2.80	3.68	6.0	0.005	1177.50	0.041
300	3.00	3.95	6.0	0.005	1180.72	0.041
320	3.20	4.21	6.0	0.005	1183.97	0.041
340	3.40	4.47	6.0	0.005	1187.23	0.040
360	3.60	4.74	6.0	0.005	1190.51	0.040

Sketch of failure conditions



'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH2(6.5)

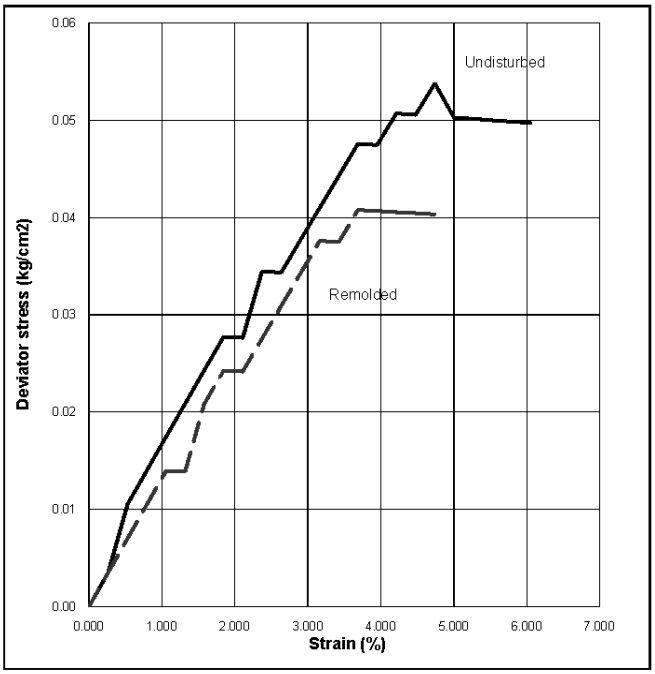
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/2/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 02
Depth : 6.50 - 7.00 m

Sample type : UDS
Soil description : 0

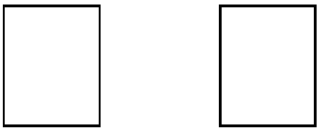
TEST RESULT



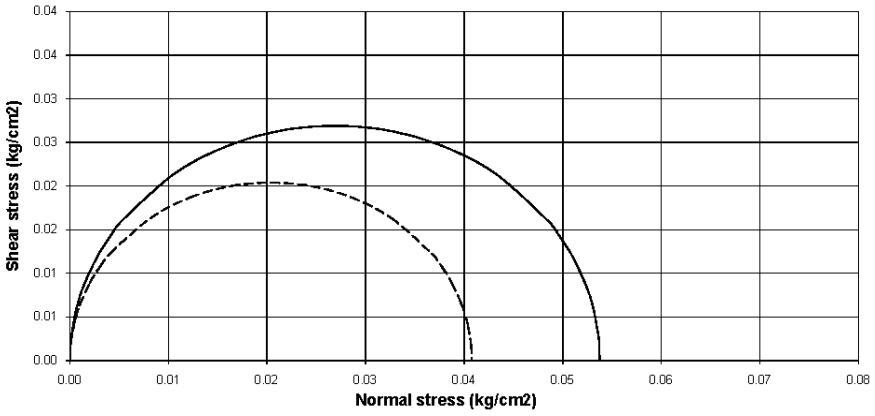
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.054	4.737
Remolded	0.041	4.211
Sensitivity	1.319	

Mode of failure

Undisturb | Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	2-Aug-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 02
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	132.19		
Density	Mg/m3	1.534		

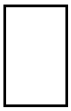
Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.0	0.000	1137.11	0.000
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	1.5	0.001	1146.18	0.010
100	1.00	1.32	1.5	0.001	1149.24	0.010
120	1.20	1.58	2.0	0.002	1152.31	0.014
140	1.40	1.84	2.5	0.002	1155.40	0.017
160	1.60	2.11	3.0	0.002	1158.50	0.021
180	1.80	2.37	3.0	0.002	1161.63	0.021
200	2.00	2.63	3.0	0.002	1164.77	0.021
220	2.20	2.89	3.5	0.003	1167.92	0.024
240	2.40	3.16	3.5	0.003	1171.10	0.024
260	2.60	3.42	3.5	0.003	1174.29	0.024
280	2.80	3.68	4.0	0.003	1177.50	0.027
300	3.00	3.95	4.0	0.003	1180.72	0.027
320	3.20	4.21	4.0	0.003	1183.97	0.027
340	3.40	4.47	4.0	0.003	1187.23	0.027
360	3.60	4.74	4.5	0.004	1190.51	0.030
380	3.80	5.00	5.0	0.004	1193.81	0.034
400	4.00	5.26	5.0	0.004	1197.12	0.033
420	4.20	5.53	5.0	0.004	1200.46	0.033
440	4.40	5.79	5.0	0.004	1203.81	0.033
460	4.60	6.05	5.0	0.004	1207.18	0.033

Sketch of failure conditions



'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH2(8.5)

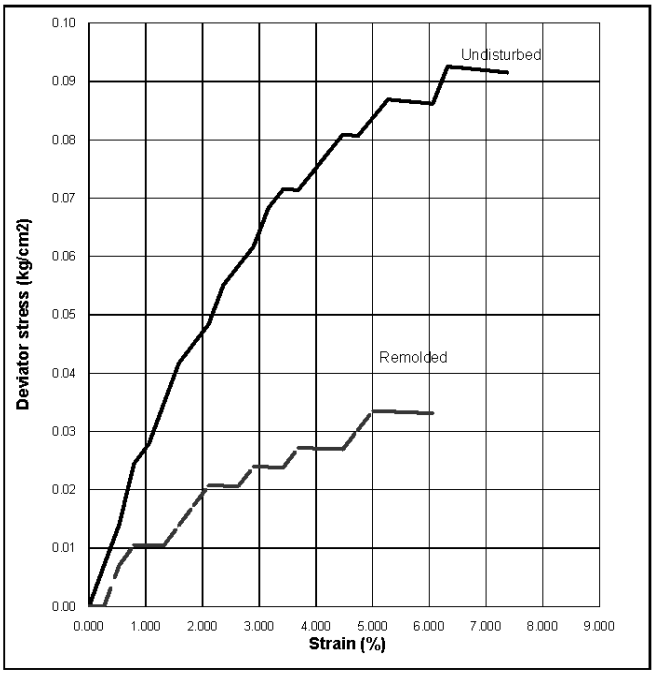
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/2/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 02
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0

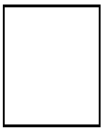
TEST RESULT



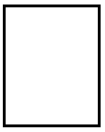
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.093	6.316
Remolded	0.034	5.000
Sensitivity	2.761	

Mode of failure

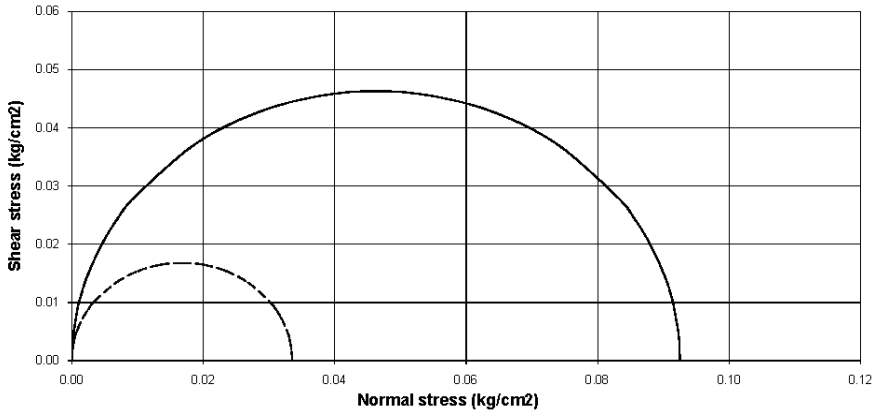
Undisturb



Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	3-Aug-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 03
Depth : 2.50 - 3.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	132.19		
Density	Mg/m3	1.534		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	2.0	0.002	1146.18	0.014
100	1.00	1.32	2.5	0.002	1149.24	0.017
120	1.20	1.58	3.0	0.002	1152.31	0.021
140	1.40	1.84	3.5	0.003	1155.40	0.024
160	1.60	2.11	3.5	0.003	1158.50	0.024
180	1.80	2.37	4.0	0.003	1161.63	0.028
200	2.00	2.63	5.0	0.004	1164.77	0.034
220	2.20	2.89	6.0	0.005	1167.92	0.041
240	2.40	3.16	6.0	0.005	1171.10	0.041
260	2.60	3.42	6.5	0.005	1174.29	0.044
280	2.80	3.68	7.0	0.006	1177.50	0.048
300	3.00	3.95	7.5	0.006	1180.72	0.051
320	3.20	4.21	8.0	0.006	1183.97	0.054
340	3.40	4.47	8.0	0.006	1187.23	0.054
360	3.60	4.74	8.5	0.007	1190.51	0.057
380	3.80	5.00	8.5	0.007	1193.81	0.057
400	4.00	5.26	9.0	0.007	1197.12	0.060
420	4.20	5.53	9.5	0.008	1200.46	0.063
440	4.40	5.79	9.5	0.008	1203.81	0.063
460	4.60	6.05	10.0	0.008	1207.18	0.066
480	4.80	6.32	10.0	0.008	1210.57	0.066
500	5.00	6.58	10.5	0.008	1213.98	0.069
520	5.20	6.84	11.0	0.009	1217.41	0.072
540	5.40	7.11	11.0	0.009	1220.86	0.072
560	5.60	7.37	11.0	0.009	1224.33	0.072
580	5.80	7.63	11.5	0.009	1227.82	0.075
600	6.00	7.89	11.5	0.009	1231.32	0.075
620	6.20	8.16	11.5	0.009	1234.85	0.075
640	6.40	8.42	11.5	0.009	1238.40	0.074
660	6.60	8.68	11.5	0.009	1241.97	0.074

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH3(2.5)

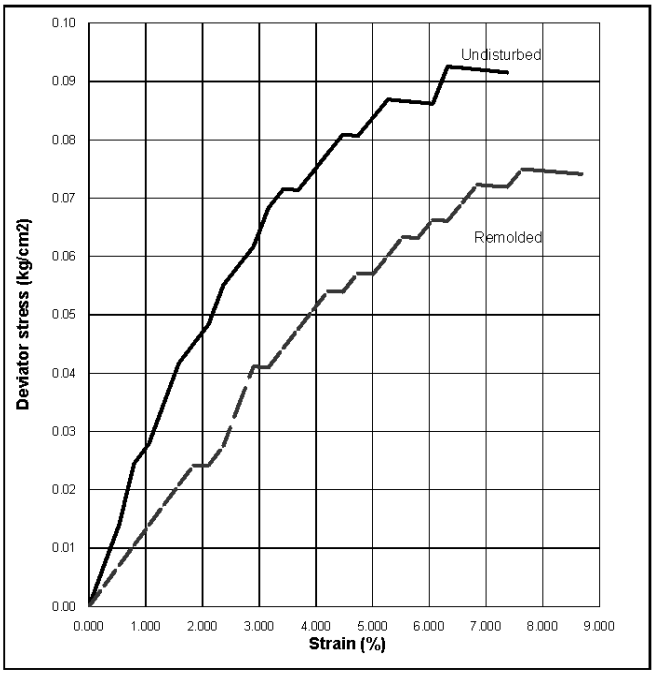
Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
Job No.	-	Date	8/3/2011
Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 03
Depth : 2.50 - 3.00 m

Sample type : UDS
Soil description : 0

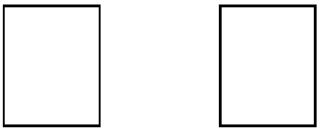
TEST RESULT



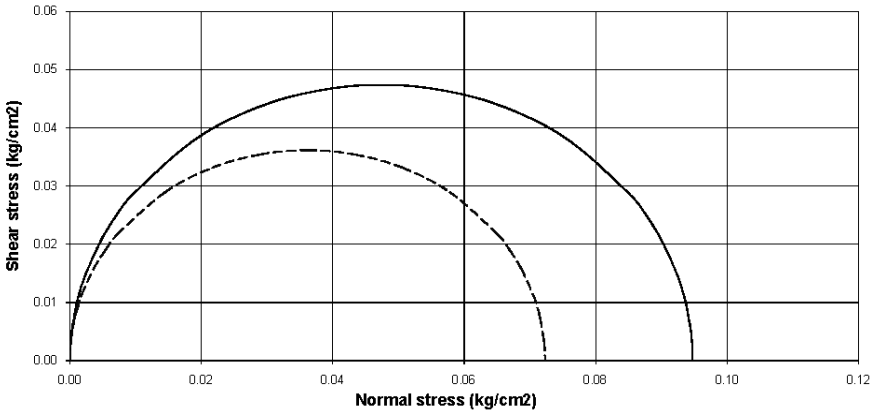
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.095	7.368
Remolded	0.072	7.368
Sensitivity	1.311	

Mode of failure

Undisturb | Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	3-Aug-11
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 03
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	132.19		
Density	Mg/m3	1.534		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.0	0.000	1137.11	0.000
40	0.40	0.53	0.5	0.000	1140.12	0.004
60	0.60	0.79	0.5	0.000	1143.14	0.003
80	0.80	1.05	0.5	0.000	1146.18	0.003
100	1.00	1.32	1.0	0.001	1149.24	0.007
120	1.20	1.58	1.5	0.001	1152.31	0.010
140	1.40	1.84	2.0	0.002	1155.40	0.014
160	1.60	2.11	2.0	0.002	1158.50	0.014
180	1.80	2.37	2.0	0.002	1161.63	0.014
200	2.00	2.63	2.5	0.002	1164.77	0.017
220	2.20	2.89	2.5	0.002	1167.92	0.017
240	2.40	3.16	2.5	0.002	1171.10	0.017
260	2.60	3.42	3.0	0.002	1174.29	0.020
280	2.80	3.68	3.0	0.002	1177.50	0.020
300	3.00	3.95	3.0	0.002	1180.72	0.020
320	3.20	4.21	3.0	0.002	1183.97	0.020
340	3.40	4.47	3.0	0.002	1187.23	0.020

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH3(8.5)

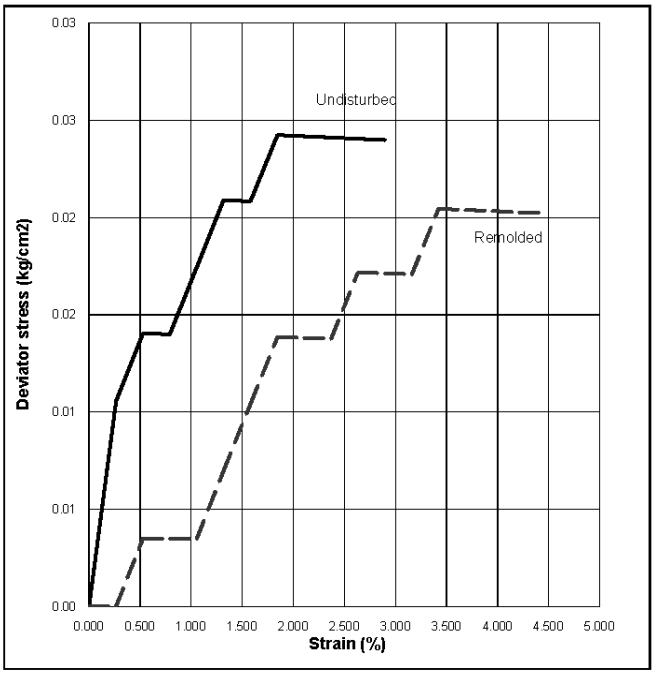
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/3/2011
	Tested By	Beny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 03
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0

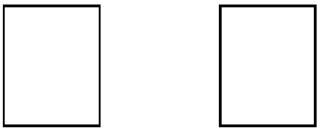
TEST RESULT



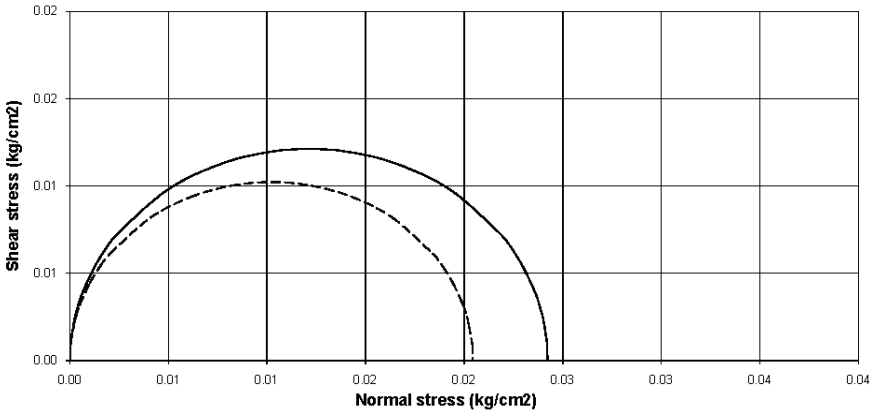
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.024	2.895
Remolded	0.020	4.474
Sensitivity	1.186	

Mode of failure

Undisturb | Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	13-Aug-11
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 04
Depth : 2.50 - 3.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	140.62		
Density	Mg/m3	1.631		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	1.0	0.001	1137.11	0.007
40	0.40	0.53	2.0	0.002	1140.12	0.014
60	0.60	0.79	2.5	0.002	1143.14	0.017
80	0.80	1.05	3.5	0.003	1146.18	0.024
100	1.00	1.32	4.0	0.003	1149.24	0.028
120	1.20	1.58	5.0	0.004	1152.31	0.035
140	1.40	1.84	5.5	0.004	1155.40	0.038
160	1.60	2.11	6.5	0.005	1158.50	0.045
180	1.80	2.37	7.0	0.006	1161.63	0.048
200	2.00	2.63	8.5	0.007	1164.77	0.058
220	2.20	2.89	9.0	0.007	1167.92	0.062
240	2.40	3.16	10.0	0.008	1171.10	0.068
260	2.60	3.42	10.9	0.009	1174.29	0.074
280	2.80	3.68	11.5	0.009	1177.50	0.078
300	3.00	3.95	12.0	0.010	1180.72	0.081
320	3.20	4.21	12.5	0.010	1183.97	0.084
340	3.40	4.47	13.0	0.010	1187.23	0.088
360	3.60	4.74	13.0	0.010	1190.51	0.087
380	3.80	5.00	13.0	0.010	1193.81	0.087
400	4.00	5.26	13.0	0.010	1197.12	0.087
420	4.20	5.53	13.0	0.010	1200.46	0.087

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH4(2.5)

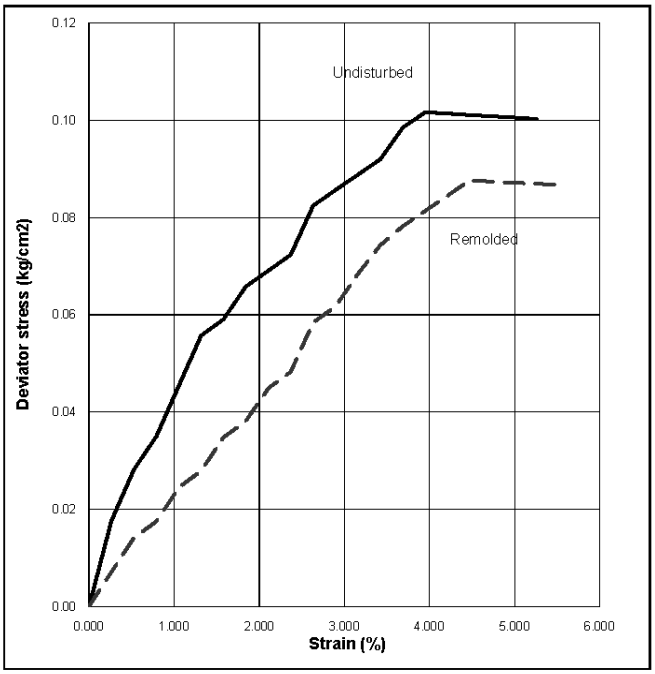
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/13/2011
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 04
Depth : 2.50 - 3.00 m

Sample type : UDS
Soil description : 0

TEST RESULT

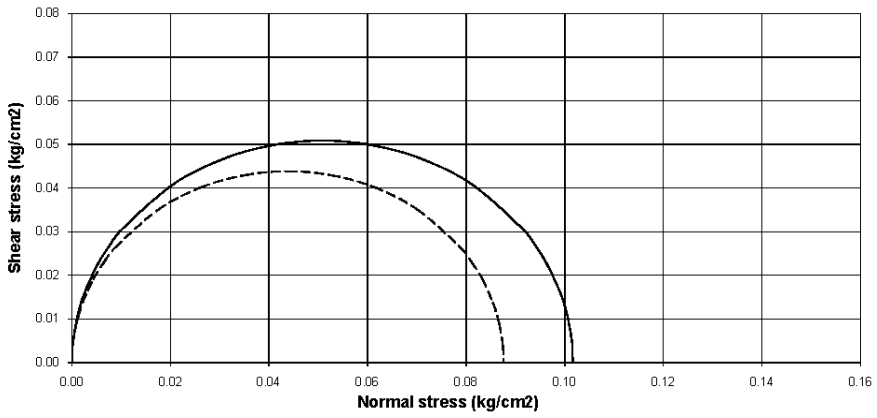


Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.102	0.000
Remolded	0.088	0.000
Sensitivity	1.160	

Mode of failure

Undisturb | Remolded

MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	13-Aug-11
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 04
Depth : 4.50 - 5.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	140.62		
Density	Mg/m3	1.631		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.0	0.000	1137.11	0.000
40	0.40	0.53	0.5	0.000	1140.12	0.004
60	0.60	0.79	1.0	0.001	1143.14	0.007
80	0.80	1.05	1.5	0.001	1146.18	0.010
100	1.00	1.32	1.8	0.001	1149.24	0.013
120	1.20	1.58	2.0	0.002	1152.31	0.014
140	1.40	1.84	2.0	0.002	1155.40	0.014
160	1.60	2.11	2.5	0.002	1158.50	0.017
180	1.80	2.37	2.8	0.002	1161.63	0.019
200	2.00	2.63	3.0	0.002	1164.77	0.021
220	2.20	2.89	3.0	0.002	1167.92	0.021
240	2.40	3.16	3.0	0.002	1171.10	0.020
260	2.60	3.42	3.0	0.002	1174.29	0.020
280	2.80	3.68	3.5	0.003	1177.50	0.024
300	3.00	3.95	4.0	0.003	1180.72	0.027
320	3.20	4.21	4.5	0.004	1183.97	0.030
340	3.40	4.47	5.0	0.004	1187.23	0.034
360	3.60	4.74	5.0	0.004	1190.51	0.034
380	3.80	5.00	5.5	0.004	1193.81	0.037
400	4.00	5.26	5.5	0.004	1197.12	0.037
420	4.20	5.53	5.5	0.004	1200.46	0.037
440	4.40	5.79	5.5	0.004	1203.81	0.037
460	4.60	6.05	5.5	0.004	1207.18	0.036

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH4(4.5)

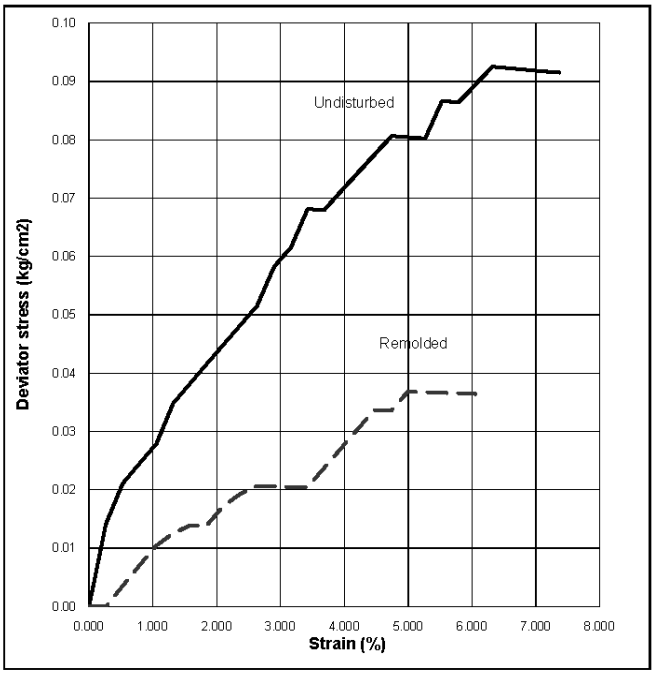
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/13/2011
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 04
Depth : 4.50 - 5.00 m

Sample type : UDS
Soil description : 0

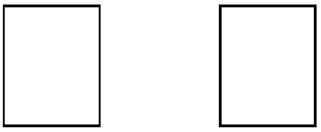
TEST RESULT



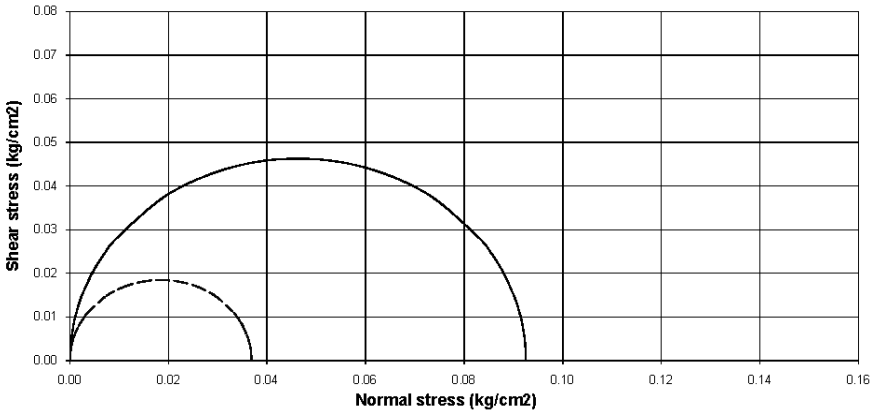
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.093	6.316
Remolded	0.037	5.789
Sensitivity	2.510	

Mode of failure

Undisturb Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	13-Aug-11
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 04
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	132.56		
Density	Mg/m3	1.538		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	1.5	0.001	1146.18	0.010
100	1.00	1.32	1.5	0.001	1149.24	0.010
120	1.20	1.58	2.0	0.002	1152.31	0.014
140	1.40	1.84	2.0	0.002	1155.40	0.014
160	1.60	2.11	2.0	0.002	1158.50	0.014
180	1.80	2.37	2.5	0.002	1161.63	0.017
200	2.00	2.63	2.5	0.002	1164.77	0.017
220	2.20	2.89	2.5	0.002	1167.92	0.017
240	2.40	3.16	2.5	0.002	1171.10	0.017
260	2.60	3.42	2.5	0.002	1174.29	0.017

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH4(8.5)

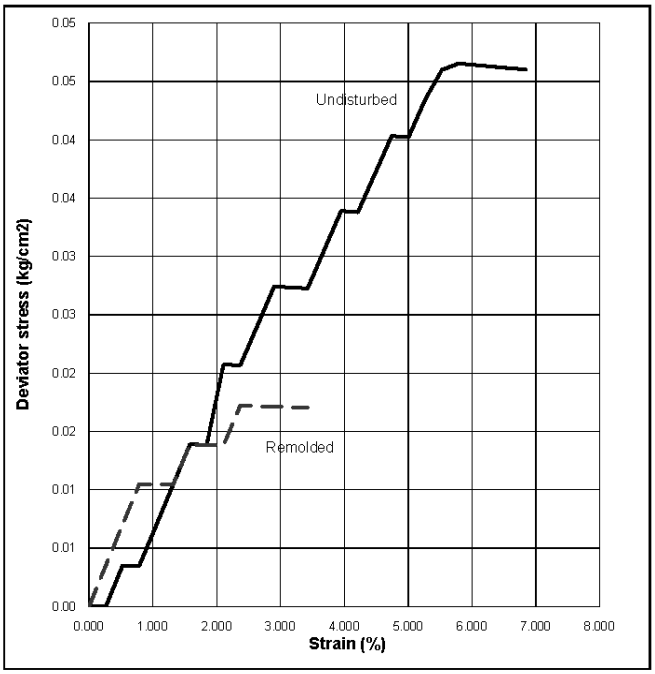
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/13/2011
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 04
Depth : 8.50 - 9.00 m

Sample type : UDS
Soil description : 0

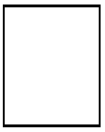
TEST RESULT



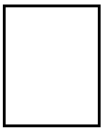
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.047	2.895
Remolded	0.017	0.000
Sensitivity	2.702	

Mode of failure

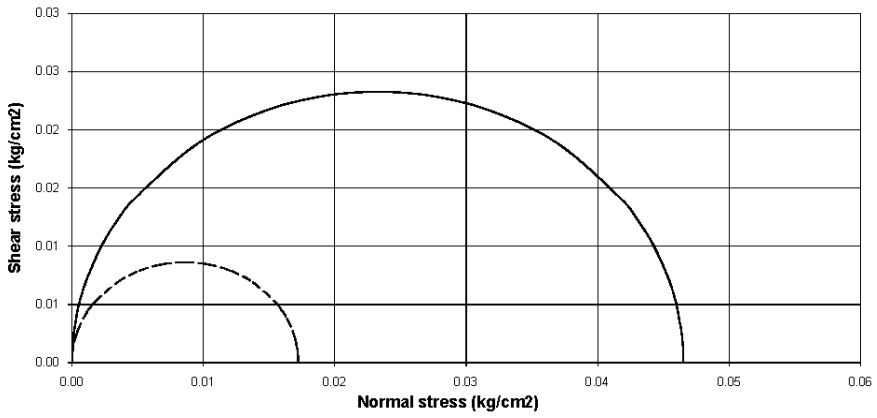
Undisturb



Remolded



MOHR CIRCLES



	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	13-Aug-11
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

REMOLTED

Location : Bali
Boring no : BH - 04
Depth : 11.50 - 12.00 m

Sample type : UDS
Soil description : 0
Sample no. :

Preparation

Specimen details		Initial	After test	
Diameter	Dmm	38.00	Mass g	
Area	Ao mm2	1134.11	Dry mass g	
Length	Lo mm	76.00	W %	
Volume	cm3	86.19		
Mass	g	121.41		
Density	Mg/m3	1.409		

Machine details		
Machine no		
Rate of deformation	mm/min	1.088
PR Calibration	N/div	0.080

Compression test Single stage

REMOLTED

Deformation gauge reading	Compression of specimen (δ L) (mm)	Strain (%)	Force gauge reading (div)	Axial force (N)	Corrected Area (mm^2)	Deviator stress (kg/cm2)
0	0	0	0	0	1134.11	0.000
20	0.20	0.26	0.5	0.000	1137.11	0.004
40	0.40	0.53	1.0	0.001	1140.12	0.007
60	0.60	0.79	1.5	0.001	1143.14	0.010
80	0.80	1.05	2.0	0.002	1146.18	0.014
100	1.00	1.32	2.0	0.002	1149.24	0.014
120	1.20	1.58	2.5	0.002	1152.31	0.017
140	1.40	1.84	3.0	0.002	1155.40	0.021
160	1.60	2.11	3.5	0.003	1158.50	0.024
180	1.80	2.37	4.0	0.003	1161.63	0.028
200	2.00	2.63	4.0	0.003	1164.77	0.027
220	2.20	2.89	5.0	0.004	1167.92	0.034
240	2.40	3.16	4.5	0.004	1171.10	0.031
260	2.60	3.42	4.5	0.004	1174.29	0.031
280	2.80	3.68	4.5	0.004	1177.50	0.031
300	3.00	3.95	5.0	0.004	1180.72	0.034
320	3.20	4.21	5.0	0.004	1183.97	0.034
340	3.40	4.47	5.0	0.004	1187.23	0.034
360	3.60	4.74	5.5	0.004	1190.51	0.037
380	3.80	5.00	6.0	0.005	1193.81	0.040
400	4.00	5.26	6.0	0.005	1197.12	0.040
420	4.20	5.53	6.0	0.005	1200.46	0.040
440	4.40	5.79	6.5	0.005	1203.81	0.043
460	4.60	6.05	7.0	0.006	1207.18	0.046
480	4.80	6.32	7.0	0.006	1210.57	0.046
500	5.00	6.58	7.0	0.006	1213.98	0.046
520	5.20	6.84	7.0	0.006	1217.41	0.046
540	5.40	7.11	7.0	0.006	1220.86	0.046

'LAB DATA/2003/PL 001/PAGAR DEWA/@BCL@FC08CE0F/BH4(11.5)

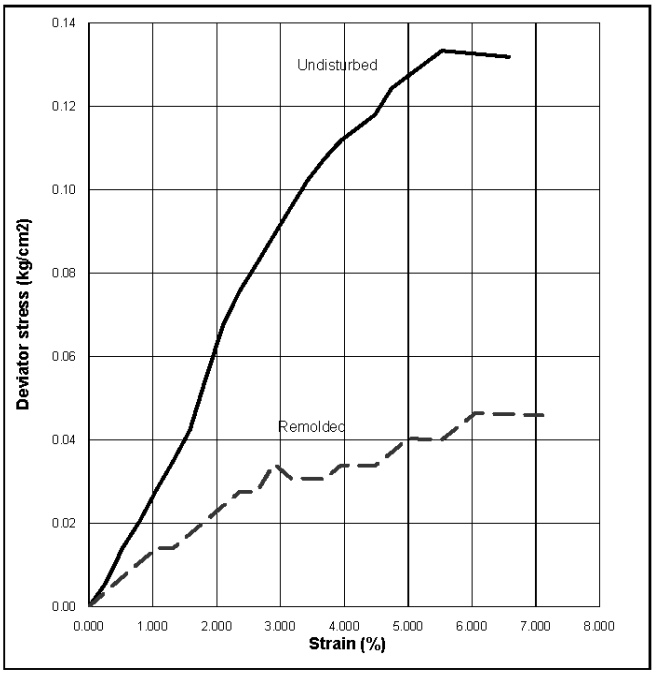
	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Job No.	-	Date	8/13/2011
	Tested By	Benny	Checked By	M.Iqbal, ST

UNCONFINED COMPRESSION TEST

Location : Bali
Boring no : BH - 04
Depth : 11.50 - 12.00 m

Sample type : UDS
Soil description : 0

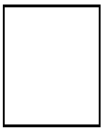
TEST RESULT



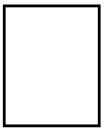
Sample	At failure	
	qu kg/cm2	Strain %
Undisturbed	0.133	6.053
Remolded	0.046	7.105
Sensitivity	2.873	

Mode of failure

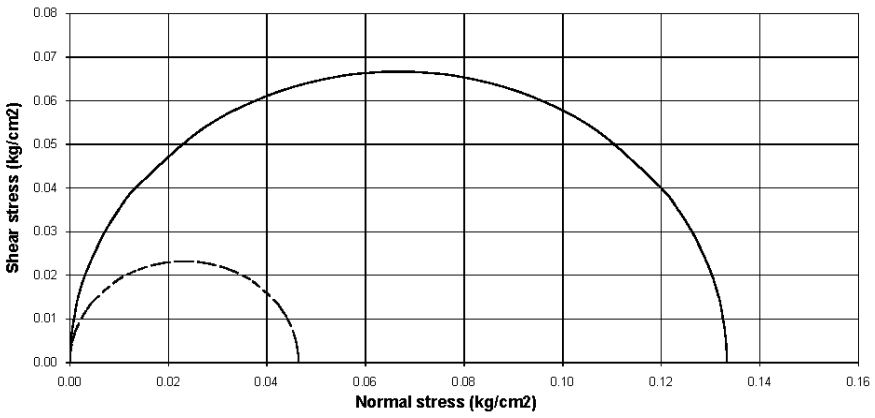
Undisturb



Remolded



MOHR CIRCLES



PT. TIGENCO GRAHA PERSADA

PROJECT : SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM

LOCATION : BALI

SUMMARY OF SOIL MECHANIC LABORATORY TEST

No	BORE HOLE	DEPTH (meter)	TYPE SOIL	CLASSIFICATION USCS	Index Properties: Determination of dry density & moisture content: Wn (%)	γn (gr/cm³)	γd (gr/cm³)	Void Ratio e	Porosity n	Sr (%)	SPECIFIC GRAFITY Gs	ATTERBERG LIMITS: WL (%)	WP (%)	IP (%)	GRAIN SIZE: GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	% finer by weight passing no. 200 sieve	Engineering Properties: TRIAXIAL UU: Ø degree	C kg/cm2	UNCONFINED COMPRESSION TEST: qus kg / cm2	qur kg / cm2	si
1	BH - 1	1.50 - 2.00	UDS	MH	48.39	1.693	1.141	1.296	0.564	97.82	2.619	52.75	32.78	19.97	1.88	42.59	27.67	27.86	55.53	-	-	0.150	0.139	1.075
2	BH - 1	15.50 - 16.00	UDS	CH	84.17	1.475	0.801	2.271	0.694	97.09	2.620	94.46	30.10	64.36	0.00	4.47	37.13	58.40	95.53	-	-	0.225	0.125	1.806
3	BH - 1	19.50 - 20.00	UDS	CH	85.30	1.412	0.762	2.463	0.711	91.39	2.639	93.52	28.22	65.30	0.00	8.63	35.39	55.98	91.37	-	-	0.084	0.060	1.404
4	BH - 2	4.50 - 5.00	UDS	CH	86.13	1.450	0.779	2.372	0.703	95.38	2.627	74.12	24.87	49.25	0.00	15.71	37.90	46.39	84.29	-	-	0.048	0.017	2.770
5	BH - 2	6.50 - 7.00	UDS	SC	67.22	1.524	0.911	1.864	0.651	94.13	2.610	67.36	47.68	19.68	0.00	54.36	20.34	25.30	45.64	-	-	0.054	0.041	1.319
6	BH - 2	8.50 - 9.00	UDS	CH	72.09	1.598	0.929	1.816	0.645	100.00	2.615	75.84	29.58	46.26	0.27	25.99	32.86	40.88	73.74	-	-	0.093	0.034	2.761
7	BH - 3	2.50 - 3.00	UDS	SC	52.68	1.649	1.080	1.429	0.588	96.722	2.623	59.65	33.20	26.45	4.84	44.16	22.90	28.10	51.00	-	-	0.095	0.072	1.311
8	BH - 3	8.50 - 9.00	UDS	SC	52.10	1.869	1.229	1.157	0.536	100.000	2.650	42.85	25.30	17.55	12.64	54.73	24.04	8.59	32.63	-	-	0.024	0.020	1.186
9	BH - 4	2.50 - 3.00	UDS	CH	46.23	1.704	1.165	1.225	0.551	97.84	2.593	62.42	11.76	50.66	4.74	38.18	22.23	34.85	57.08	-	-	0.102	0.088	1.160
10	BH - 4	4.50 - 5.00	UDS	SC	53.55	1.572	1.024	1.569	0.611	89.766	2.630	56.55	30.12	26.43	0.31	53.76	17.44	28.49	45.93	-	-	0.093	0.037	2.510
11	BH - 4	8.50 - 9.00	UDS	SC	56.03	1.551	0.994	1.638	0.621	89.70	2.622	54.99	33.4	21.59	1.75	53.93	18.21	26.11	44.32	-	-	0.047	0.017	2.702
12	BH - 4	11.50 - 12.00	UDS	CH	90.64	1.448	0.760	2.448	0.710	96.967	2.619	73.38	30.77	42.61	0.00	18.61	28.11	53.28	81.39	-	-	0.133	0.046	2.873

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	16-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

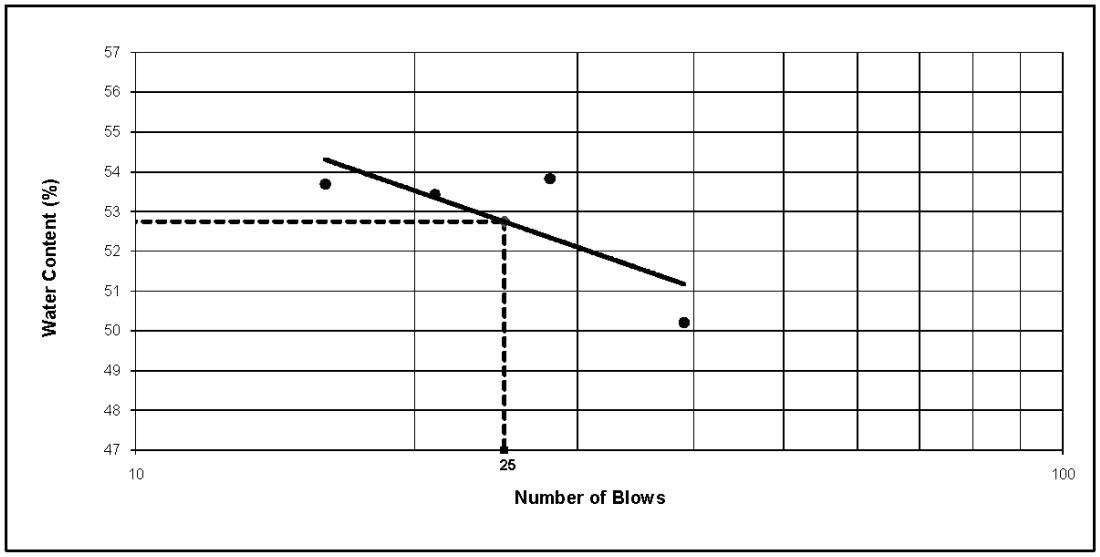
ASTM D 4318

Location : Bali
Hole No. : BH - 01
Depth : 1.50 - 2.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		39	28	21	16		
Container No.		C.25	C.34	C.15	C.26	A.27	A.28
Wt. Container + Wet Soil	g	11.34	12.23	12.97	13.50	21.55	22.24
Wt. Container + Dry Soil	g	9.00	9.49	10.02	10.30	19.21	19.87
Wt. Water	g	2.34	2.74	2.95	3.20	2.34	2.37
Wt. Container	g	4.34	4.40	4.50	4.34	12.01	12.70
Wt. Dry Soil (Ws)	g	4.66	5.09	5.52	5.96	7.20	7.17
Water Content (w)	%	50.21	53.83	53.44	53.69	32.50	33.05

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	52.75
PLASTIC LIMIT	%	32.78
PLASTICITY INDEX	%	19.97
CLASSIFICATION		MH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	29-Jul-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

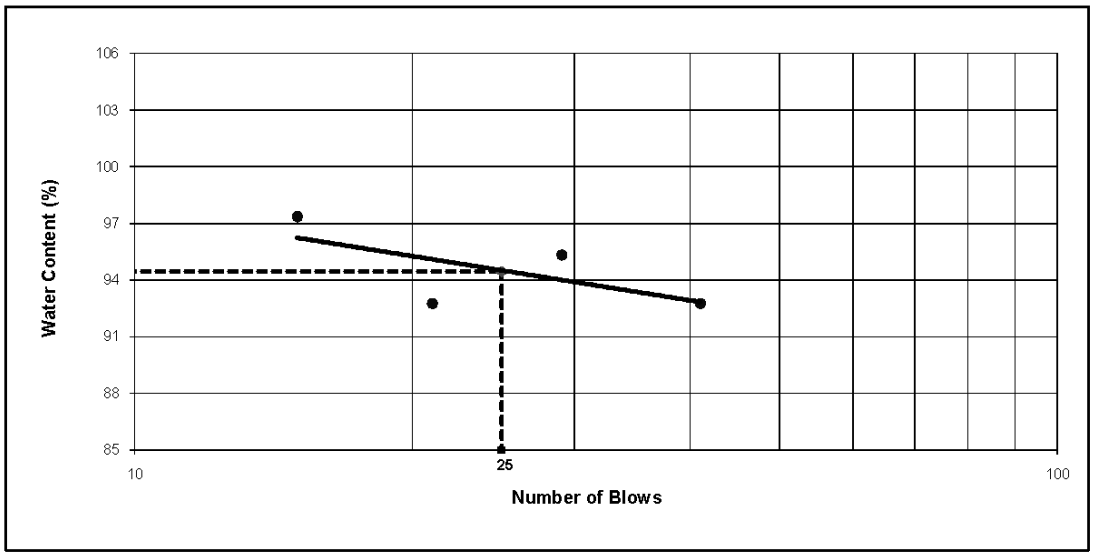
ASTM D 4318

Location : Bali
Hole No. : BH - 01
Depth : 15.50 - 16.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		41	29	21	15		
Container No.		C.5	C.13	C.24	C.18	A.1	A.2
Wt. Container + Wet Soil	g	10.21	10.61	11.54	12.53	21.73	21.76
Wt. Container + Dry Soil	g	7.39	7.55	8.08	8.50	19.58	19.72
Wt. Water	g	2.82	3.06	3.46	4.03	2.15	2.04
Wt. Container	g	4.35	4.34	4.35	4.36	12.49	12.89
Wt. Dry Soil (Ws)	g	3.04	3.21	3.73	4.14	7.09	6.83
Water Content (w)	%	92.76	95.33	92.76	97.34	30.32	29.87

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	94.46
PLASTIC LIMIT	%	30.10
PLASTICITY INDEX	%	64.36
CLASSIFICATION		CH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	29-Jul-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

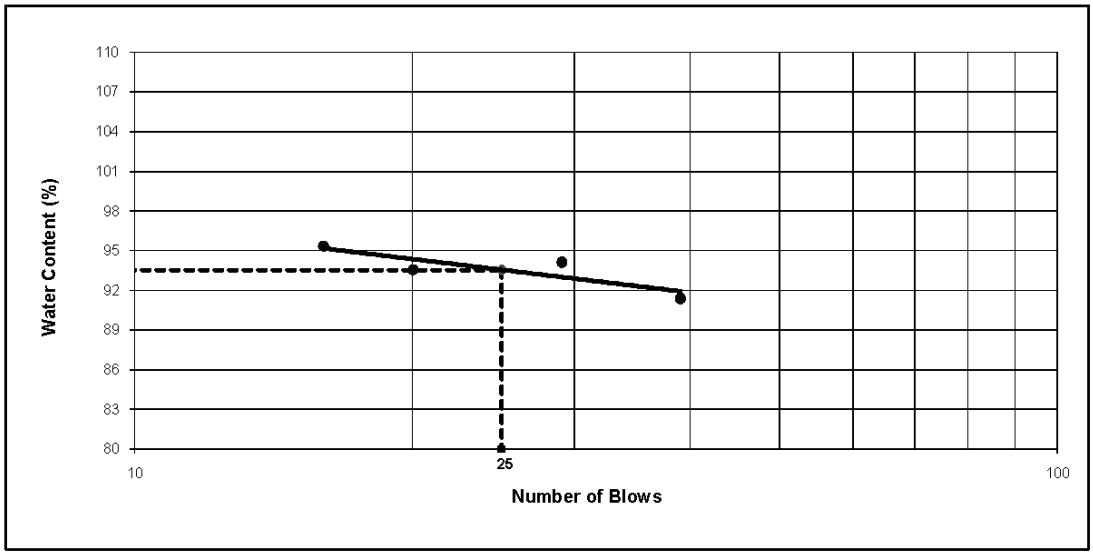
ASTM D 4318

Location : Bali
Hole No. : BH - 01
Depth : 19.50 - 20.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		39	29	20	16		
Container No.		C.12	C.29	C.17	C.38	A.17	A.18
Wt. Container + Wet Soil	g	11.09	11.24	11.87	12.00	22.54	22.95
Wt. Container + Dry Soil	g	7.92	7.89	8.23	8.28	20.43	20.70
Wt. Water	g	3.17	3.35	3.64	3.72	2.11	2.25
Wt. Container	g	4.45	4.33	4.34	4.38	12.81	12.87
Wt. Dry Soil (Ws)	g	3.47	3.56	3.89	3.90	7.62	7.83
Water Content (w)	%	91.35	94.10	93.57	95.38	27.69	28.74

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	93.52
PLASTIC LIMIT	%	28.22
PLASTICITY INDEX	%	65.30
CLASSIFICATION		CH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

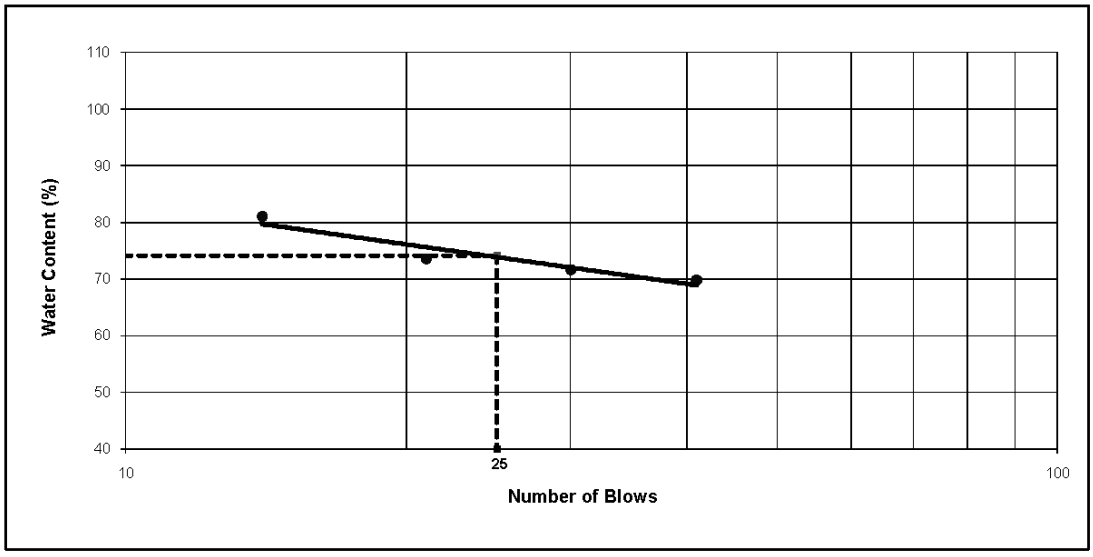
ASTM D 4318

Location : Bali
Hole No. : BH - 02
Depth : 4.50 - 5.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		41	30	21	14		
Container No.		C.21	C.22	C.14	C.15	A.7	A.8
Wt. Container + Wet Soil	g	11.25	11.84	12.15	13.65	20.80	20.66
Wt. Container + Dry Soil	g	8.42	8.73	8.83	9.54	19.25	19.10
Wt. Water	g	2.83	3.11	3.32	4.11	1.55	1.56
Wt. Container	g	4.37	4.39	4.32	4.47	13.03	12.81
Wt. Dry Soil (Ws)	g	4.05	4.34	4.51	5.07	6.22	6.29
Water Content (w)	%	69.88	71.66	73.61	81.07	24.92	24.80

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	74.12
PLASTIC LIMIT	%	24.87
PLASTICITY INDEX	%	49.25
CLASSIFICATION		CH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

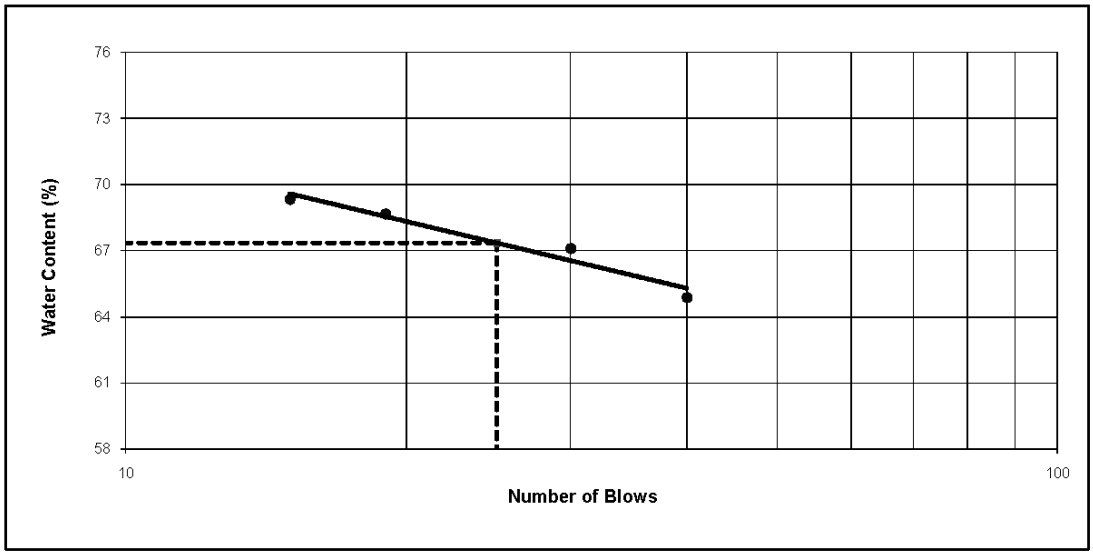
ASTM D 4318

Location : Bali
Hole No. : BH - 02
Depth : 6.50 - 7.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		40	30	19	15		
Container No.		C.4	C.22	C.3	C.6	A.25	A.26
Wt. Container + Wet Soil	g	11.80	12.01	12.43	13.02	21.97	20.56
Wt. Container + Dry Soil	g	8.88	8.93	9.14	9.54	19.03	18.00
Wt. Water	g	2.92	3.08	3.29	3.48	2.94	2.56
Wt. Container	g	4.38	4.34	4.35	4.52	12.77	12.71
Wt. Dry Soil (Ws)	g	4.50	4.59	4.79	5.02	6.26	5.29
Water Content (w)	%	64.89	67.10	68.68	69.32	46.96	48.39

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	67.36
PLASTIC LIMIT	%	47.68
PLASTICITY INDEX	%	19.68
CLASSIFICATION		MH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	2-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

ASTM D 4318

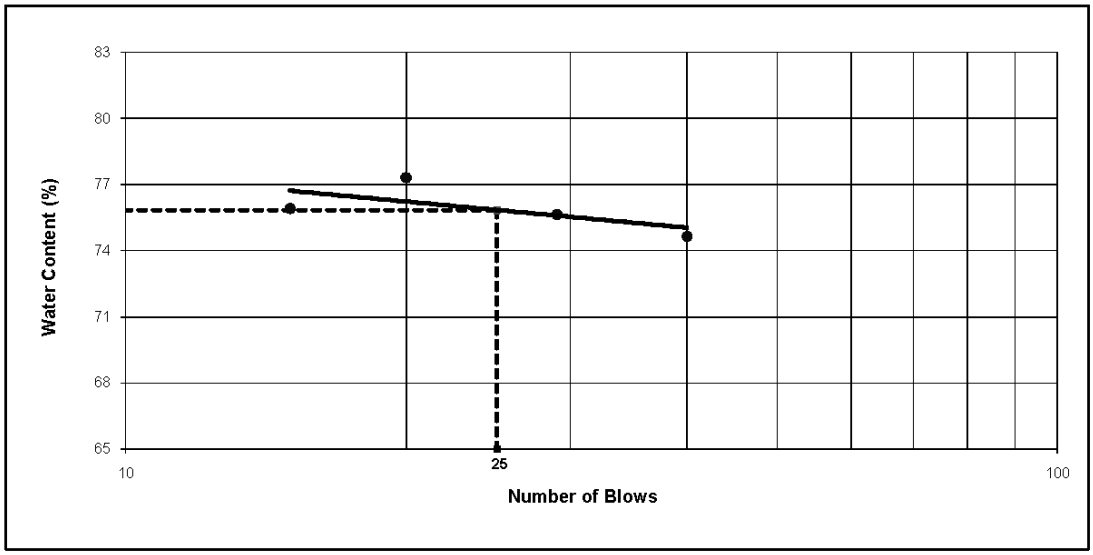
Location : Bali
Hole No. : BH - 02
Depth : 8.50 - 9.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT / **PLASTIC LIMIT**

No. of Blows		40	29	20	15		
Container No.		C.36	C.40	C.42	C.39	A.31	A.32
Wt. Container + Wet Soil	g	11.05	11.16	12.21	12.45	23.10	22.80
Wt. Container + Dry Soil	g	8.22	8.21	8.80	8.95	20.88	20.66
Wt. Water	g	2.83	2.95	3.41	3.50	2.22	2.14
Wt. Container	g	4.43	4.31	4.39	4.34	13.42	13.38
Wt. Dry Soil (Ws)	g	3.79	3.90	4.41	4.61	7.46	7.28
Water Content (w)	%	74.67	75.64	77.32	75.92	29.76	29.40

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	75.84
PLASTIC LIMIT	%	29.58
PLASTICITY INDEX	%	46.26
CLASSIFICATION		CH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	4-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

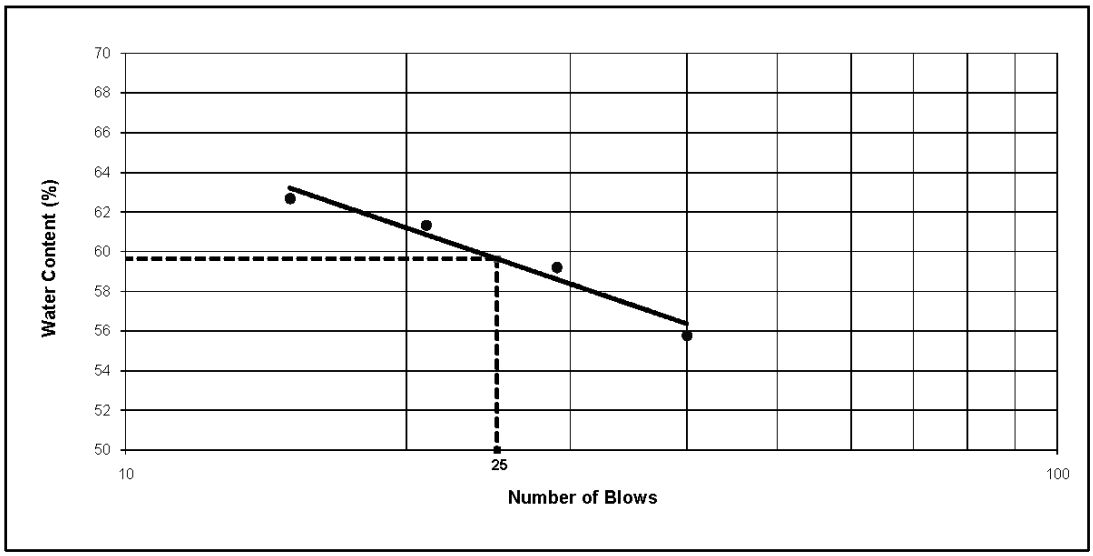
ASTM D 4318

Location : Bali
Hole No. : BH - 03
Depth : 2.50 - 3.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		40	29	21	15		
Container No.		C39	C40	C36	C37	A.15	A.16
Wt. Container + Wet Soil	g	11.35	12.19	13.53	14.21	22.08	22.69
Wt. Container + Dry Soil	g	8.84	9.26	10.07	10.43	19.74	20.23
Wt. Water	g	2.51	2.93	3.46	3.78	2.34	2.46
Wt. Container	g	4.34	4.31	4.43	4.40	12.72	12.79
Wt. Dry Soil (Ws)	g	4.50	4.95	5.64	6.03	7.02	7.44
Water Content (w)	%	55.78	59.19	61.35	62.69	33.33	33.06

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	59.65
PLASTIC LIMIT	%	33.20
PLASTICITY INDEX	%	26.45
CLASSIFICATION		MH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	4-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

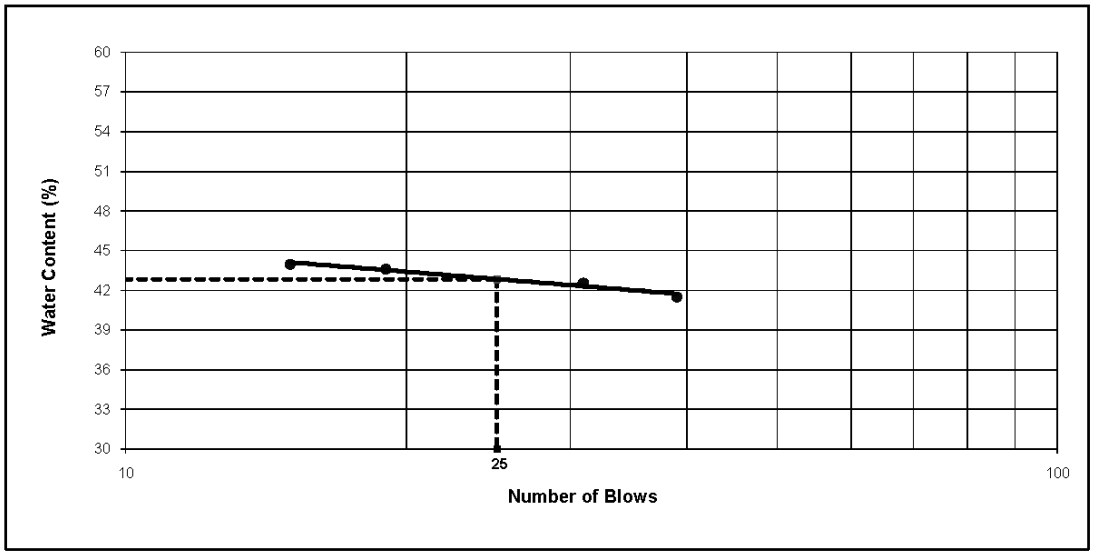
ASTM D 4318

Location : Bali
Hole No. : BH - 03
Depth : 8.50 - 9.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		39	31	19	15		
Container No.		C3	C42	C4	C22	A.29	A.30
Wt. Container + Wet Soil	g	12.70	13.50	14.29	15.60	20.64	20.00
Wt. Container + Dry Soil	g	10.25	10.78	11.28	12.16	19.00	18.47
Wt. Water	g	2.45	2.72	3.01	3.44	1.64	1.53
Wt. Container	g	4.35	4.39	4.38	4.34	12.53	12.41
Wt. Dry Soil (Ws)	g	5.90	6.39	6.90	7.82	6.47	6.06
Water Content (w)	%	41.53	42.57	43.62	43.99	25.35	25.25

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	42.85
PLASTIC LIMIT	%	25.30
PLASTICITY INDEX	%	17.55
CLASSIFICATION		CL

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

ASTM D 4318

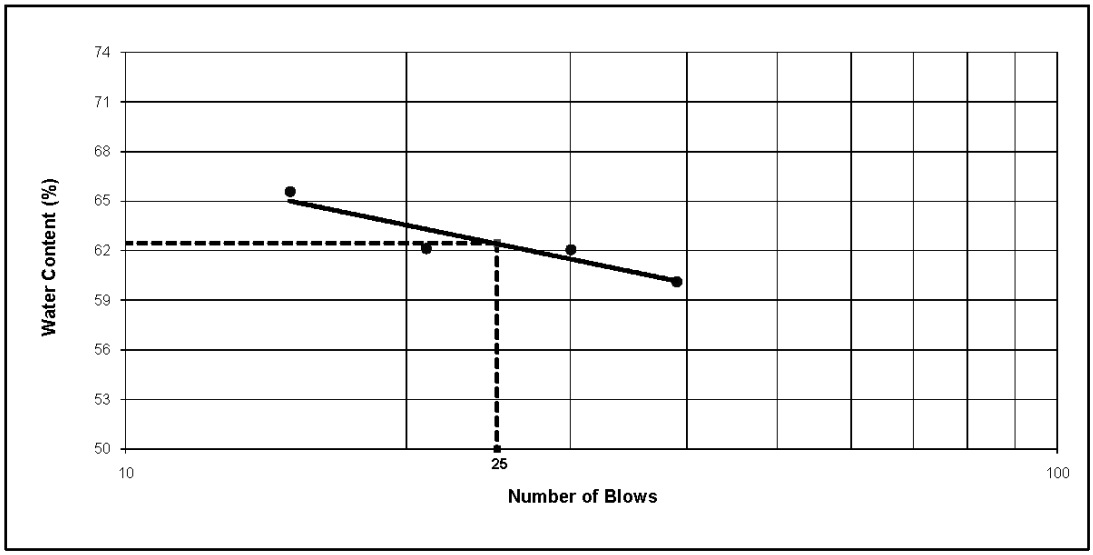
Location : Bali
Hole No. : BH - 04
Depth : 2.50 - 3.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT / **PLASTIC LIMIT**

No. of Blows		39	30	21	15		
Container No.		C.36	C.42	C.40	C.39	A.5	A.6
Wt. Container + Wet Soil	g	11.62	11.57	11.38	11.03	22.25	20.67
Wt. Container + Dry Soil	g	8.92	8.82	8.67	8.38	21.26	19.79
Wt. Water	g	2.70	2.75	2.71	2.65	0.99	0.88
Wt. Container	g	4.43	4.39	4.31	4.34	12.68	12.44
Wt. Dry Soil (Ws)	g	4.49	4.43	4.36	4.04	8.58	7.35
Water Content (w)	%	60.13	62.08	62.16	65.59	11.54	11.97

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	62.42
PLASTIC LIMIT	%	11.76
PLASTICITY INDEX	%	50.66
CLASSIFICATION		CH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

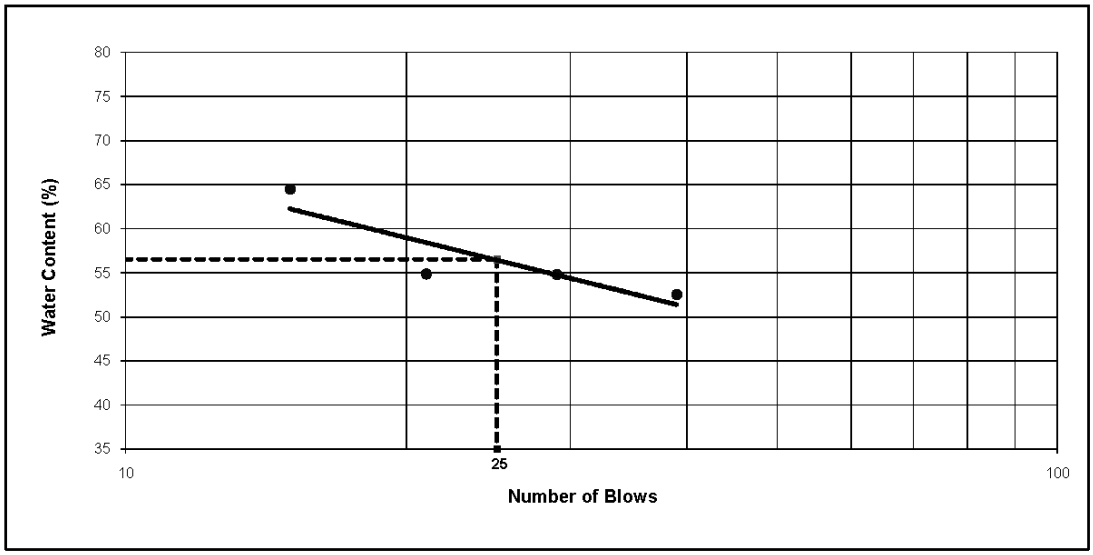
ASTM D 4318

Location : Bali
Hole No. : BH - 04
Depth : 4.50 - 5.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		39	29	21	15		
Container No.		C.32	C.14	C.15	C.21	A.27	A.28
Wt. Container + Wet Soil	g	14.49	15.67	16.07	16.15	25.07	25.74
Wt. Container + Dry Soil	g	11.01	11.65	11.96	11.53	22.02	22.75
Wt. Water	g	3.48	4.02	4.11	4.62	3.05	2.99
Wt. Container	g	4.39	4.32	4.47	4.37	12.01	12.70
Wt. Dry Soil (Ws)	g	6.62	7.33	7.49	7.16	10.01	10.05
Water Content (w)	%	52.57	54.84	54.87	64.53	30.47	29.75

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	56.55
PLASTIC LIMIT	%	30.12
PLASTICITY INDEX	%	26.43
CLASSIFICATION		MH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

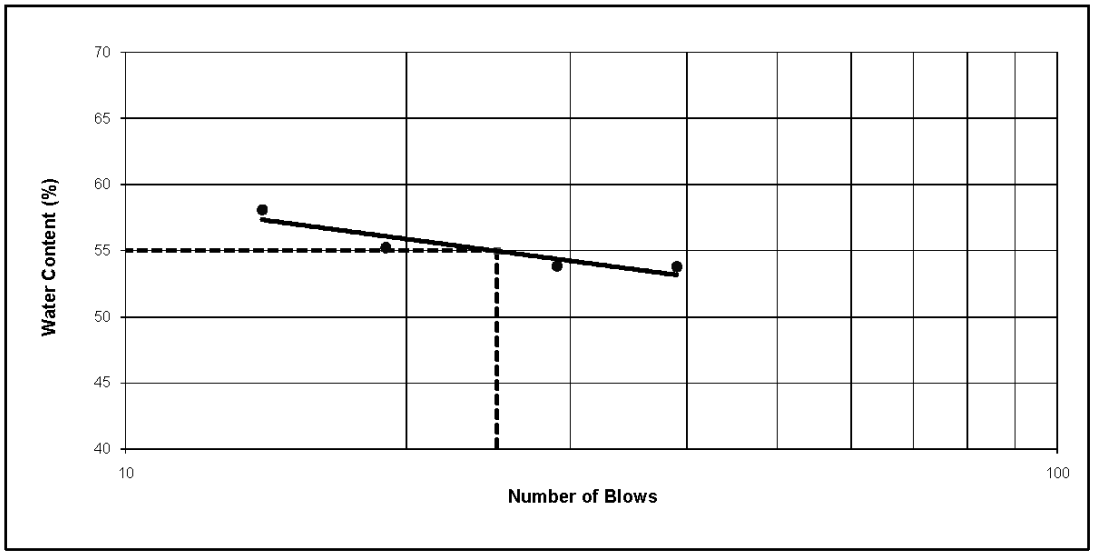
ASTM D 4318

Location : Bali
Hole No. : BH - 04
Depth : 8.50 - 9.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT						PLASTIC LIMIT	
No. of Blows		39	29	19	14		
Container No.		C.37	C.25	C.34	C.15	A.3	A.4
Wt. Container + Wet Soil	g	11.86	12.34	12.75	13.37	21.33	21.37
Wt. Container + Dry Soil	g	9.25	9.54	9.78	10.11	19.12	19.15
Wt. Water	g	2.61	2.80	2.97	3.26	2.21	2.22
Wt. Container	g	4.40	4.34	4.40	4.50	12.39	12.61
Wt. Dry Soil (Ws)	g	4.85	5.20	5.38	5.61	6.73	6.54
Water Content (w)	%	53.81	53.85	55.20	58.11	32.84	33.94

FLOW CURVE



RESULT SUMMARY

LIQUID LIMIT	%	54.99
PLASTIC LIMIT	%	33.40
PLASTICITY INDEX	%	21.59
CLASSIFICATION		MH

PT. TIGENCO GRAHA PERSADA	Project	SOIL INVESTIGATION FOR SOUTHERN BALI WATER SUPPLY SYSTEM		
	Client	NIHON SUIDOI CONSULTANT	Date	11-Aug-11
	Tested By	Ria Irmawan	Checked By	M.Iqbal, ST

ATTERBERG LIMITS

ASTM D 4318

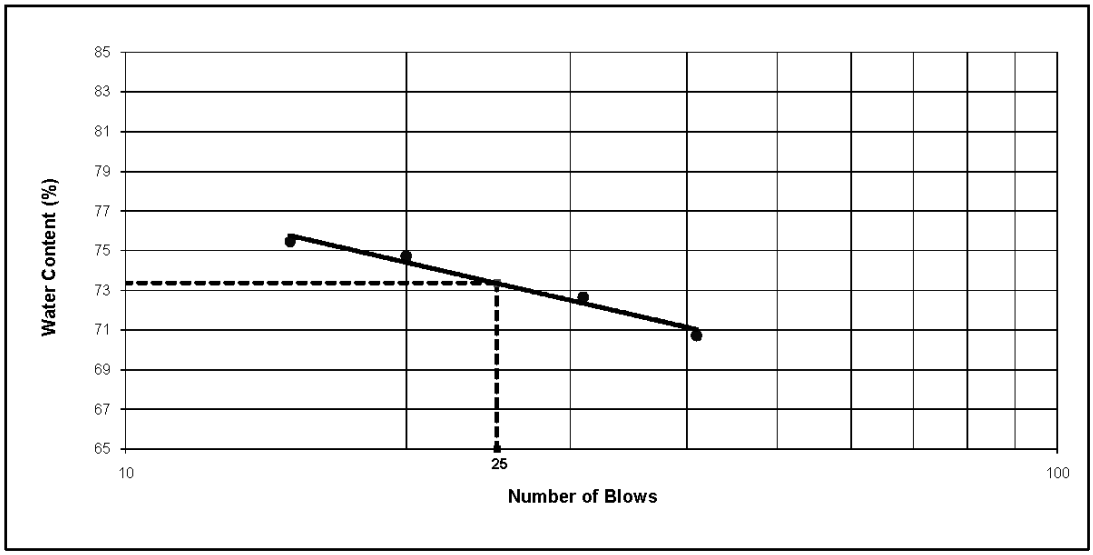
Location : Bali
Hole No. : BH - 04
Depth : 11.50 - 12.00 m

Sample No. : -
Sample Type : UDS
Soil Description : -

LIQUID LIMIT / **PLASTIC LIMIT**

No. of Blows		41	31	20	15		
Container No.		C.26	C.13	C.5	C.24	A.19	A.20
Wt. Container + Wet Soil	g	12.09	13.82	14.99	15.27	20.85	20.10
Wt. Container + Dry Soil	g	8.88	9.83	10.44	10.57	18.90	18.45
Wt. Water	g	3.21	3.99	4.55	4.70	1.95	1.65
Wt. Container	g	4.34	4.34	4.35	4.34	12.65	13.01
Wt. Dry Soil (Ws)	g	4.54	5.49	6.09	6.23	6.25	5.44
Water Content (w)	%	70.70	72.68	74.71	75.44	31.20	30.33

FLOW CURVE



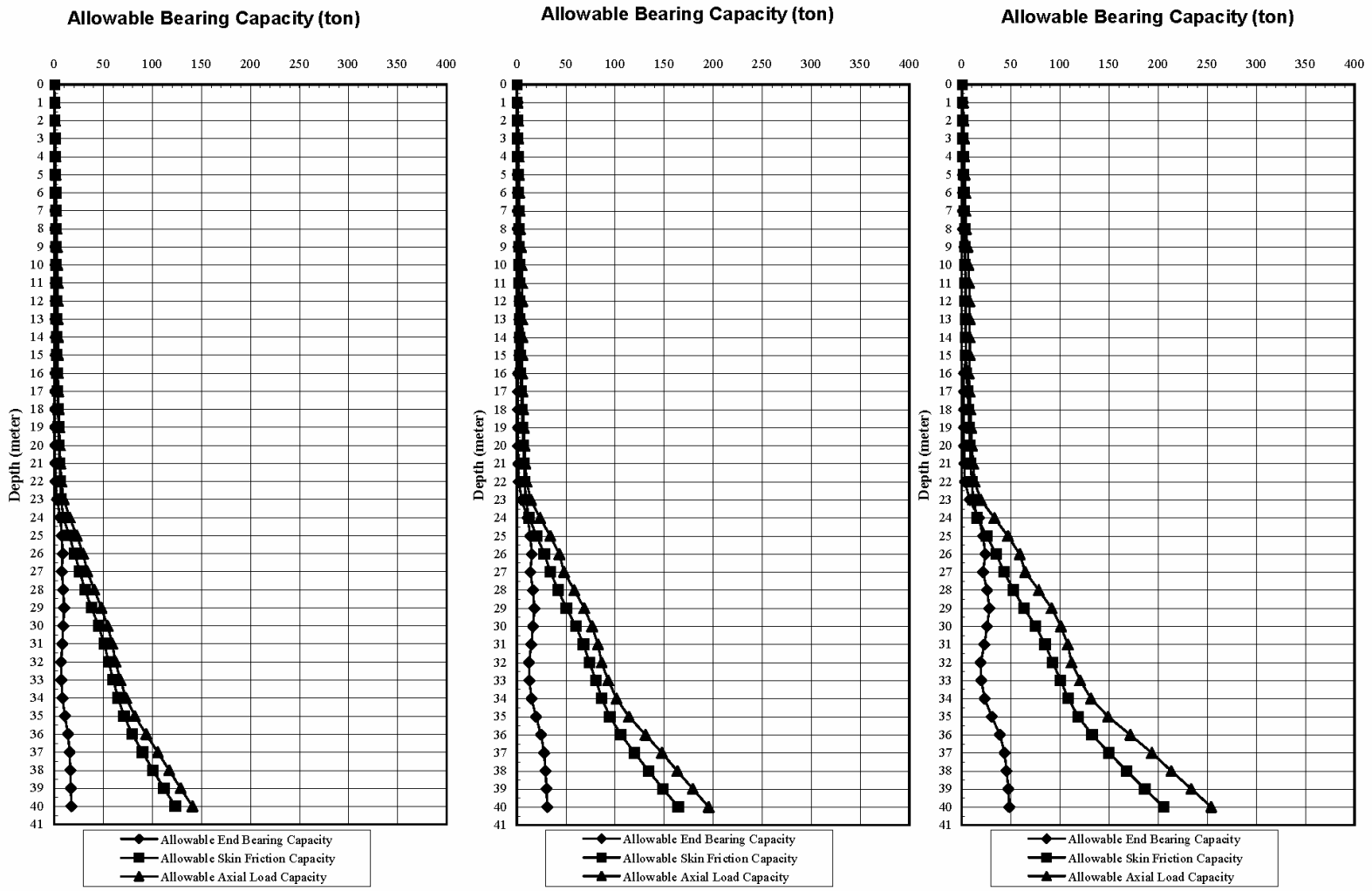
RESULT SUMMARY

LIQUID LIMIT	%	73.38
PLASTIC LIMIT	%	30.77
PLASTICITY INDEX	%	42.61
CLASSIFICATION		CH

BEARING CAPACITY

PT. TIGENCO GRAHA PERSADA

Graph 1 of Allowable Bearing Capacity of Round Driven Pile Based on N-SPT of BH1



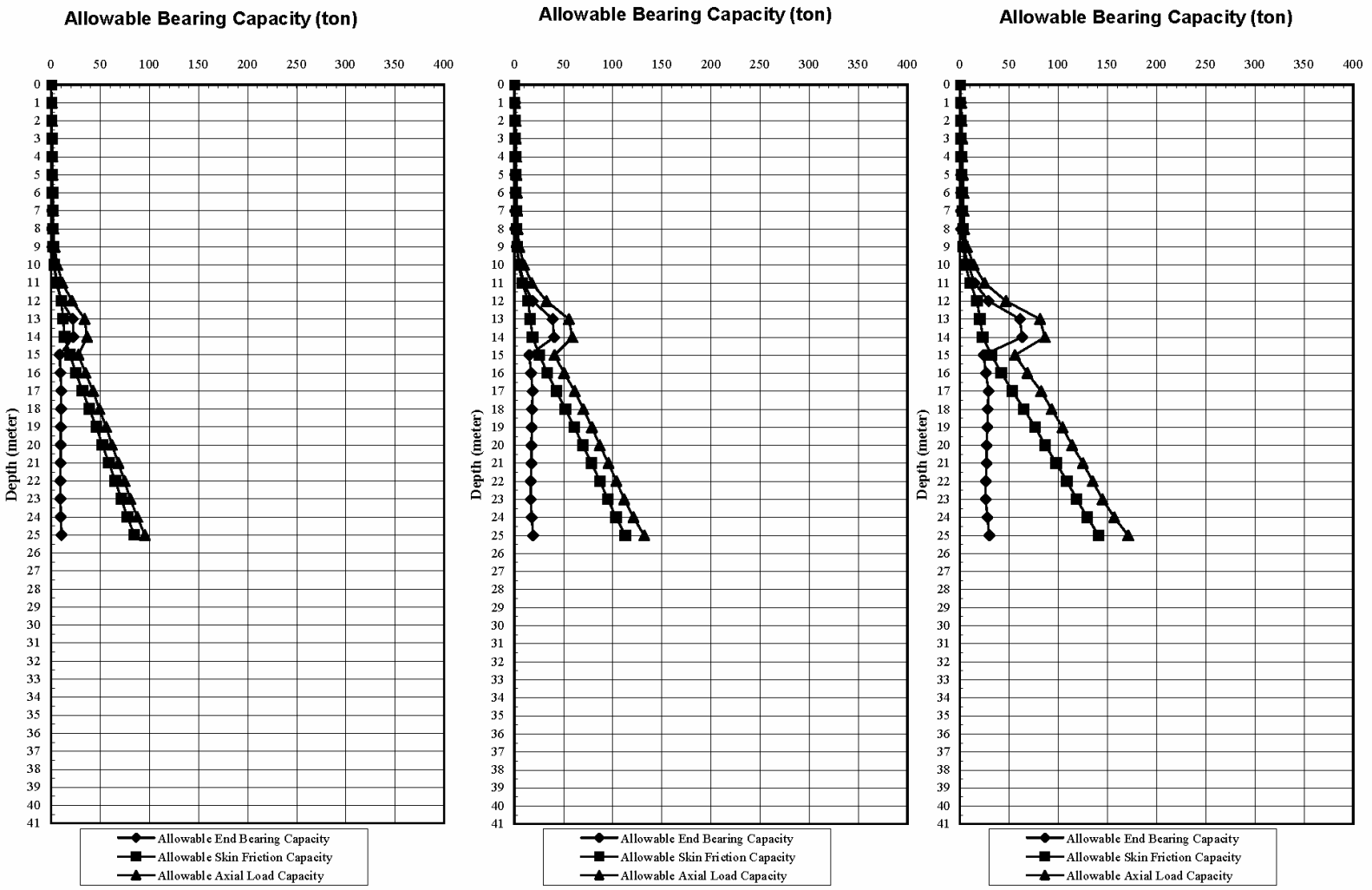
Precast
0,3 Round

Precast
Round 0,4

Precast
Round 0,5

PT. TIGENCO GRAHA PERSADA

Graph 2 of Allowable Bearing Capacity of Round Driven Pile Based on N-SPT of BH2



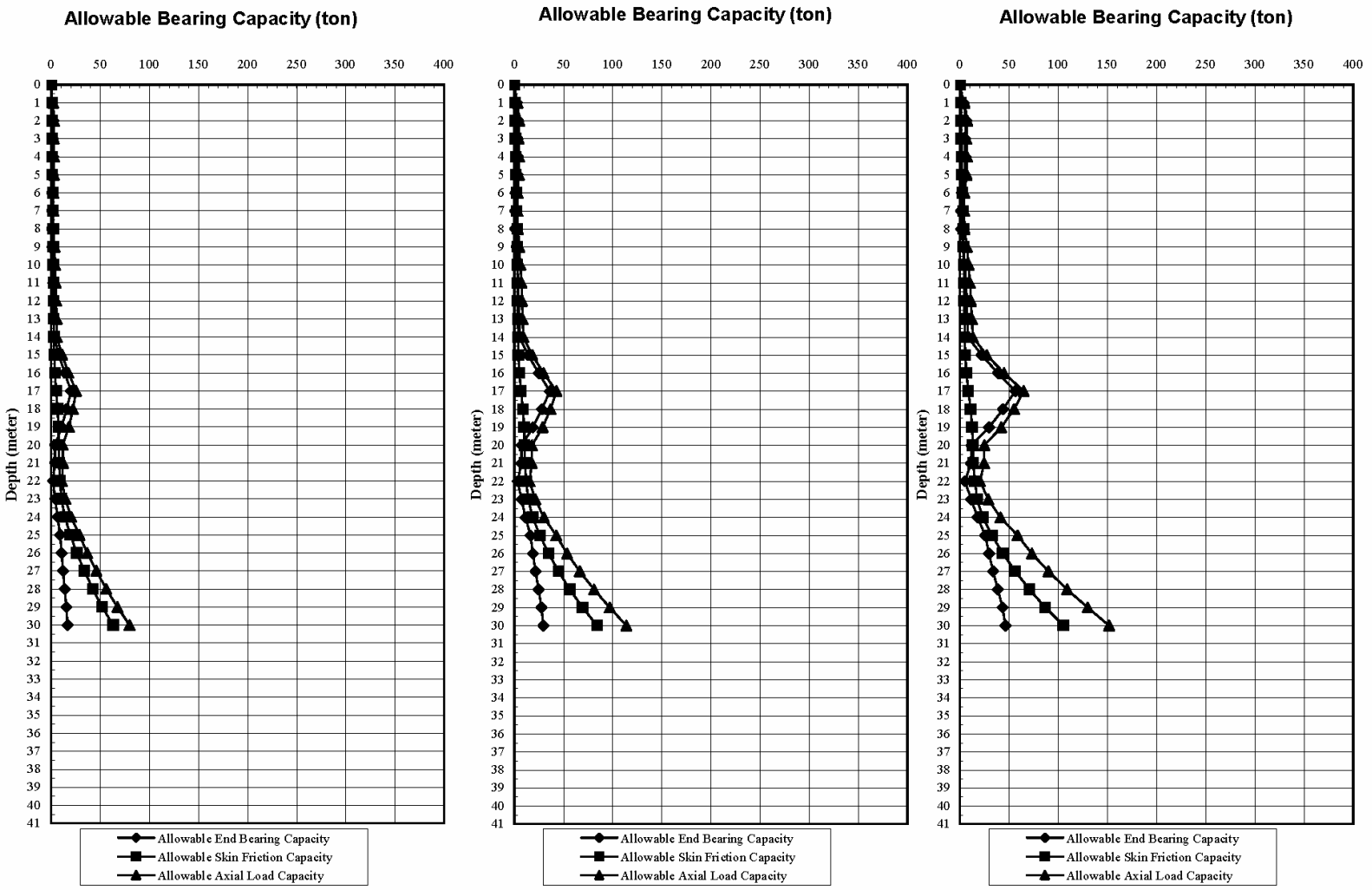
Precast Round 0,3

Precast Round 0,4

Precast Round 0,5

PT. TIGENCO GRAHA PERSADA

Graph 3 of Allowable Bearing Capacity of Round Driven Pile Based on N-SPT of BH3



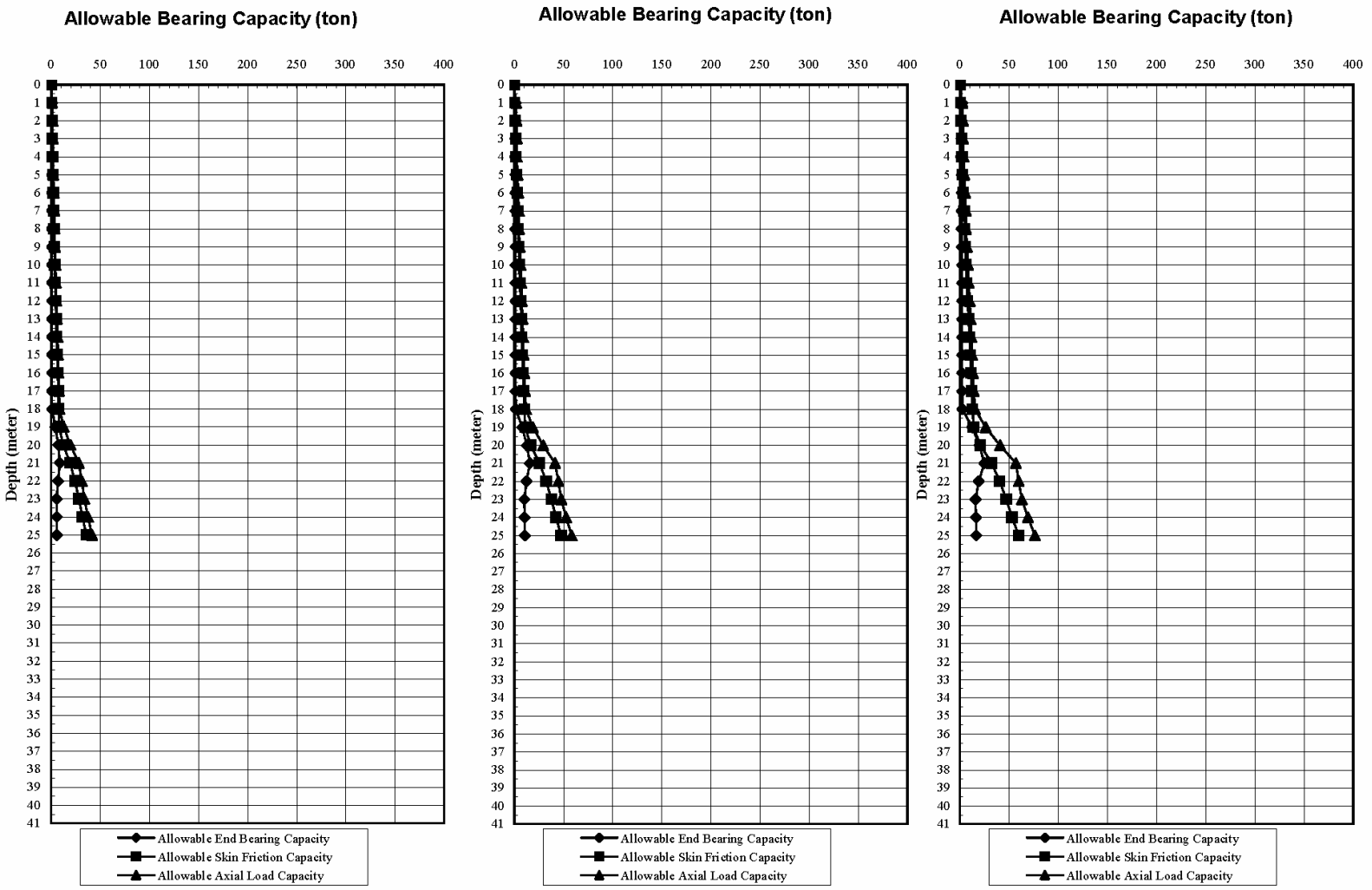
Precast 0,3 Round

Precast Round 0,4

Precast Round 0,5

PT. TIGENCO GRAHA PERSADA

Graph 4 of Allowable Bearing Capacity of Round Driven Pile Based on N-SPT of BH4



Precast Round 0,3

Precast Round 0,4

Precast Round 0,5

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	1	1	**2**	0	1	1	0	0
2	1	1	**2**	1	1	2	1	0
3	1	1	**2**	2	1	3	1	0
4	1	1	**2**	3	1	4	1	1
5	1	1	**2**	3	1	4	1	1
6	1	1	**2**	4	1	5	2	1
7	1	1	**2**	5	1	6	2	1
8	1	1	**2**	6	1	7	2	1
9	1	1	**1**	6	3	9	3	1
10	2	2	**1**	6	4	10	3	1
11	2	2	**1**	6	4	11	4	1
12	2	2	**1**	7	4	11	4	2
13	2	2	**1**	7	4	11	4	2
14	2	2	**1**	7	4	12	4	2
15	2	2	**1**	7	4	12	4	2
16	2	2	**2**	9	2	11	4	2
17	2	2	**2**	10	2	13	4	2
18	2	2	**2**	12	2	14	5	3
19	2	2	**2**	13	2	16	5	3
20	2	2	**2**	15	2	17	6	3
21	2	2	**2**	16	3	19	6	4
22	3	2	**2**	18	3	21	7	4
23	4	3	**2**	21	9	29	10	5

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	16	13	**2**	28	19	47	16	7
25	31	24	**2**	46	23	69	23	11
26	16	13	**2**	63	26	89	30	15
27	23	18	**2**	77	23	101	34	18
28	24	19	**2**	95	28	123	41	22
29	28	22	**2**	114	30	144	48	27
30	30	24	**2**	136	28	163	54	32
31	17	13	**2**	153	25	178	59	36
32	20	16	**2**	167	21	187	62	39
33	19	15	**2**	181	21	203	68	42
34	19	15	**2**	195	25	220	73	46
35	30	24	**2**	213	33	246	82	50
36	40	31	**2**	239	42	281	94	56
37	43	34	**2**	270	47	317	106	63
38	44	35	**2**	302	49	351	117	70
39	46	36	**2**	335	51	387	129	78
40	48	38	**2**	370	52	422	141	86

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	1	1	**2**	0	2	2	1	0
2	1	1	**2**	1	2	3	1	0
3	1	1	**2**	2	2	4	1	1
4	1	1	**2**	3	2	5	2	1
5	1	1	**2**	4	2	6	2	1
6	1	1	**2**	5	2	7	2	1
7	1	1	**2**	6	2	8	3	1
8	1	1	**2**	7	2	9	3	2
9	1	1	**1**	8	5	13	4	2
10	2	2	**1**	8	7	14	5	2
11	2	2	**1**	8	8	16	5	2
12	2	2	**1**	9	8	17	6	2
13	2	2	**1**	9	8	17	6	2
14	2	2	**1**	9	8	17	6	2
15	2	2	**1**	10	8	18	6	2
16	2	2	**2**	12	4	16	5	3
17	2	2	**2**	14	4	18	6	3
18	2	2	**2**	16	4	20	7	4
19	2	2	**2**	18	4	22	7	4
20	2	2	**2**	20	4	24	8	5
21	2	2	**2**	22	5	26	9	5
22	3	2	**2**	24	6	30	10	6
23	4	3	**2**	28	15	43	14	6

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	16	13	**2**	38	34	71	24	9
25	31	24	**2**	61	41	102	34	14
26	16	13	**2**	84	46	130	43	20
27	23	18	**2**	103	41	145	48	24
28	24	19	**2**	126	49	176	59	29
29	28	22	**2**	152	54	206	69	35
30	30	24	**2**	181	49	230	77	42
31	17	13	**2**	204	44	248	83	48
32	20	16	**2**	222	37	259	86	52
33	19	15	**2**	241	38	280	93	56
34	19	15	**2**	260	45	305	102	61
35	30	24	**2**	284	59	343	114	66
36	40	31	**2**	319	74	393	131	74
37	43	34	**2**	360	84	443	148	84
38	44	35	**2**	403	88	490	163	94
39	46	36	**2**	447	91	538	179	104
40	48	38	**2**	494	93	586	195	115

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	1	1	**2**	1	3	4	1	0
2	1	1	**2**	2	3	5	2	0
3	1	1	**2**	3	3	6	2	1
4	1	1	**2**	4	3	7	2	1
5	1	1	**2**	6	3	9	3	1
6	1	1	**2**	7	3	10	3	2
7	1	1	**2**	8	3	11	4	2
8	1	1	**2**	9	3	12	4	2
9	1	1	**1**	10	8	18	6	2
10	2	2	**1**	10	10	20	7	2
11	2	2	**1**	10	12	23	8	2
12	2	2	**1**	11	12	23	8	3
13	2	2	**1**	11	12	24	8	3
14	2	2	**1**	12	12	24	8	3
15	2	2	**1**	12	12	25	8	3
16	2	2	**2**	15	6	21	7	3
17	2	2	**2**	17	6	23	8	4
18	2	2	**2**	20	6	26	9	5
19	2	2	**2**	22	6	28	9	5
20	2	2	**2**	25	6	31	10	6
21	2	2	**2**	27	7	34	11	6
22	3	2	**2**	30	9	39	13	7
23	4	3	**2**	35	24	58	19	8

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **40,45** m — BOREHOLE BH1

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	16	13	**2**	47	52	99	33	11
25	31	24	**2**	76	65	141	47	18
26	16	13	**2**	105	72	177	59	24
27	23	18	**2**	129	65	194	65	30
28	24	19	**2**	158	77	235	78	37
29	28	22	**2**	190	84	274	91	44
30	30	24	**2**	226	77	303	101	53
31	17	13	**2**	255	69	324	108	59
32	20	16	**2**	278	58	335	112	65
33	19	15	**2**	302	60	361	120	70
34	19	15	**2**	325	70	395	132	76
35	30	24	**2**	355	92	447	149	83
36	40	31	**2**	399	116	515	172	93
37	43	34	**2**	450	131	580	193	105
38	44	35	**2**	504	137	640	213	117
39	46	36	**2**	559	142	701	234	130
40	48	38	**2**	617	145	762	254	144

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH2

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	1	1	**2**	0	1	1	0	0
2	1	1	**2**	1	1	2	1	0
3	1	1	**2**	2	1	3	1	0
4	1	1	**2**	3	1	4	1	1
5	1	1	**2**	3	1	4	1	1
6	1	1	**2**	4	1	5	2	1
7	1	1	**2**	5	1	6	2	1
8	1	1	**2**	6	1	7	2	1
9	1	1	**2**	6	4	10	3	1
10	8	6	**2**	10	9	19	6	2
11	16	13	**2**	19	16	34	11	4
12	19	15	**2**	31	31	63	21	7
13	50	39	**1**	37	66	102	34	9
14	20	16	**1**	42	68	110	37	10
15	22	17	**2**	57	26	83	28	13
16	28	22	**2**	76	29	104	35	18
17	27	21	**2**	96	31	128	43	22
18	30	24	**2**	117	30	148	49	27
19	25	20	**2**	138	30	168	56	32
20	26	20	**2**	157	29	186	62	37
21	28	22	**2**	177	29	206	69	41
22	25	20	**2**	196	28	224	75	46
23	23	18	**2**	214	28	242	81	50
24	28	22	**2**	233	30	263	88	54
25	30	24	**2**	254	32	287	96	59

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH2

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	1	1	**2**	0	2	2	1	0
2	1	1	**2**	1	2	3	1	0
3	1	1	**2**	2	2	4	1	1
4	1	1	**2**	3	2	5	2	1
5	1	1	**2**	4	2	6	2	1
6	1	1	**2**	5	2	7	2	1
7	1	1	**2**	6	2	8	3	1
8	1	1	**2**	7	2	9	3	2
9	1	1	**2**	8	7	15	5	2
10	8	6	**2**	13	16	29	10	3
11	16	13	**2**	25	28	53	18	6
12	19	15	**2**	42	56	98	33	10
13	50	39	**1**	49	117	166	55	11
14	20	16	**1**	56	121	177	59	13
15	22	17	**2**	76	46	122	41	18
16	28	22	**2**	101	51	152	51	24
17	27	21	**2**	128	56	184	61	30
18	30	24	**2**	156	54	210	70	36
19	25	20	**2**	184	53	237	79	43
20	26	20	**2**	209	52	261	87	49
21	28	22	**2**	235	52	287	96	55
22	25	20	**2**	262	50	312	104	61
23	23	18	**2**	285	50	335	112	67
24	28	22	**2**	310	53	364	121	72
25	30	24	**2**	339	57	396	132	79

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH2

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		2					0
1	1	1	2	1	3	4	1	0
2	1	1	2	2	3	5	2	0
3	1	1	2	3	3	6	2	1
4	1	1	2	4	3	7	2	1
5	1	1	2	6	3	9	3	1
6	1	1	2	7	3	10	3	2
7	1	1	2	8	3	11	4	2
8	1	1	2	9	3	12	4	2
9	1	1	2	10	10	21	7	2
10	8	6	2	16	26	42	14	4
11	16	13	2	31	44	75	25	7
12	19	15	2	52	87	140	47	12
13	50	39	1	61	183	244	81	14
14	20	16	1	70	189	259	86	16
15	22	17	2	96	72	168	56	22
16	28	22	2	126	79	206	69	29
17	27	21	2	160	87	248	83	37
18	30	24	2	195	84	280	93	46
19	25	20	2	229	83	313	104	54
20	26	20	2	261	81	342	114	61
21	28	22	2	294	81	375	125	69
22	25	20	2	327	78	405	135	76
23	23	18	2	357	78	435	145	83
24	28	22	2	388	83	471	157	91
25	30	24	2	424	89	513	171	99

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	5	4	**2**	2	4	6	2	0
2	2	2	**1**	2	7	9	3	1
3	2	2	**1**	3	5	8	3	1
4	3	2	**1**	3	6	9	3	1
5	3	2	**1**	3	5	9	3	1
6	1	1	**2**	5	2	7	2	1
7	1	1	**2**	6	1	7	2	1
8	1	1	**2**	6	1	8	3	2
9	1	1	**1**	7	4	10	3	2
10	3	2	**1**	7	5	12	4	2
11	3	2	**1**	7	7	14	5	2
12	3	2	**1**	8	7	15	5	2
13	4	3	**1**	8	8	16	5	2
14	4	3	**1**	9	9	18	6	2
15	4	3	**1**	9	24	33	11	2
16	24	19	**1**	12	41	53	18	3
17	28	22	**1**	15	61	76	25	4
18	30	24	**1**	20	47	67	22	5
19	6	5	**1**	22	32	54	18	5
20	7	6	**1**	23	13	36	12	5
21	4	3	**1**	24	12	36	12	6
22	5	4	**2**	27	6	33	11	6
23	6	5	**2**	32	12	44	15	7

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	22	17	**2**	42	19	61	20	10
25	24	19	**2**	59	28	87	29	14
26	29	23	**2**	79	32	110	37	18
27	33	26	**2**	102	36	138	46	24
28	36	28	**2**	127	41	169	56	30
29	43	34	**2**	156	47	203	68	36
30	47	37	**2**	190	50	240	80	44

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	5	4	**2**	2	7	9	3	1
2	2	2	**1**	3	12	15	5	1
3	2	2	**1**	4	9	13	4	1
4	3	2	**1**	4	11	15	5	1
5	3	2	**1**	5	9	14	5	1
6	1	1	**2**	7	3	10	3	2
7	1	1	**2**	8	2	10	3	2
8	1	1	**2**	9	2	11	4	2
9	1	1	**1**	9	7	15	5	2
10	3	2	**1**	9	9	18	6	2
11	3	2	**1**	10	12	22	7	2
12	3	2	**1**	10	13	24	8	2
13	4	3	**1**	11	14	26	9	3
14	4	3	**1**	12	16	28	9	3
15	4	3	**1**	13	42	55	18	3
16	24	19	**1**	15	74	89	30	4
17	28	22	**1**	21	108	128	43	5
18	30	24	**1**	26	84	111	37	6
19	6	5	**1**	30	57	86	29	7
20	7	6	**1**	31	22	53	18	7
21	4	3	**1**	32	21	53	18	8
22	5	4	**2**	37	10	47	16	9
23	6	5	**2**	42	22	64	21	10

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	22	17	**2**	56	34	90	30	13
25	24	19	**2**	79	49	128	43	18
26	29	23	**2**	105	57	161	54	24
27	33	26	**2**	135	65	200	67	32
28	36	28	**2**	169	74	243	81	40
29	43	34	**2**	208	83	291	97	49
30	47	37	**2**	253	89	342	114	59

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	5	4	**2**	3	11	14	5	1
2	2	2	**1**	4	19	22	7	1
3	2	2	**1**	4	14	19	6	1
4	3	2	**1**	5	16	22	7	1
5	3	2	**1**	6	14	20	7	1
6	1	1	**2**	8	5	13	4	2
7	1	1	**2**	10	3	13	4	2
8	1	1	**2**	11	3	14	5	3
9	1	1	**1**	11	10	21	7	3
10	3	2	**1**	11	14	26	9	3
11	3	2	**1**	12	19	31	10	3
12	3	2	**1**	13	21	34	11	3
13	4	3	**1**	14	23	36	12	3
14	4	3	**1**	15	25	39	13	3
15	4	3	**1**	16	66	82	27	4
16	24	19	**1**	19	115	134	45	4
17	28	22	**1**	26	169	194	65	6
18	30	24	**1**	33	132	164	55	8
19	6	5	**1**	37	88	126	42	9
20	7	6	**1**	39	35	74	25	9
21	4	3	**1**	40	33	73	24	9
22	5	4	**2**	46	15	61	20	11
23	6	5	**2**	53	34	87	29	12

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **30,45** m — BOREHOLE BH3

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
24	22	17	**2**	70	53	123	41	16
25	24	19	**2**	98	77	175	58	23
26	29	23	**2**	131	88	219	73	31
27	33	26	**2**	169	101	270	90	39
28	36	28	**2**	212	115	327	109	49
29	43	34	**2**	261	130	390	130	61
30	47	37	**2**	316	139	455	152	74

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,0707 m2

Dimension **0,30** m — Perimeter 0,942477796 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH4

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	2	2	**2**	1	2	3	1	0
2	2	2	**2**	2	2	4	1	1
3	1	1	**2**	3	1	5	2	1
4	1	1	**2**	4	1	5	2	1
5	1	1	**2**	5	2	7	2	1
6	3	2	**2**	6	2	8	3	1
7	1	1	**2**	8	2	10	3	2
8	1	1	**2**	9	1	10	3	2
9	2	2	**2**	10	2	11	4	2
10	2	2	**2**	11	2	13	4	3
11	2	2	**2**	13	2	15	5	3
12	2	2	**2**	14	2	16	5	3
13	2	2	**2**	16	2	18	6	4
14	2	2	**2**	17	2	19	6	4
15	2	2	**2**	19	2	21	7	4
16	2	2	**2**	20	2	22	7	5
17	2	2	**2**	21	2	24	8	5
18	2	2	**2**	23	3	26	9	5
19	3	2	**2**	25	13	38	13	6
20	31	24	**2**	37	21	59	20	9
21	24	19	**2**	58	27	84	28	13
22	17	13	**2**	73	21	94	31	17
23	15	12	**2**	85	17	102	34	20
24	14	11	**2**	96	17	113	38	22
25	18	14	**2**	107	18	125	42	25

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1257 m2

Dimension **0,40** m — Perimeter 1,256637061 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH4

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	2	2	**2**	1	4	5	2	0
2	2	2	**2**	3	3	6	2	1
3	1	1	**2**	4	3	7	2	1
4	1	1	**2**	5	2	7	2	1
5	1	1	**2**	6	3	10	3	1
6	3	2	**2**	8	3	12	4	2
7	1	1	**2**	10	3	14	5	2
8	1	1	**2**	11	3	14	5	3
9	2	2	**2**	13	3	16	5	3
10	2	2	**2**	15	4	19	6	3
11	2	2	**2**	17	4	21	7	4
12	2	2	**2**	19	4	23	8	4
13	2	2	**2**	21	4	25	8	5
14	2	2	**2**	23	4	27	9	5
15	2	2	**2**	25	4	29	10	6
16	2	2	**2**	27	4	31	10	6
17	2	2	**2**	29	4	33	11	7
18	2	2	**2**	31	5	35	12	7
19	3	2	**2**	33	24	57	19	8
20	31	24	**2**	50	38	88	29	12
21	24	19	**2**	77	47	124	41	18
22	17	13	**2**	97	37	134	45	23
23	15	12	**2**	113	30	143	48	26
24	14	11	**2**	127	31	158	53	30
25	18	14	**2**	143	32	175	58	33

PILE CAPACITY CALCULATION FOR DRIVEN PILE (MEYERHOFF'S FORMULA)

PILE INFORMATION

Length : **15** m

Pile type **Precast** Round — Area 0,1963 m2

Dimension **0,50** m — Perimeter 1,571 m

SOIL INFORMATION

DEPTH OF SOIL DATA : **25,45** m — BOREHOLE BH4

SPT INTERVAL **1** m

note : *soil type* *clay, silty clay (CH/CL), clayey silt (MH) = 2*
sand (SP/SW), silty sand (SM), sandy silt (ML) = 1

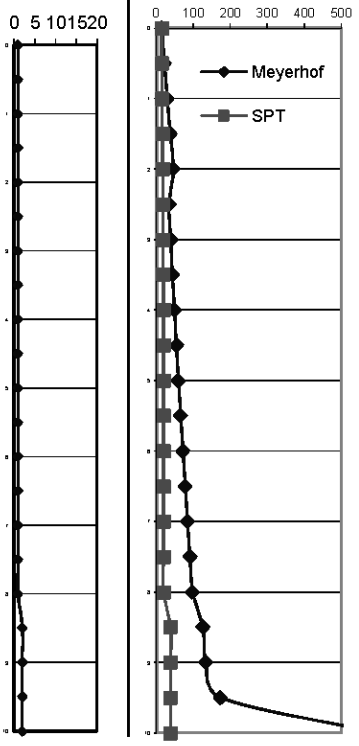
depth m	NSPT	Corrected NSPT N70 --> N55	soil type	Pf ton	Pb ton	ultimate capacity Pf+Pb ton	allowable capacity Pa SF=3 ton	remarks Pullout Sf=3
0	0		**2**					0
1	2	2	**2**	1	6	7	2	0
2	2	2	**2**	4	5	9	3	1
3	1	1	**2**	6	4	10	3	1
4	1	1	**2**	7	3	10	3	2
5	1	1	**2**	8	5	13	4	2
6	3	2	**2**	10	5	16	5	2
7	1	1	**2**	13	5	18	6	3
8	1	1	**2**	14	4	18	6	3
9	2	2	**2**	16	5	21	7	4
10	2	2	**2**	19	6	25	8	4
11	2	2	**2**	21	6	27	9	5
12	2	2	**2**	23	6	30	10	5
13	2	2	**2**	26	6	32	11	6
14	2	2	**2**	28	6	35	12	7
15	2	2	**2**	31	6	37	12	7
16	2	2	**2**	33	6	39	13	8
17	2	2	**2**	36	6	42	14	8
18	2	2	**2**	38	7	45	15	9
19	3	2	**2**	41	37	78	26	10
20	31	24	**2**	62	60	122	41	15
21	24	19	**2**	96	74	170	57	22
22	17	13	**2**	122	58	179	60	28
23	15	12	**2**	141	47	189	63	33
24	14	11	**2**	159	48	208	69	37
25	18	14	**2**	179	49	228	76	42

SHALLOW BEARING

CALCULATION OF SOIL BEARING CAPACITY SHALLOW FOUNDATION

Project	Southern Bali Water Supply System	**Made By**	Andrianto
Client	NIHON SUIDO CONSULTANT	Undrained shear strength and friction	
Borehole Number	BH-1	angle is obtained from lab tests.	
Method	Meyerhoff (1963, SPT 1974)	Unit weight value also taken from lab	
Width of Foundation (B)	4 m	All values subject to engineer judgement	

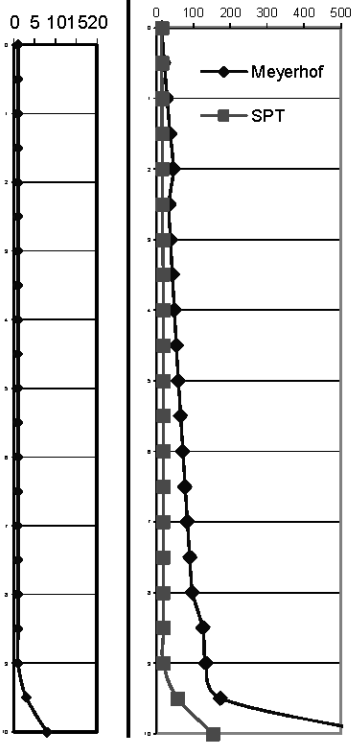
Depth	SPT Value (Weighed)	c_u	ϕ	Soil Symbol	γ'	q ultimate (Meyerhoff 1963)	q allowable (Meyerhoff 1963) (SF=3)	qa Value (kPa) -SPT (Meyerhoff 1974)	SPT N Value (N55)	Allowable Bearing Capacity (kPa)
(m)	(N55)	(kPa)			(kPa)	(kPa)	(kPa)	(kPa)		
0	1	5	6	SOFT CLAY	16	43	14	14.45		
0.5	1	5	6		16	64	21	15.04		
1	1	5	6		16	87	29	15.64		
1.5	1	5	6		16	112	37	16.23		
2	1	5	6		16	138	46	16.83		
2.5	1	5	6		6	103	34	17.42		
3	1	5	6		6	117	39	18.02		
3.5	1	5	6		6	132	44	18.62		
4	1	5	6		6	148	49	19.21		
4.5	1	5	6		6	164	55	19.21		
5	1	5	6		6	180	60	19.21		
5.5	1	5	6		6	197	66	19.21		
6	1	5	6		6	215	72	19.21		
6.5	1	5	6		6	234	78	19.21		
7	1	5	6		6	253	84	19.21		
7.5	1	5	6		6	273	91	19.21		
8	1	5	6		6	293	98	19.21		
8.5	2	5	8		6	377	126	38.42		
9	2	5	8		6	404	135	38.42		
9.5	2	8	8		6	522	174	38.42		
10	2	8	20		6	1792	597	38.42		



CALCULATION OF SOIL BEARING CAPACITY SHALLOW FOUNDATION

Project	Southern Bali Water Supply System	**Made By**	Andrianto
Client	NIHON SUIDO CONSULTANT	Undrained shear strength and friction	
Borehole Number	BH-2	angle is obtained from lab tests.	
Method	Meyerhoff (1963, SPT 1974)	Unit weight value also taken from lab	
Width of Foundation (B)	4 m	All values subject to engineer judgement	

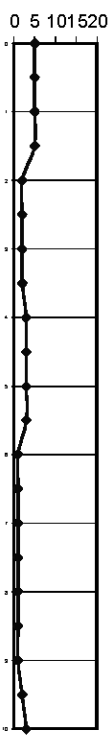
Depth	SPT Value (Weighed)	c_u	ϕ	Soil Symbol	γ'	q ultimate (Meyerhoff 1963)	q allowable (Meyerhoff 1963) (SF=3)	qa Value (kPa) -SPT (Meyerhoff 1974)	SPT N Value (N55)	Allowable Bearing Capacity (kPa)
(m)	(N55)	(kPa)			(kPa)	(kPa)	(kPa)	(kPa)		
0	1	5	6	SOFT CLAY	16	43	14	14.45		
0.5	1	5	6		16	64	21	15.04		
1	1	5	6		16	87	29	15.64		
1.5	1	5	6		16	112	37	16.23		
2	1	5	6		16	138	46	16.83		
2.5	1	5	6		6	103	34	17.42		
3	1	5	6		6	117	39	18.02		
3.5	1	5	6		6	132	44	18.62		
4	1	5	6		6	148	49	19.21		
4.5	1	5	6		6	164	55	19.21		
5	1	5	6		6	180	60	19.21		
5.5	1	5	6		6	197	66	19.21		
6	1	5	6		6	215	72	19.21		
6.5	1	5	6		6	234	78	19.21		
7	1	5	6		6	253	84	19.21		
7.5	1	5	6		6	273	91	19.21		
8	1	5	6		6	293	98	19.21		
8.5	1	5	8		6	377	126	19.21		
9	1	5	8		6	404	135	19.21		
9.5	3	8	8		6	522	174	57.64		
10	8	8	20		6	1792	597	153.70		

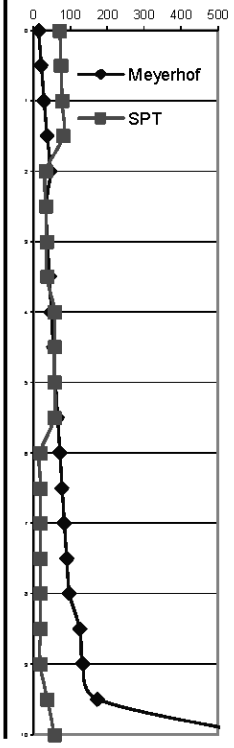


CALCULATION OF SOIL BEARING CAPACITY SHALLOW FOUNDATION

Project	Southern Bali Water Supply System	**Made By**	Andrianto
Client	NIHON SUIDO CONSULTANT	Undrained shear strength and friction	
Borehole Number	BH-3	angle is obtained from lab tests.	
Method	Meyerhoff (1963, SPT 1974)	Unit weight value also taken from lab	
Width of Foundation (B)	4 m	All values subject to engineer judgement	

Depth	SPT Value (Weighed)	c_u	ϕ	Soil Symbol	γ'	q ultimate (Meyerhoff 1963)	q allowable (Meyerhoff 1963) (SF=3)	qa Value (kPa) -SPT (Meyerhoff 1974)	SPT N Value (N55)	Allowable Bearing Capacity (kPa)
(m)	(N55)	(kPa)			(kPa)	(kPa)	(kPa)	(kPa)		
0	5	5	6	FILL	16	43	14	72.23		
0.5	5	5	6		16	64	21	75.21		
1	5	5	6		16	87	29	78.19		
1.5	5	5	6		16	112	37	81.16		
2	2	5	6	SILTY CLAY WITH CORAL	16	138	46	33.66		
2.5	2	5	6		6	103	34	34.85		
3	2	5	6		6	117	39	36.04		
3.5	2	5	6		6	132	44	37.23		
4	3	5	6		6	148	49	57.64		
4.5	3	5	6		6	164	55	57.64		
5	3	5	6		6	180	60	57.64		
5.5	3	5	6		6	197	66	57.64		
6	1	5	6		6	215	72	19.21		
6.5	1	5	6		6	234	78	19.21		
7	1	5	6		6	253	84	19.21		
7.5	1	5	6		6	273	91	19.21		
8	1	5	6		6	293	98	19.21		
8.5	1	5	8		6	377	126	19.21		
9	1	5	8		6	404	135	19.21		
9.5	2	8	8		6	522	174	38.42		
10	3	8	20		6	1792	597	57.64		

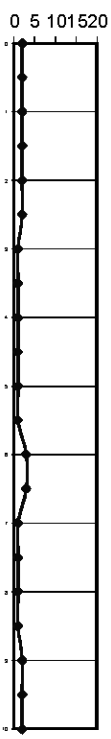


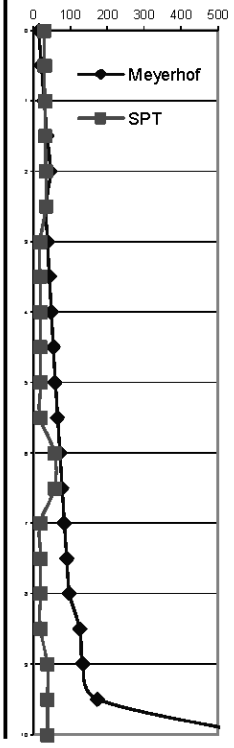


CALCULATION OF SOIL BEARING CAPACITY SHALLOW FOUNDATION

Project	Southern Bali Water Supply System	**Made By**	Andrianto
Client	NIHON SUIDO CONSULTANT	Undrained shear strength and friction	
Borehole Number	BH-4	angle is obtained from lab tests.	
Method	Meyerhoff (1963, SPT 1974)	Unit weight value also taken from lab	
Width of Foundation (B)	4 m	All values subject to engineer judgement	

Depth	SPT Value (Weighed)	c_u	ϕ	Soil Symbol	γ'	q ultimate (Meyerhoff 1963)	q allowable (Meyerhoff 1963) (SF=3)	qa Value (kPa) -SPT (Meyerhoff 1974)	SPT N Value (N55)	Allowable Bearing Capacity (kPa)
(m)	(N55)	(kPa)			(kPa)	(kPa)	(kPa)	(kPa)		
0	2	5	6	FILL	16	43	14	28.89		
0.5	2	5	6		16	64	21	30.08		
1	2	5	6		16	87	29	31.27		
1.5	2	5	6		16	112	37	32.47		
2	2	5	6	SILTY CLAY WITH CORAL	16	138	46	33.66		
2.5	2	5	6		6	103	34	34.85		
3	1	5	6		6	117	39	18.02		
3.5	1	5	6		6	132	44	18.62		
4	1	5	6		6	148	49	19.21		
4.5	1	5	6		6	164	55	19.21		
5	1	5	6		6	180	60	19.21		
5.5	1	5	6		6	197	66	19.21		
6	3	5	6		6	215	72	57.64		
6.5	3	5	6		6	234	78	57.64		
7	1	5	6		6	253	84	19.21		
7.5	1	5	6		6	273	91	19.21		
8	1	5	6		6	293	98	19.21		
8.5	1	5	8		6	377	126	19.21		
9	2	5	8		6	404	135	38.42		
9.5	2	8	8		6	522	174	38.42		
10	2	8	20		6	1792	597	38.42		





付属資料 5

再生水処理施設概略設計資料

付属資料5　　再生水処理施設概略設計資料

5.a　再生水施設容量計算書（バリ）

項目	ケース1	ケース2
1.設計条件		
1-1 プラント概要		
(1) プラント面積		
(2) 基準高さ		
(3) 方式		
(4) 処理方法		
1-2 設計水量		
最大再生水水量	4500m^3/日	9000m^3/日
各過程処理水量		
原水水量	5900m^3/日	11800m^3/日
生物膜ろ過処理水量	5900m^3/日	11800m^3/日
オゾン反応槽処理水量	4800m^3/日	9600m^3/日
セラミック膜ろ過処理水量	4800m^3/日	9600m^3/日
再生水水量	4800m^3/日	9600m^3/日
1-3 系統数	2系統	2系統
2.原水		
2-1 原水槽		
原水水量	= 5900m^3/日	= 11800m^3/日
滞留時間	= 5分	= 5分
必要容量	= 5900m^3/日 / 1440分/日 X 5分 ≒ 20.5m^3	= 11800m^3/日 / 1440分/日 X 5分 ≒ 41m^3
系統数	= 1系統	= 2系統
槽数	= 1槽	= 1槽
1槽あたり必要容量	= 20.5 / 1 / 1 = 20.5m^3	= 41 / 2 / 1 = 20.5m^3
長さ	= 3.3 m	= 3.3 m
幅	= 2.5 m	= 2.5 m
水深	= 2.5 m	= 2.5 m
原水容量	= 3.3 X 2.5 X 2.5 = 20.625m^3/1系統	= 3.3 X 2.5 X 2.5 = 20.625m^3/1系統
槽数	= 2槽	= 2槽
生物膜ろ過送水ポンプ		
総吐出量	= 5900m^3/日 / 1440min/日 ≒ 4.1m^3/分	= 11800m^3/日 / 1440min/日 ≒ 8.2m^3/分
系統数	= 1系統	= 2系統
1系統あたり吐出量	= 4.1 / 1 = 4.1m^3/分	= 8.2 / 2 = 4.1m^3/分
ポンプ台数	= 2台（内予備1台）	= 3台（内予備1台）

項目	ケース1	ケース2
3.生物膜ろ過		
3-1 生物膜ろ過槽		
生物膜ろ過処理水量	= 5900m^3/日	= 11800m^3/日
ろ過速度	= 40m/日	= 40m/日
必要面積	= 5900m^3/日 / 40m/日 = 148m^2	= 11800m^3/日 / 40m/日 = 295m^2
系統数	= 1系統	= 2系統
槽数	= 4槽	= 4槽
1槽あたり必要面積	= 148 / 1 / 4 = 37.0m^2	= 295 / 2 / 4 = 36.9m^2
長さ	= 6.1 m	= 6.1 m
幅	= 6.1 m	= 6.1 m
生物膜ろ過処理面積	= 6.1 X 6.1 = 37.21m^2	= 6.1 X 6.1 = 37.21m^2
槽数	= 4槽	= 8槽
生物膜ろ過逆洗ポンプ		
生物膜ろ過処理面積	= 37.21m^2	= 37.21m^2
逆洗速度	= 0.45m^3/m^2・分	= 0.45m^3/m^2・分
1槽あたり吐出量	= 37.21 X 0.45 ≒ 16.8m^3/分	= 37.21 X 0.45 ≒ 16.8m^3/分
系統数	= 1系統	= 2系統
1系統あたりの必要台数	= 1台	= 1台
ポンプ台数	= 2台 （内予備1台）	= 3台 （内予備1台）

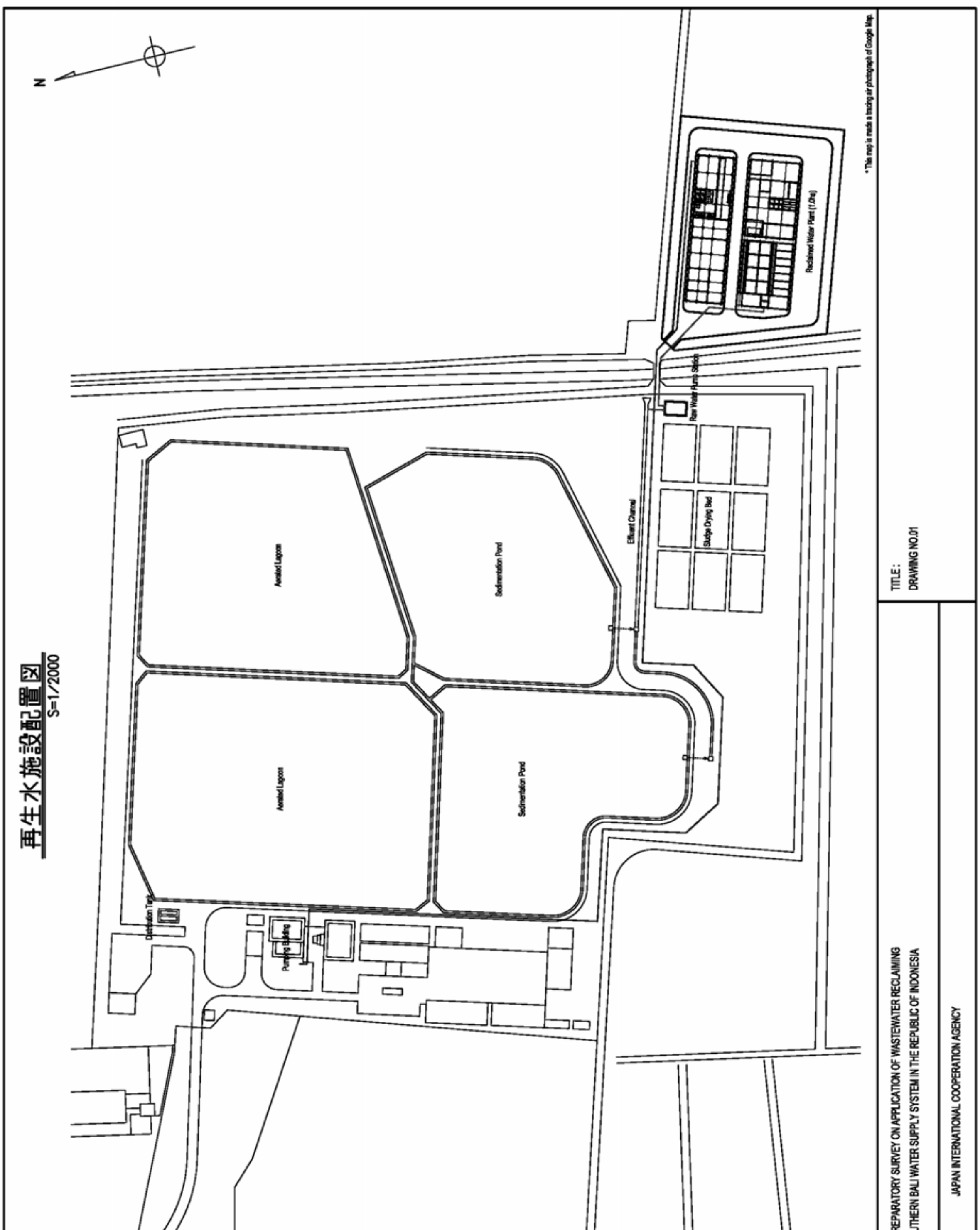
項目	ケース1	ケース2
3-2 生物膜ろ過処理水槽		
生物膜ろ過処理水量	= 5900m^3/日	= 11800m^3/日
オゾン反応槽処理水量	= 4800m^3/日	= 9600m^3/日
生物膜ろ過逆洗水量	= 5900m^3 − 4800m^3 = 1100m^3	= 11800m^3 − 9600m^3 = 2200m^3
系統数	= 1系統	= 2系統
槽数	= 4槽	= 4槽
1槽あたり生物膜ろ過槽必要逆洗水量	= 1100 / 1 / 4 = 275m^3	= 2200 / 2 / 4 = 275m^3
逆洗時間	= 30分	= 30分
生物膜ろ過処理水槽流出量	= 3.4m^3/分	= 3.4m^3/分
生物膜ろ過処理水槽流入量	= 4.1m^3/分	= 4.1m^3/分
必要容量	= 275 + 3.4 X 30 − 4.1 X 30 = 254m^3	= 275 + 3.4 X 30 − 4.1 X 30 = 254m^3
長さ	= 15.0 m	= 15.0 m
幅	= 6.3 m	= 6.3 m
水深	= 3.3 m	= 3.3 m
生物膜ろ過処理水容量	= 15.0 X 6.3 X 3.3 ≒ 311.8m^3	= 15.0 X 6.3 X 3.3 ≒ 311.8m^3
槽数	= 1槽	= 1槽
オゾン反応槽送水ポンプ 総吐出量	= 4800m^3/日 / 1440min/日 ≒ 3.4m^3/分	= 9600m^3/日 / 1440min/日 ≒ 6.8m^3/分
系統数	= 2系統	= 2系統
1系統あたり吐出量	= 3.4 / 1 = 3.4m^3/分	= 6.8 / 2 = 3.4m^3/分
ポンプ台数	= 3台（内予備1台）	= 3台（内予備1台）

項目	ケース1	ケース2
4.オゾン反応槽 4-1 オゾン反応槽		
オゾン反応槽処理水量	= 4800m^3/日	= 9600m^3/日
滞留時間	= 5分	= 5分
必要容量	= 4800m^3/日 / 1440min/日 X 5分 ≒ 16.7m^3	= 9600m^3/日 / 1440min/日 X 5分 ≒ 33.4m^3
系統数	= 1系統	= 2系統
槽数	= 1槽	= 1槽
1槽あたり必要容量	= 16.7 / 1 / 1 = 16.7m^3	= 33.4 / 2 / 1 = 16.7m^3
長さ	= 2.9 m	= 2.9 m
幅	= 1.3 m	= 1.3 m
水深	= 5.0 m	= 5.0 m
オゾン反応槽容量	= 2.9 X 1.3 X 5.0 = 18.8m^3/槽	= 2.9 X 1.3 X 5.0 = 18.8m^3/槽
槽数	= 1槽	= 2槽

項目	ケース1	ケース2
4-2 凝集混和槽 凝集槽		
オゾン反応槽処理水量	= 4800m^3/日	= 9600m^3/日
滞留時間	= 1分	= 1分
必要容量	= 4800m^3/日 / 1440min/日 X 1分 ≒ 3.4m^3	= 9600m^3/日 / 1440min/日 X 1分 ≒ 6.8m^3
系統数	= 1系統	= 2系統
槽数	= 1槽	= 1槽
1槽あたり必要容量	= 3.4 / 1 / 1 = 3.4m^3	= 6.8 / 2 / 1 = 3.4m^3
長さ	= 1.5 m	= 1.5 m
幅	= 2.0 m	= 2.0 m
水深	= 1.7 m	= 1.7 m
凝集槽容量	= 1.5 X 2.0 X 1.7 = 5.1m^3	= 1.5 X 2.0 X 1.7 = 5.1m^3
混和槽 滞留時間	= 2分	= 2分
必要容量	= 4800m^3/日 / 1440min/日 X 2分 ≒ 6.7m^3	= 9600m^3/日 / 1440min/日 X 2分 ≒ 13.4m^3
系統数	= 1系統	= 2系統
槽数（2槽1連）	= 1槽	= 1槽
1槽あたり必要容量	= 6.7 / 1 / 1 = 6.8m^3	= 13.4 / 2 / 1 = 6.7m^3
長さ	= 2.0 m	= 2.0 m
幅	= 2.0 m	= 2.0 m
水深	= 1.7 m	= 1.7 m
混和槽容量	= 2.0 X 2.0 X 1.7 = 6.8m^3	= 2.0 X 2.0 X 1.7 = 6.8m^3
凝集混和槽数	= 1槽	= 2槽
膜供給ポンプ 総吐出量	= 4800m^3/日 / 1440min/日 ≒ 3.4m^3/分	= 9600m^3/日 / 1440min/日 ≒ 6.8m^3/分
系統数	= 1系統	= 2系統
1台あたり吐出量	= 3.4 / 1 = 3.4m^3/分	= 6.8 / 2 = 3.4m^3/分
ポンプ台数	= 2台（内予備1台）	= 3台（内予備1台）

項目	ケース1	ケース2
5.セラミック膜ろ過装置		
セラミック膜ろ過処理水量	= 4800m^3/日	= 9600m^3/日
膜1本あたりの処理面積	= 25m^2	= 25m^2
設計流速	= 4.0m^3/m^2/d	= 4.0m^3/m^2/d
稼動効率	= 0.9	= 0.9
必要膜ろ過本数	= 4800m^3/d / 25m^2 / 4.0m^3/m^2/d / 0.9 ≒ 53.4	= 9600m^3/d / 25m^2 / 4.0m^3/m^2/d / 0.9 ≒ 106.7
1モジュールあたりの設計膜本数	= 10本	= 10本
1系統あたりの設計モジュール数	= 6モジュール	= 6モジュール
系統数	= 1系統	= 2系統
総本数	= 10本 X 6モジュール X 1系統 = 60本	= 10本 X 6モジュール X 2系統 = 120本
6.精密膜ろ過処理水槽		
再生水水量	= 4800m^3/d	= 9600m^3/d
滞留時間	= 5分	= 5分
必要容量	= 4800m^3/d / 1440min/d X 5min ≒ 16.7m^3	= 9600m^3/d / 1440min/d X 5min ≒ 33.3m^3
槽数	= 1槽	= 1槽
1槽あたり必要容量	= 16.7 / 1 = 16.7m^3	= 33.3 / 1 = 33.3m^3
長さ	= 8.1 m	= 8.1 m
幅	= 3.8 m	= 3.8 m
水深	= 2.0 m	= 2.0 m
生物膜ろ過処理水容量	= 8.1 X 3.8 X 2.0 = 61.5m^3/System	= 8.1 X 3.8 X 2.0 = 61.5m^3/System
槽数	= 1槽	= 1槽

5.b 設計図面

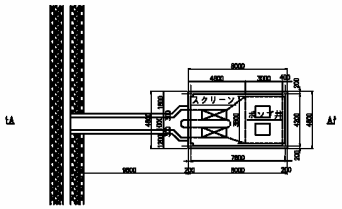

再生水施設配置図
S=1/2000
N
Aerated Lagoon
Aerated Lagoon
Sedimentation Pond
Sedimentation Pond
Effluent Channel
Sludge Drying Bed
Raw Water Pump Station
Reclaimed Water Plant (1.0ha)
Pumping Building
Distribution Tank
0m
50m
* This map is made a tracing air photograph of Google Map.
TITLE :
DRAWING NO.01
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY

ケース１ 再生水施設平面図

S=1/400

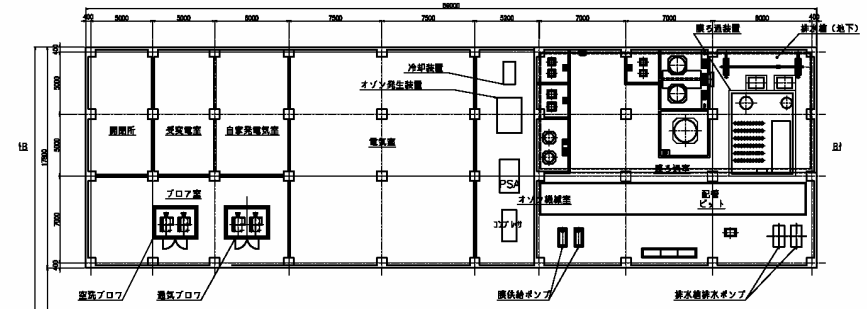
取水施設平面図

原水ポンプ棟

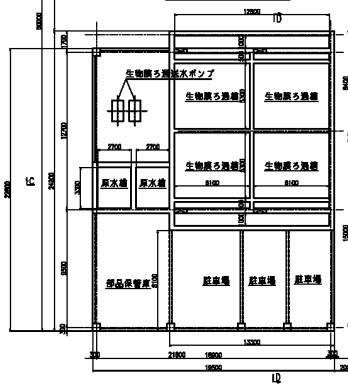


再生水施設平面図

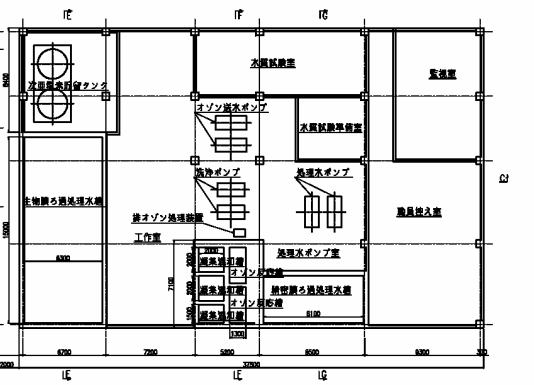
膜ろ過棟



生物処理棟



オゾン処理棟



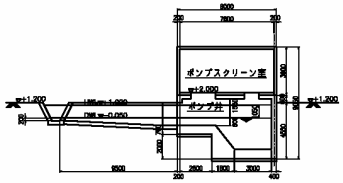
0m 10m

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE : DRAWING NO.01
JAPAN INTERNATIONAL COOPERATION AGENCY	

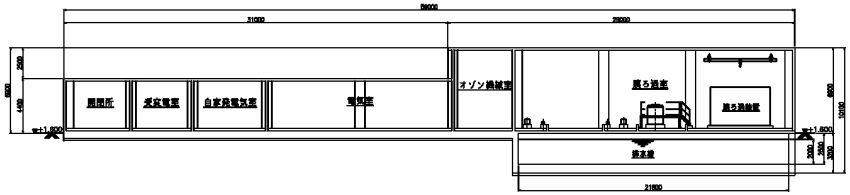
ケース１ 再生水施設断面図

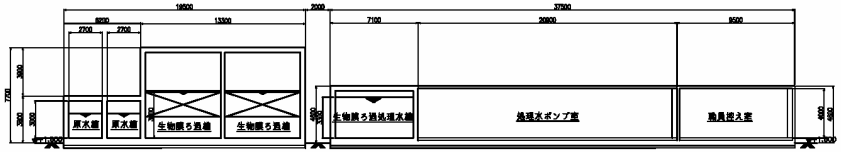
S=1/400

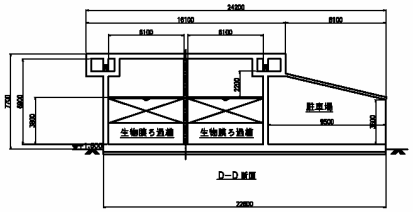
取水施設平面図

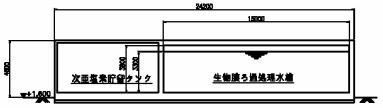


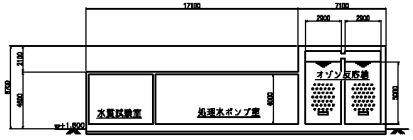
再生水施設平面図

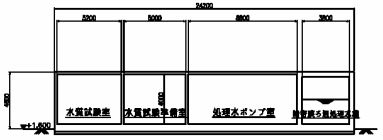












0m 10m

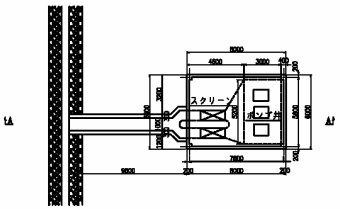
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE : DRAWING NO.01
JAPAN INTERNATIONAL COOPERATION AGENCY	

ケース2 再生水施設平面図

S=1/400

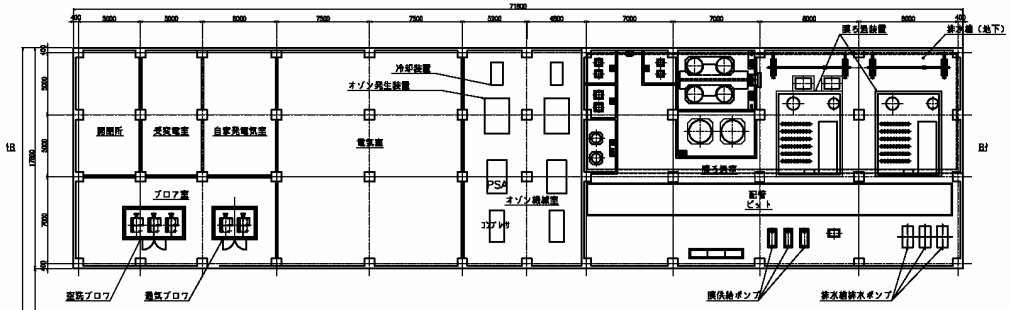
取水施設平面図

原水ポンプ棟

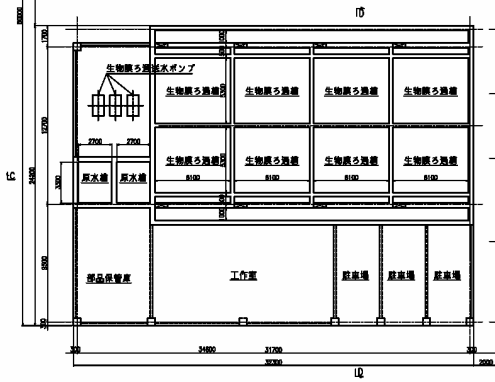


再生水施設平面図

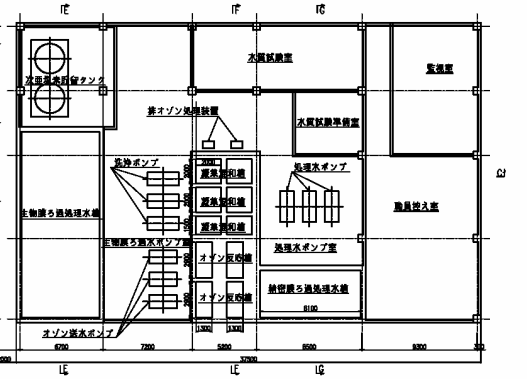
膜ろ過棟



生物処理棟



オゾン処理棟



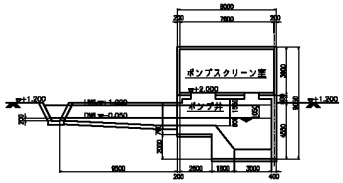
0m 10m

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE : DRAWING NO.01
JAPAN INTERNATIONAL COOPERATION AGENCY	

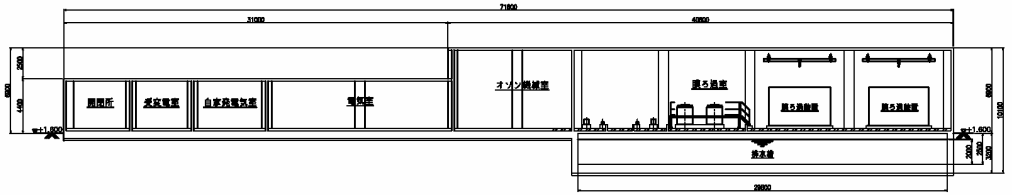
ケース２ 再生水施設断面図

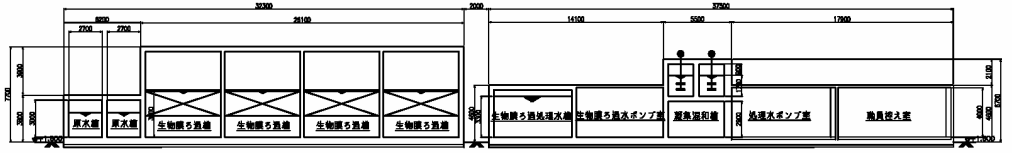
S=1/400

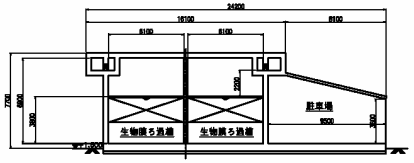
取水施設平面図

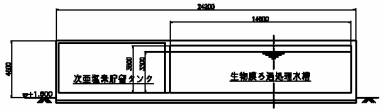


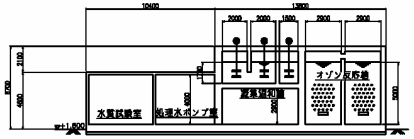
再生水施設平面図

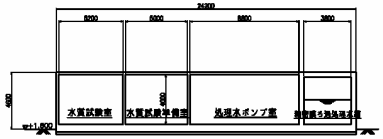






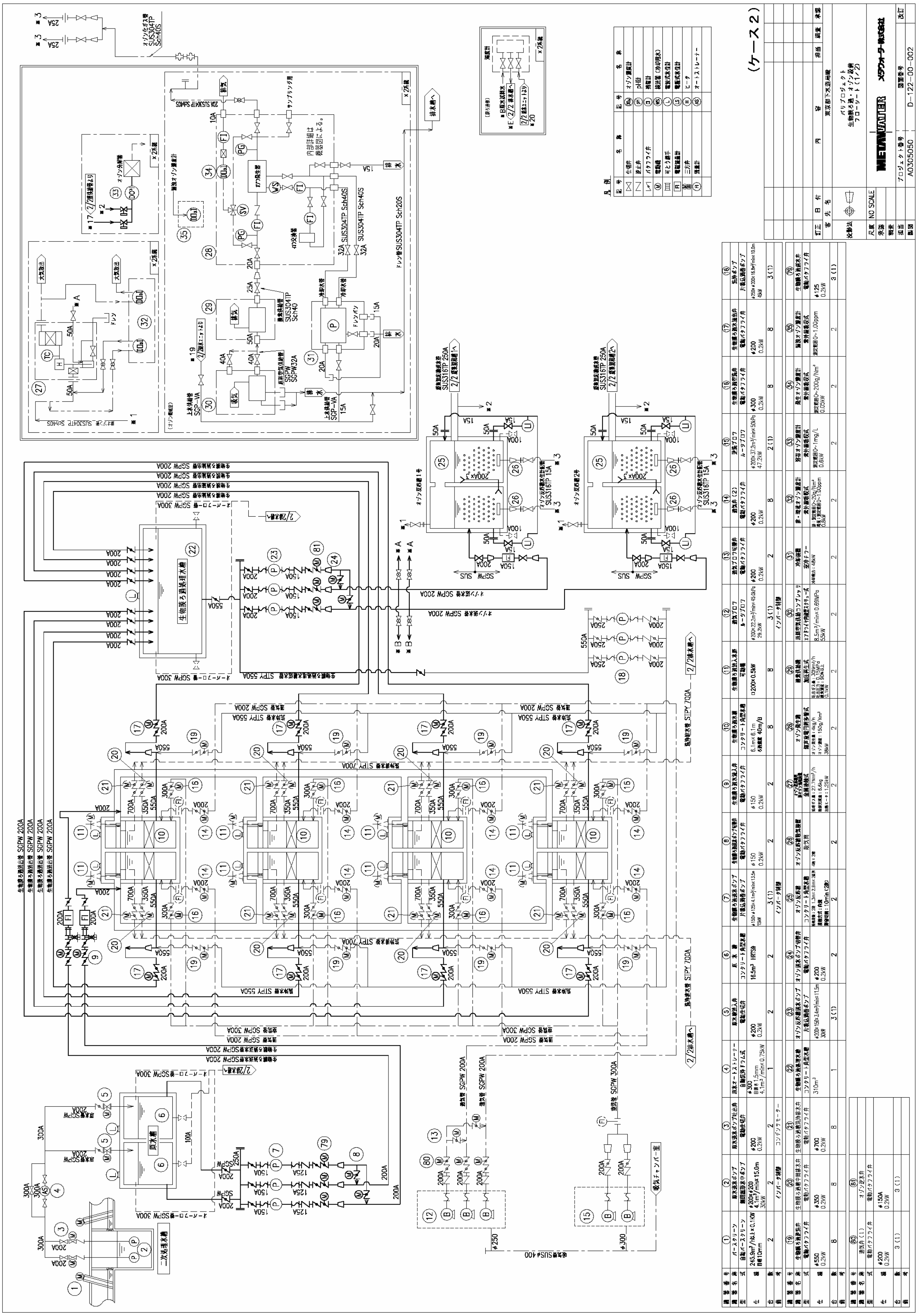


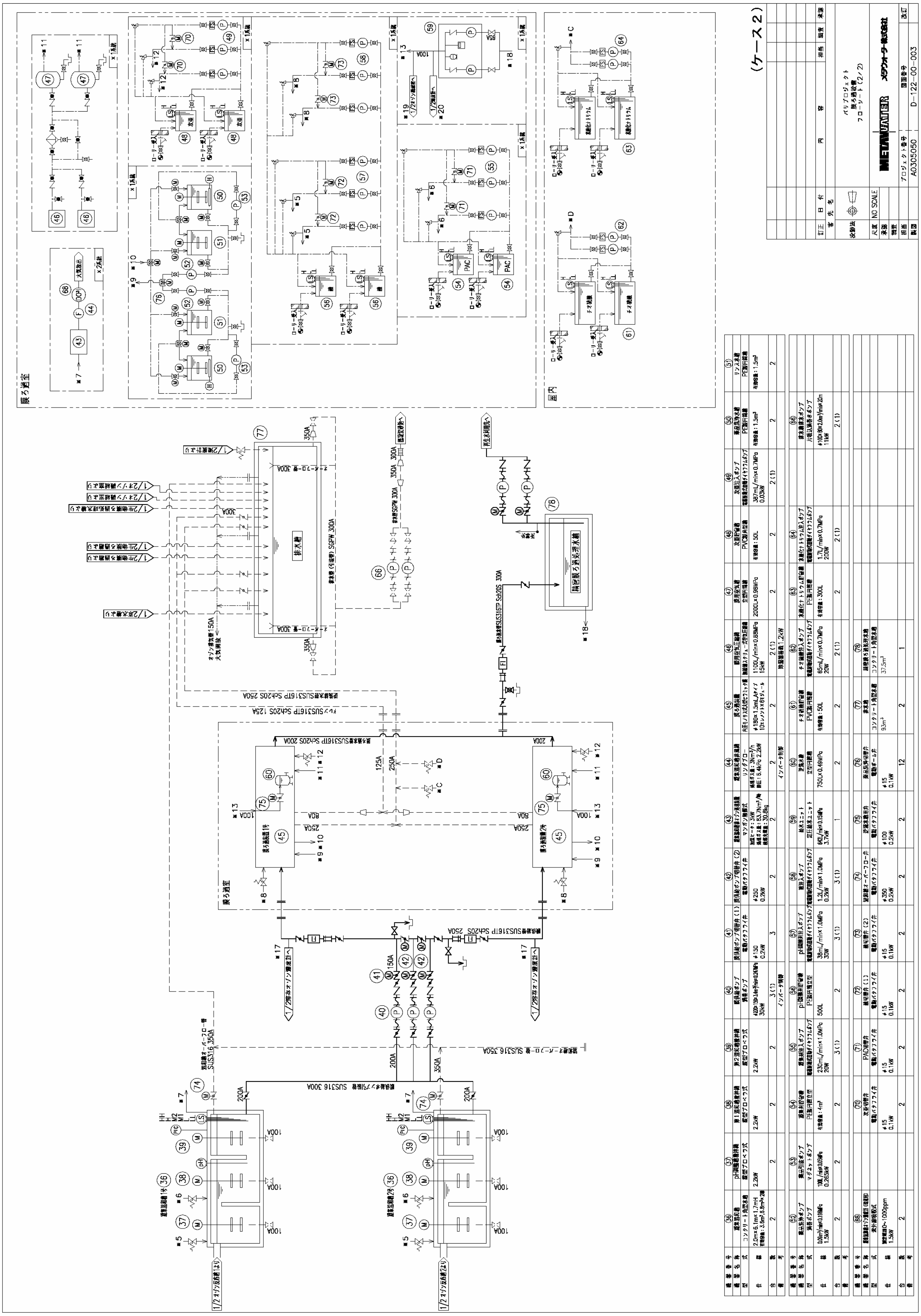




0m 10m

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE : DRAWING NO.01
JAPAN INTERNATIONAL COOPERATION AGENCY	





（ケース２）
パリプロジェクト
膜ろ過設備
フローシート（2／2）
METAWATER
メタウォーター株式会社
プロジェクト番号
A0305050
図面番号
D−122−00−003
NO SCALE
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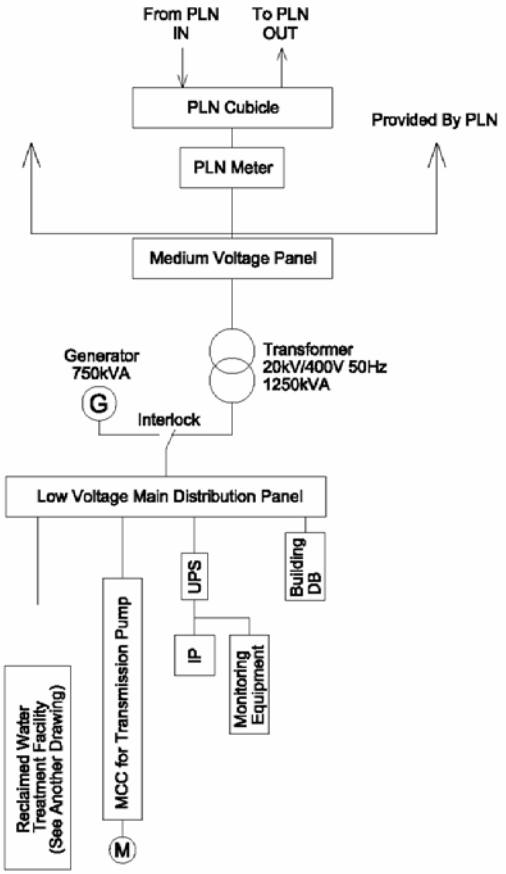
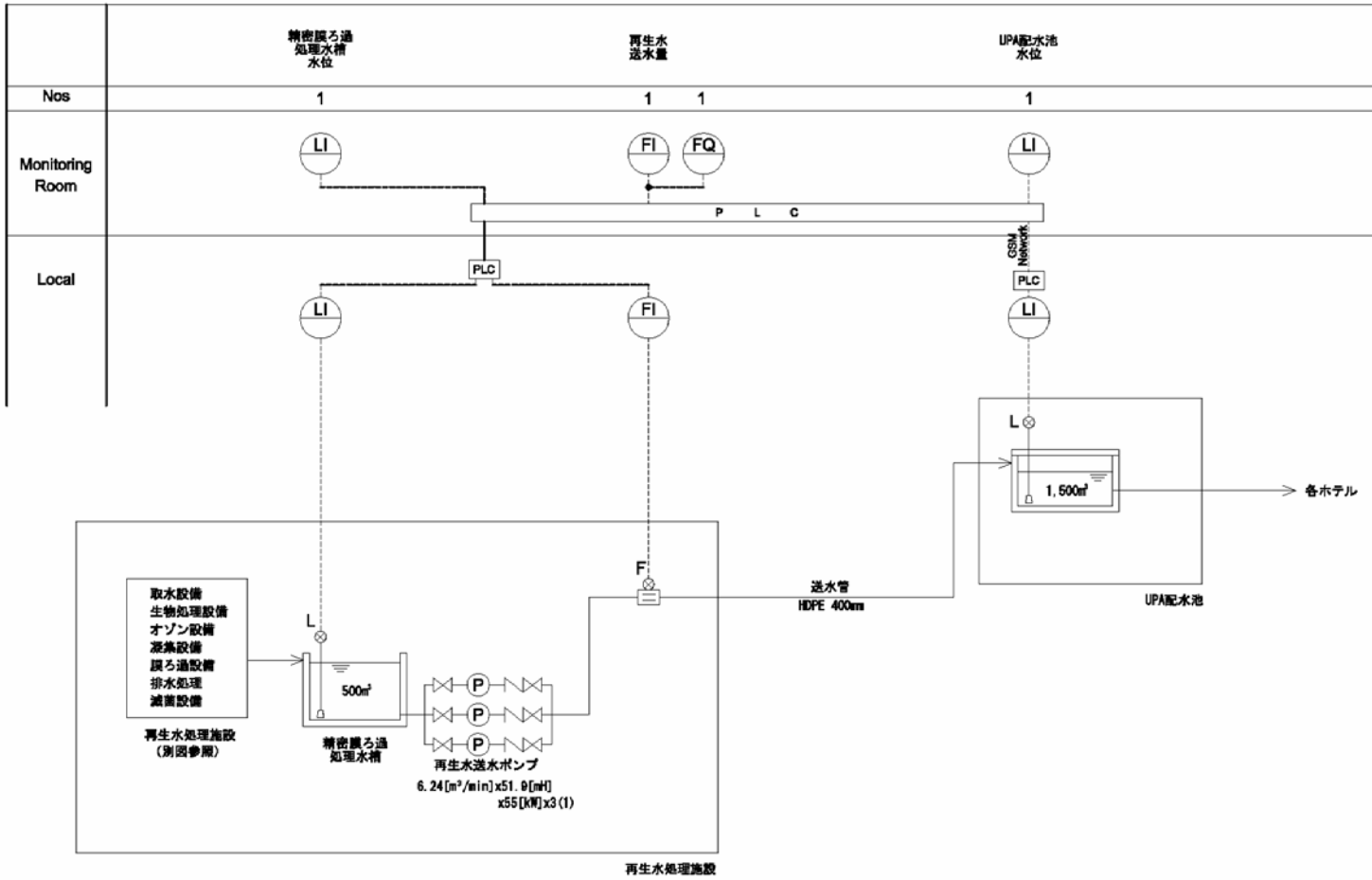


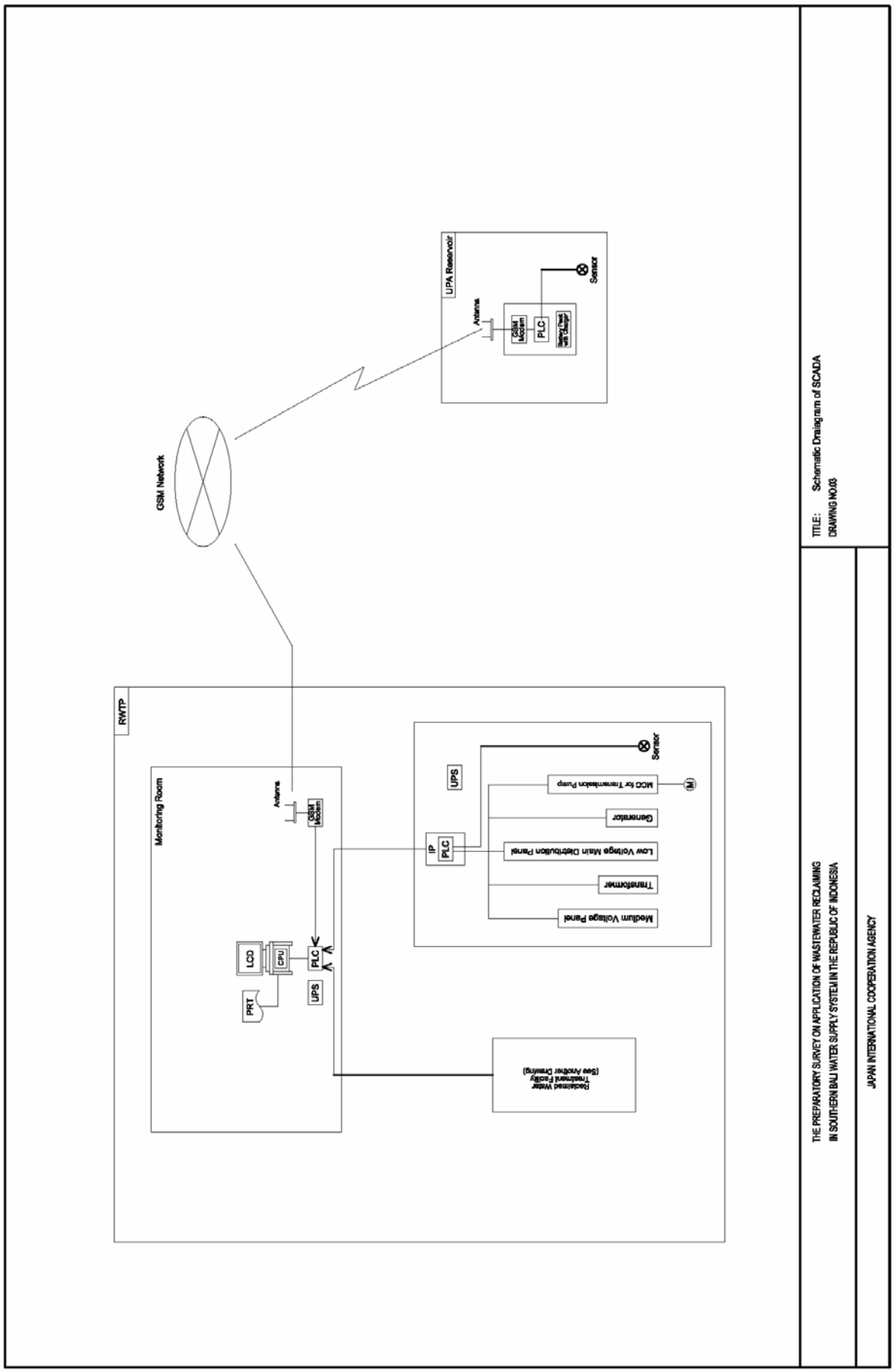
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE: Power Distribution Diagram
DRAWING NO.01



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: P&I Diagram DRAWING NO.02
JAPAN INTERNATIONAL COOPERATION AGENCY	


UPA Reservoir
Antenna
GSM Modem
PLC
Sensor
GSM Network
RWTP
Monitoring Room
Antenna
GSM Modem
LCD
CPU
PRT
PLC
UPS
IP
PLC
UPS
Sensor
MCC for Translation Pump
Generator
Low Voltage Main Distribution Panel
Transformer
Medium Voltage Panel
Reclaimed Water Treatment Facility (See Another Drawing)
TITLE: Schematic Dralagram of SCADA
DRAWING NO.03
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY

付属資料 6

送水施設概略設計資料

付属資料 6　送水施設概略設計資料

6.a　　設計条件

本概略設計資料は Case2 の場合について示す。

6.a.1　　送水ポンプ施設

計画送水量：送水ポンプの計画は日最大水量で行う。

計画日平均水量：　　9,000 m^3/日（＝6.250 m^3/分＝104.2 L/s）

送水ポンプ仕様：デンパサール市 Suwung 下水処理場と既設 UPA 配水池の標高差、送水管損失水頭、管まわり損失水頭、ウォーターハンマー検討などの検討により決定する。

受配電施設：送水ポンプ常用運転に必要な受電容量とする。

自家発電施設：送水ポンプ非常時運転に必要な発電容量とする。

電機計装設備・監視制御設備：自動運転可能な設備とする。

6.a.2　　送水管

布設ルート：送水管の布設ルートは図 6.a.1 に示す約 16km の区間とする。

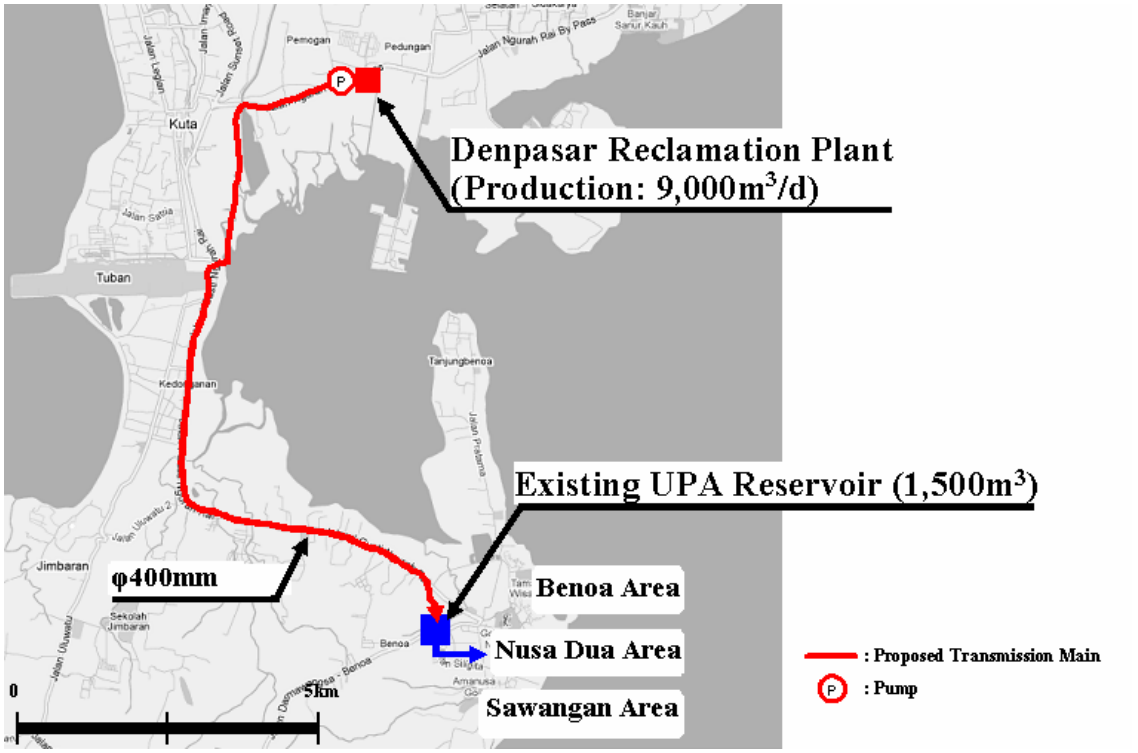


図 6.a.1　送水管敷設ルート

計画送水量：送水ポンプの計画は日最大水量で行う。

計画日平均水量：　9,000 m^3/日（＝6.250 m^3/分＝104.2 L/s）

管種、口径：HDPE、φ400(ウォータハンマー検討結果による)

布設工法：

一般開削工法部分　図 6.a.2 の標準断面とする。

その他特殊工法部分　現地調査の結果、図 6.a.3 に示す工法とする。

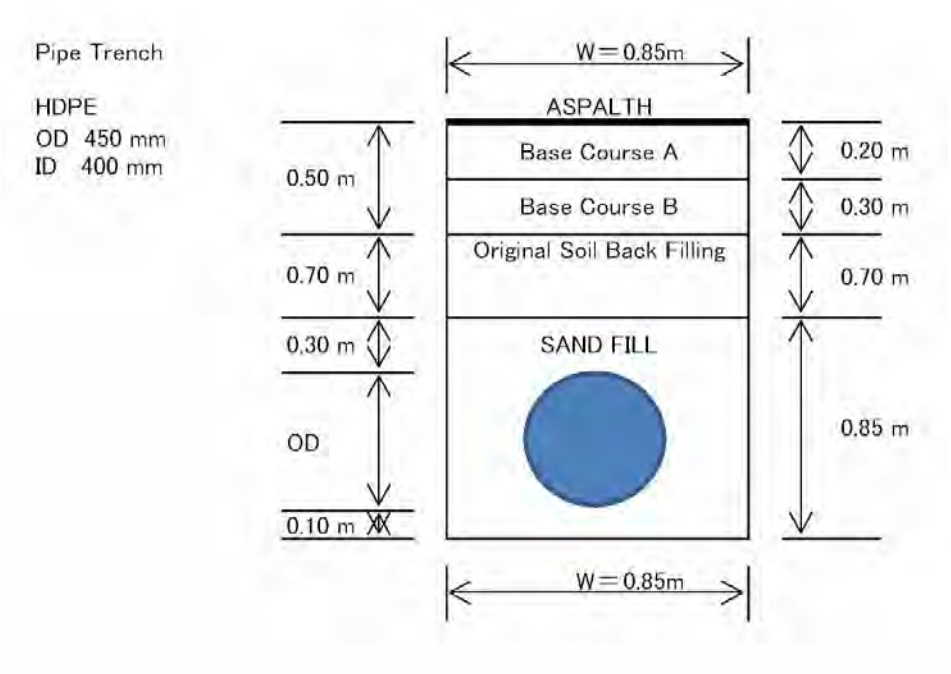


図 6.a.2　配管土工標準断面図(一般開削工法部)

図 6.a.3　送水管特殊工法位置図

6. b 設備概略設計

6.b.1　再生水送水ポンプ設備

(1) 設計条件

計画水量

日平均送水量：　6.250[m^3/min]

水位条件

ポンプ井 LWL：　約 1.6 [m]

UPA 配水池 HWL：　約 29.335 [m]

(2) ポンプ仕様

送水量：　3.125　[m^3/min]

電動機容量：　75　[kW]

台数：　3(1)　[台]

(3) ウォーターハンマー検討

最低圧力勾配線は管路縦断線より下回る点がなく負圧が発生しない管路であり、水柱分離は起こらないということを確認した。(添付計算書参照)

6.b.2　受変電設備

本施設の最大需要電力は約 780kW に達すると想定される。電力会社から 20kV で受電を行った後、場内の変圧器で 400V に降圧し、各負荷へ電源供給を行う。電源系統図を図 6.b.1 に示す。なお、電力会社の配電盤設置スペースとして 3m×7m 以上の屋内スペースが必要である。電力供給規定に基づき、受電手続きの際は、電力会社に接続料を支払う必要がある。

6.b.3　自家発電設備

本設備は、買電停電時においても再利用水の生産を行い、処理水を UPA 配水池へ送水するための電源供給を行うための設備である。

(1) 自家発設置理由

本施設は買電停電時においても PPP 契約に基づき常に安定して再利用水の生産、送水を行う必要がある。電力会社へのヒアリングによると、20kV 級送電線の停電頻度は年間 10 回程度であり、停電時間は最大で 2 時間程度とのことであ

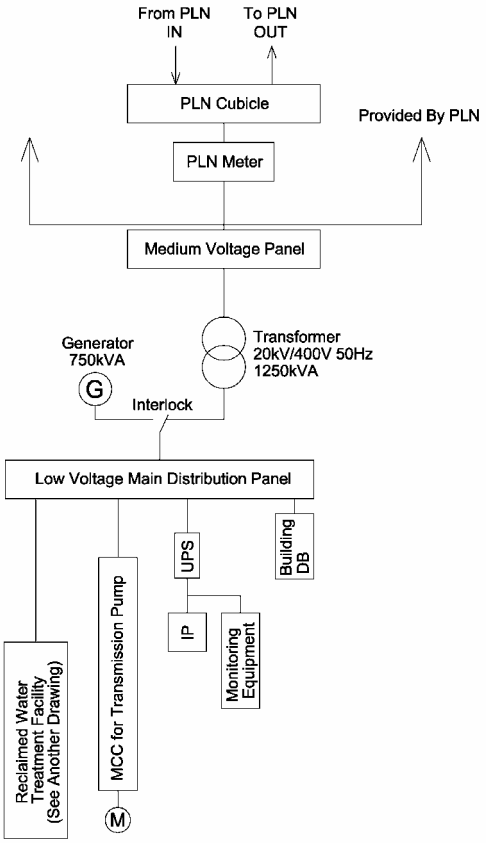


図 6.b.1　再生水処理施設電源系統図

る。従って、最低でも 2 時間程度の電源を確保する自家発電設備の設置が必要である。
なお、本プロジェクトに関連する下水道、水道施設には全て自家発電装置が設置されており、停電対策が行われている。設置状況は下記の通りである。停電は頻発しており、使用頻度は高い。

- Suwung 下水処理場（再生水処理施設の水源となる施設）
  形式： ディーゼル機関
  台数： 1 台
  発電機容量： 500kVA
  燃料種別： 軽油
  燃料タンク容量： 4m^3

- Teluk Benoa 配水池（Clean Water を UPA 配水池へ送水する施設）
  形式： ディーゼル機関
  台数： 1 台
  発電機容量： 750kVA
  燃料種別： 軽油
  燃料タンク容量： 1m^3

- UPA 配水池（Clean Water を Nusa Dua 地区等へ配水する施設）
  形式： ディーゼル機関
  台数： 1 台
  発電機容量： 106kVA
  燃料種別： 軽油
  燃料タンク容量： 1.3m^3

(2) 自家発対象負荷
自家発対象とするプラント負荷は、全系列分としてしまうと発電機容量が過大になり投資額が増大することから、1 系列（4,500m^3/d）分とする。1 系列分の能力が確保できれば、UPA 配水池の残量を考慮すれば、4 時間程度の停電に対しても十分対応可能である。また、建築動力、建築照明等、維持管理に必要な保守動力は、需要率等を考慮して最小限の容量とする。

(3) 機種選定
原動機には、ディーゼル機関とガスタービン機関があるが、周辺施設では、ディーゼル機関が採用されているため維持管理性を考慮してディーゼル機関を採用する。なお、再生水はディーゼル機関用の冷却水としても使用する。

(4) 発電機仕様
本施設に設置する発電設備の概要は以下の通りとなる（添付計算書参照）。

形式：　　ディーゼル機関
台数：　　1 台
発電機容量：　750kVA
燃料種別：　軽油
燃料タンク容量：　2.5m^3

6.b.4 再生水送水ポンプ電気計装設備

本設備は処理された再利用水を UPA 配水池へ送水するための設備である。再生水送水ポンプは実働 2 台運転となる。運転は UPA 配水池水位による自動運転とする。自動運転のために再生水送水ポンプ井水位計および UPA 配水池水位計を設置する。また、再生水送水量を把握するために送水量流量計を設置する。

6.b.5 監視制御設備

監視制御設備は、広範囲に分散しているプラント設備を操作員が中央監視室で一括監視、操作を行い、安全かつ安定に効率的なプラント運転操作を行うための設備であり、維持管理費の低減、省力化、労働環境の改善及び作業性の向上等の目的で設置される。監視制御装置の基本機能は以下の通りである。

- 監視機能（状態表示、故障表示、計測表示）
- 操作・設定機能
- 記録機能

システム構成図を図 6.b.2 に示す。

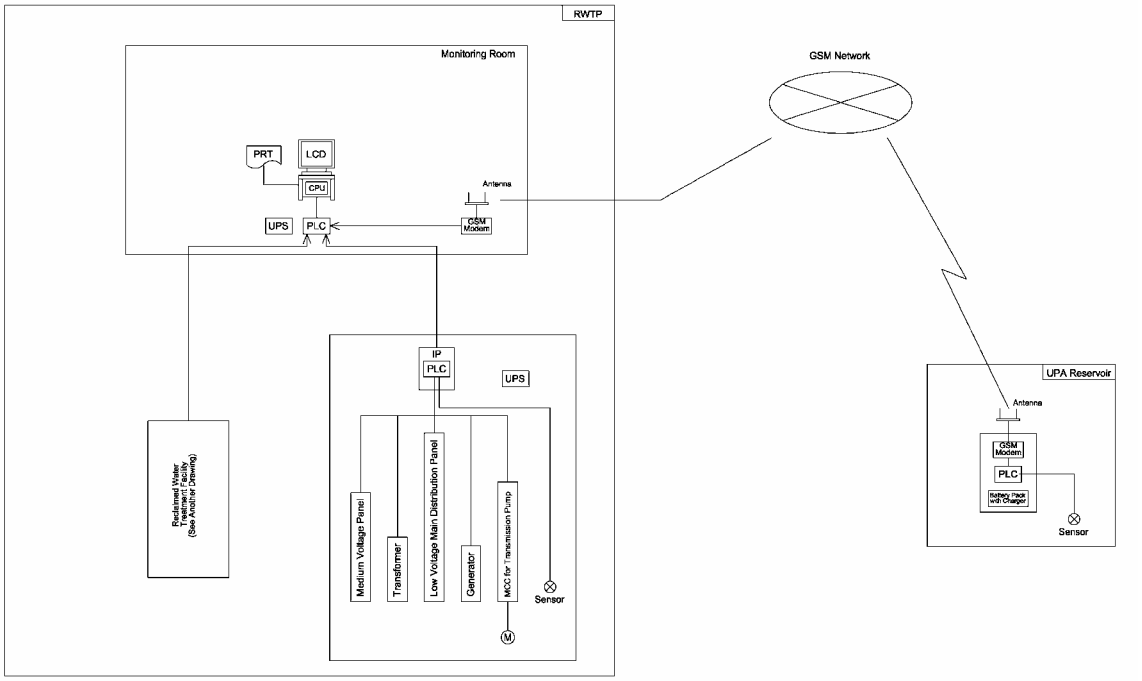


図 6.b.2　概略システム構成図

【添付計算書】

1. 再生水送水ポンプ容量計算
2. ウォーターハンマー検討
3. 変圧器容量計算
4. 発電機容量計算
5. 燃料タンク容量計算

1. 再生水送水ポンプ容量計算

i) 損失

a) ポンプ廻り損失 H_{f1}

10 [m]と仮定する。

b) 送水管路損失 H_{f2}

b-1) 直管部損失（ウイリアム・ヘーゼンの式）

$Hl = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$

C　係数　HDPE

D　内径　[m]

Q　流量　[m^3/s]

L　管長　[m]

$= 10.666 \times 140^{-1.85} \times 0.4^{-4.87} \times 0.104^{1.85} \times 15{,}230$

= 22.90 [m]

b-2) 曲部損失

送水管路損失の 10%程度とする。

=2.29[m]

ii) ポンプ kW の算出

$$P = \frac{0.163 \times \gamma \times Q \times H}{\eta} \times (1+a)$$

γ　揚液の密度

Q　送水量　日平均[m^3/min]

H　全揚程　[m]

η　ポンプ効率

a　余裕度

$$= \frac{0.163 \times 1 \times 6.24 \times (10+22.90+2.29+27.735)}{0.6} \times (1+0.1)$$

= 117　[kW]

→ 75[kW]×3(1) [台]

2. ウォーターハンマー検討

1. ポンプ仕様

	単位 Unit	記号 Symbol	数値 Value	備考 Remarks
出力	[kW]		75	
周波数	[Hz]		50	
実揚程	[m]	Ha	27.735	
損失水頭	[m]	Hf	35.19	
全揚程	[m]	Ht	63	Ha+Hf
ポンプ軸動力	[kW]	Pw	53.4	$0.163\gamma QH/\eta p$
ポンプ効率	[%]	ηp	60	
吐出し量	$[m^3/min]$	Q_0	3.12	
回転速度	$[min^{-1}]$	N	1,000	6P
フライホイール効果	$[kg\text{-}m^2]$	GD^2	16.50	
ポンプ台数		n	2	

2. 管路状態

	単位 Unit	記号 Symbol	数値 Value	備考 Remarks
管路全長	[m]	L	15,230	
管径	[mm]	D	400	
管厚	[mm]	t	23.7	
材質	HDPE			
k/E値	-	k/E	2.07	
ポンプ吸込水位	[m]		1.6	
管路プロフィル				別紙

3. 計算

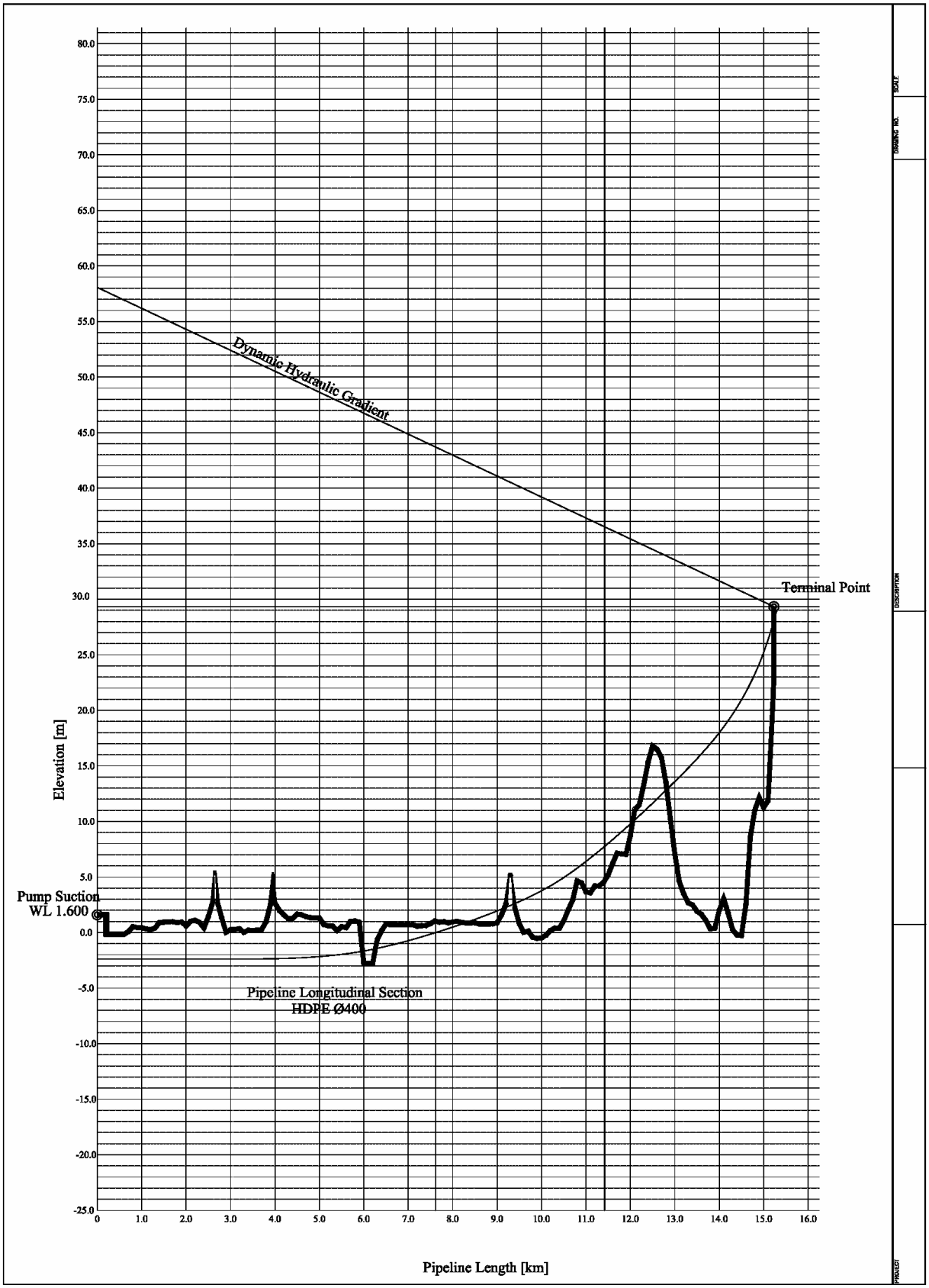
	単位 Unit	記号 Symbol	計算式 Formula	数値 Result
運転時トルク Pump Torque	[N・m]	M	$\frac{\Sigma(9{,}550*Pw)}{N} = \frac{9{,}550*53.4*2}{1{,}000} =$	1019.9
慣性係数 Inertial Coefficient	-	k	$\frac{38.2*\Sigma M}{\Sigma(GD^2_n*N_n)} = \frac{38.2*1019.9}{16.5*2*1000} =$	1.181
損失百分率 Pipeline loss of head [percentage]	[%]	R	$\frac{Hf}{Ht}*100 = \frac{35.19}{63}*100 =$	55.9
圧力伝播速度 Pressure Propagation Velocity	[m/s]	a	$\frac{1425}{\sqrt{1+K/E\cdot D/t}} = \frac{1425}{\sqrt{1+2.07\cdot 400/23.7}} =$	237.7
管内流速 Average Flow Velocity	[m/s]	V	$\frac{Q_0}{60*\pi/4*D^2} = \frac{3.12}{60*\pi/4*0.4\text{^}2/2} =$	0.828
管路定数 Pipeline Constant	-	2ρ	$\frac{a*V}{g*Ht} = \frac{237.7*0.828}{9.8*63} =$	0.32
サージ係数 Surge Coefficient	-	S	$2*k*\frac{L}{a} = 2*1.181*\frac{15{,}230}{237.7} =$	151.339

4. 圧力降下

地点	Location	最低圧力比 Lowest Pressure Ratio [%]	最低圧力 Lowest Pressure Estimated
ポンプ直後	At pump installation point	10.0	6.30
1/2L 地点	At 1/2L point	35.0	22.05
3/4L 地点	At 3/4L point	38.0	23.94

５．結果

水柱分離は起こらないと考えられるが、詳細設計にて再度確認する必要がある。


Dynamic Hydraulic Gradient
Terminal Point
Pump Suction
WL 1.600
Pipeline Longitudinal Section
HDPE Ø400
Elevation [m]
Pipeline Length [km]
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0

4.b.2　管路プロフィル

3. 変圧器容量計算

負荷集計表

	kW	Nos	Total [kW]
取水ポンプ～再生水設備	706.94	1	706.94
再生水送水ポンプ	75	3(1)	150
建築付帯	60	1	60
その他	10	1	10
3-phase Total [kW]			**926.94**
建築付帯	50	1	50
水質試験室	30	1	30
その他	10	1	10
1-phase Total [kW]			**90**

1) 容量計算式

$$\text{変圧器容量 P[kVA]} = \text{総設備容量[kW]} \times \frac{\beta \times \alpha}{\eta \times \varphi}$$

ここで、 φ: 総合力率 0.85
η: 総合効率 0.85
β: 需要率 0.8
α: 余裕率 1.1

2) 容量計算

$$1016.94 \times \frac{0.8 \times 1.1}{0.85 \times 0.85} = 1{,}239\text{[kVA]}$$

3) 結論

必要容量が 1,239[kVA]であるため定格容量 1,250[kVA]を選定する。

4. 発電機容量計算

自家発対象負荷集計表

	kW	Nos	Total [kW]
取水ポンプ～再生水設備	455.755	1	455.755
再生水送水ポンプ	75	1	75

建築付帯	18	1	18
その他	10	1	10
3-phase Total [kW]			**558.755**
建築付帯	15	1	15
水質試験室	9	1	9
その他	3	1	3
1-phase Total [kW]			**27**

(1)計算式

発電設備の発電機容量は次の算式により算出した容量の内で最も大きい容量以上とする。

a. 全負荷定常運転に必要とする容量 PG_1

$$PG_1=\frac{\Sigma P_0}{\eta_L \times \varphi_L} \times \alpha \times Sf \ [kVA]$$

$$Sf=1+0.6\times\frac{\Delta P}{\Sigma P_0}$$

ここで、

ΣP_0: 自家発対象負荷出力の総和[kW]

ΣP_0 の容量算出

a)定格が出力 kW 表示の機器(一般誘導原動機など)

P_i=定格出力[kW]

b)定格が出力 kVA 表示の機器(CVCF など)

P_i=定格出力[kVA]×負荷力率(0.9)

c) 整流装置

P_i=定格直流電圧[V]×直流側の定格電流[A]

d) 蛍光灯・白熱灯

P_i=定格消費電力またはランプ電力[kW]

=蛍光灯負荷容量が[kVA]で計算されている場合は、P_i=[kVA]×0.8 とする。

η_L: 負荷の総合効率 0.85

φ_L: 負荷の総合力率 0.8

α: 需要率 0.8

ΔP: 単相負荷不平衡分合計出力値

始動方式による始動 kVA

始動方式		β×C
かご形	直入始動	7.2×1.0
	Y-Δ 始動	7.2×2/3
	リアクトル始動	50% 7.2×0.5 65% 7.2×0.65 80% 7.2×0.8
	コントドルファ始動	50% 7.2×0.25 65% 7.2×0.42 80% 7.2×0.64
	VVVF 始動	1.2
巻線形		1.2

（注）Y-Δ 始動抵抗器付は β×C=7.2×1/3 とする。

b. 許容電圧降下から必要とする容量 PG_2

$$PG_2=P_m\times\beta\times C\times Xd'\times\frac{1-\Delta E}{\Delta E} \quad [kVA]$$

ここで、

P_m: 最大容量の電動機出力 [kW]

β: 最大容量の 1kW 当りの始動 [kVA]

C:　始動方式による係数

Xd':　発電機定数　0.25

ΔE:　許容電圧降下率　0.25

c. 最大容量の電動機を最後に始動するために必要とする容量 PG_3

$$PG_3=\frac{f_{v1}}{\gamma_G}\{(\Sigma P_0-P_m)\times\frac{\alpha}{\eta_L\times\varphi_L}+P_m\times\beta\times C\}\ [kVA]$$

ここで、

ΣP_0:　自家発対象負荷出力の総和（予備機は除く）　[kW]

η_L:　負荷の総合効率　0.85

α:　需要率　0.8

P_m:　最大容量の電動機出力　[kW]

φ_L:　負荷の総合力率　0.8

β:　最大容量の1kW当りの始動　[kVA]

C:　始動方式による係数

γ_G:　発電機の瞬時過負荷耐量　1.5

f_{v1}:　負荷投入減少係数　1.0

(2)計算

a.全負荷定常運転に必要とする容量 PG_1

$\Sigma P_0=558.755+0\times0.9+33.75\times0.8=585.8$

$$Sf=1+0.6\times\frac{27}{585.8}=1.028$$

$$PG_1=\frac{585.8}{0.85\times0.8}\times0.8\times1.028\fallingdotseq 708.4$$

b.許容電圧降下から必要とする容量 PG_2

$$PG_2=75\times7.2\times0.8\times0.25\times\frac{1-0.25}{0.25}$$

$$\fallingdotseq 324$$

c.最大容量の電動機を最後に始動するために必要とする容量 PG_3

$$PG_3=\frac{1.0}{1.5}\{(585.8-75)\times\frac{0.8}{0.85\times0.8}+75\times7.2\times0.8\}$$

$$\fallingdotseq 688.6$$

(3)結論

必要容量が 708.4[kVA]であるため定格容量 750[kVA]を選定する。

5. 燃料タンク容量計算

1) 容量計算式

燃料タンク必要容量 $Q[m^3]=\frac{P\times be\times H\times \alpha}{d}$

ここで、 P: 原動機出力 kW
be: 燃料消費率 kg/kW･h
H: 運転時間 h
α: 余裕率 1.1
d: 燃料密度

2) 容量計算

原動機出力 $P[kW]=\frac{P_G\times \varphi_G}{\eta_G}=\frac{750\times 0.8}{0.923}=650.1$

ここで、 P_G: 発電機出力
φ_G: 発電機力率
η_G: 発電機効率

$Q=\frac{P\times be\times H\times \alpha}{d}=\frac{650.1\times 0.231\times 12\times 1.1}{830}=2.38[m^3]$

3) 結論

必要容量が $2.38[m^3]$であるため定格容量 $2.5[m^3]$を選定する。

6.c　　設計図面

添付図面に、全体平面図、送水管平面図、送水管横断図、送水管縦断図、水管橋配置図を示す。下表に図面目録を示す。

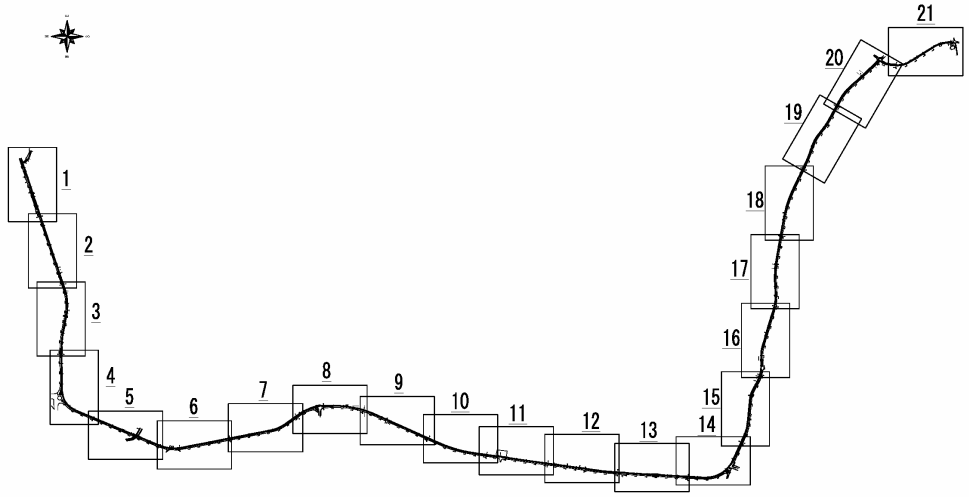
表 6.c.1　送水管概略設計図 図面目録

番号.	図面タイトル	縮尺	備考
1-1	全体平面図	None	
2-1	送水管平面図(1)	1/2000	
2-2	送水管平面図(2)	1/2000	
2-3	送水管平面図(3)	1/2000	
2-4	送水管平面図(4)	1/2000	
2-5	送水管平面図(5)	1/2000	
2-6	送水管平面図(6)	1/2000	
2-7	送水管平面図(7)	1/2000	
2-8	送水管平面図(8)	1/2000	
2-9	送水管平面図(9)	1/2000	
2-10	送水管平面図(10)	1/2000	
2-11	送水管平面図(11)	1/2000	
2-12	送水管平面図(12)	1/2000	
2-13	送水管平面図(13)	1/2000	
2-14	送水管平面図(14)	1/2000	
2-15	送水管平面図(15)	1/2000	
2-16	送水管平面図(16)	1/2000	
2-17	送水管平面図(17)	1/2000	
2-18	送水管平面図(18)	1/2000	
2-19	送水管平面図(19)	1/2000	
2-20	送水管平面図(20)	1/2000	
2-21	送水管平面図(21)	1/2000	

番号.	図面タイトル	縮尺	備考
3-1	送水管横断図(1)	1/100	
3-2	送水管横断図(2)	1/100	
3-3	送水管横断図(3)	1/100	
3-4	送水管横断図(4)	1/100	
3-5	送水管横断図(5)	1/100	
3-6	送水管横断図(6)	1/100	
3-7	送水管横断図(7)	1/100	
3-8	送水管横断図(8)	1/100	
3-9	送水管横断図(9)	1/100	
3-10	送水管横断図(10)	1/100	
3-11	送水管横断図(11)	1/100	
3-12	送水管横断図(12)	1/100	
3-13	送水管横断図(13)	1/100	
3-14	送水管横断図(14)	1/100	
3-15	送水管横断図(15)	1/100	
3-16	送水管横断図(16)	1/100	
3-17	送水管横断図(17)	1/100	
3-18	送水管横断図(18)	1/100	
3-19	送水管横断図(19)	1/100	
3-20	送水管横断図(20)	1/100	
3-21	送水管横断図(21)	1/100	
3-22	送水管横断図(22)	1/100	
3-23	送水管横断図(23)	1/100	
3-24	送水管横断図(24)	1/100	
3-25	送水管横断図(25)	1/100	
3-26	送水管横断図(26)	1/100	
3-27	送水管横断図(27)	1/100	
3-28	送水管横断図(28)	1/100	
3-29	送水管横断図(29)	1/100	
3-30	送水管横断図(30)	1/100	
3-31	送水管横断図(31)	1/100	
3-32	送水管横断図(32)	1/100	
3-33	送水管横断図(33)	1/100	
3-34	送水管横断図(34)	1/100	
3-35	送水管横断図(35)	1/100	
3-36	送水管横断図(36)	1/100	
3-37	送水管横断図(37)	1/100	

番号.	図面タイトル	縮尺	備考
4-1	送水管縦断図(1)	H=1/2000,V=1/200	
4-2	送水管縦断図(2)	H=1/2000,V=1/200	
4-3	送水管縦断図(3)	H=1/2000,V=1/200	
4-4	送水管縦断図(4)	H=1/2000,V=1/200	
4-5	送水管縦断図(5)	H=1/2000,V=1/200	
4-6	送水管縦断図(6)	H=1/2000,V=1/200	
4-7	送水管縦断図(7)	H=1/2000,V=1/200	
4-8	送水管縦断図(8)	H=1/2000,V=1/200	
4-9	送水管縦断図(9)	H=1/2000,V=1/200	
4-10	送水管縦断図(10)	H=1/2000,V=1/200	
4-11	送水管縦断図(11)	H=1/2000,V=1/200	
4-12	送水管縦断図(12)	H=1/2000,V=1/200	
4-13	送水管縦断図(13)	H=1/2000,V=1/200	
4-14	送水管縦断図(14)	H=1/2000,V=1/200	
4-15	送水管縦断図(15)	H=1/2000,V=1/200	
4-16	送水管縦断図(16)	H=1/2000,V=1/200	
4-17	送水管縦断図(17)	H=1/2000,V=1/200	
4-18	送水管縦断図(18)	H=1/2000,V=1/200	
4-19	送水管縦断図(19)	H=1/2000,V=1/200	
4-20	送水管縦断図(20)	H=1/2000,V=1/200	
4-21	送水管縦断図(21)	H=1/2000,V=1/200	
4-22	送水管縦断図(22)	H=1/2000,V=1/200	
4-23	送水管縦断図(23)	H=1/2000,V=1/200	
4-24	送水管縦断図(24)	H=1/2000,V=1/200	
4-25	送水管縦断図(25)	H=1/2000,V=1/200	
5-1	水管橋配置図(1)	1/200	
5-2	水管橋配置図(2)	1/200	

Key Plan

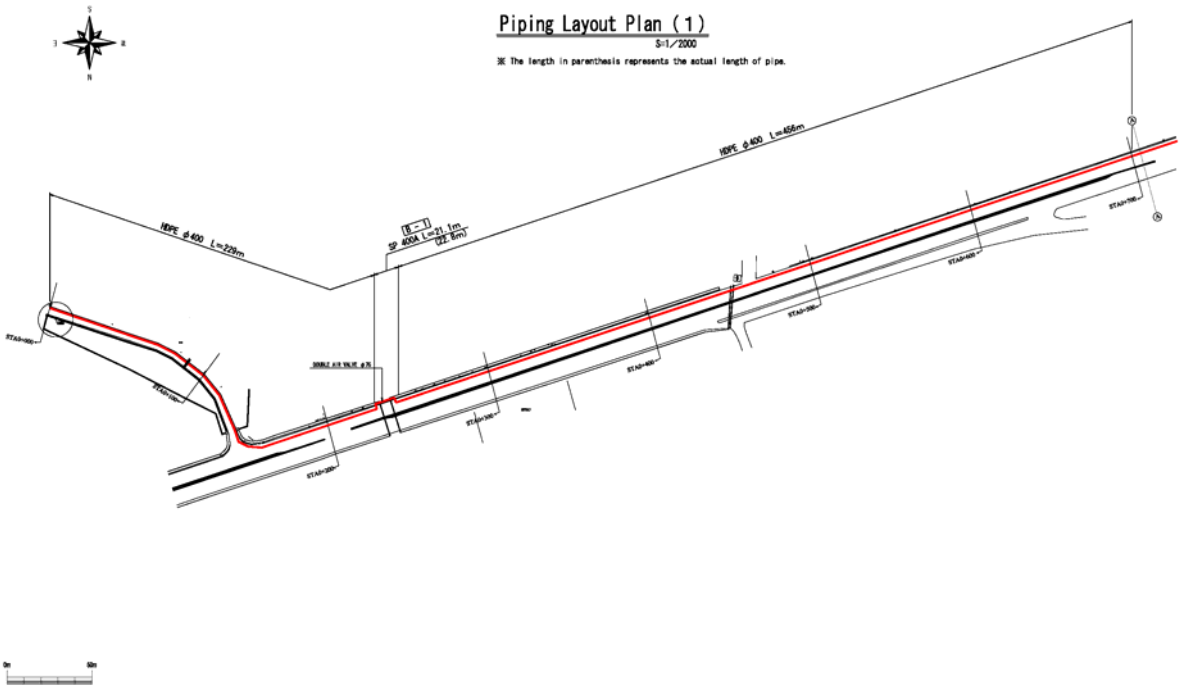


THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Key Plan
JAPAN INTERNATIONAL COOPERATION AGENCY	

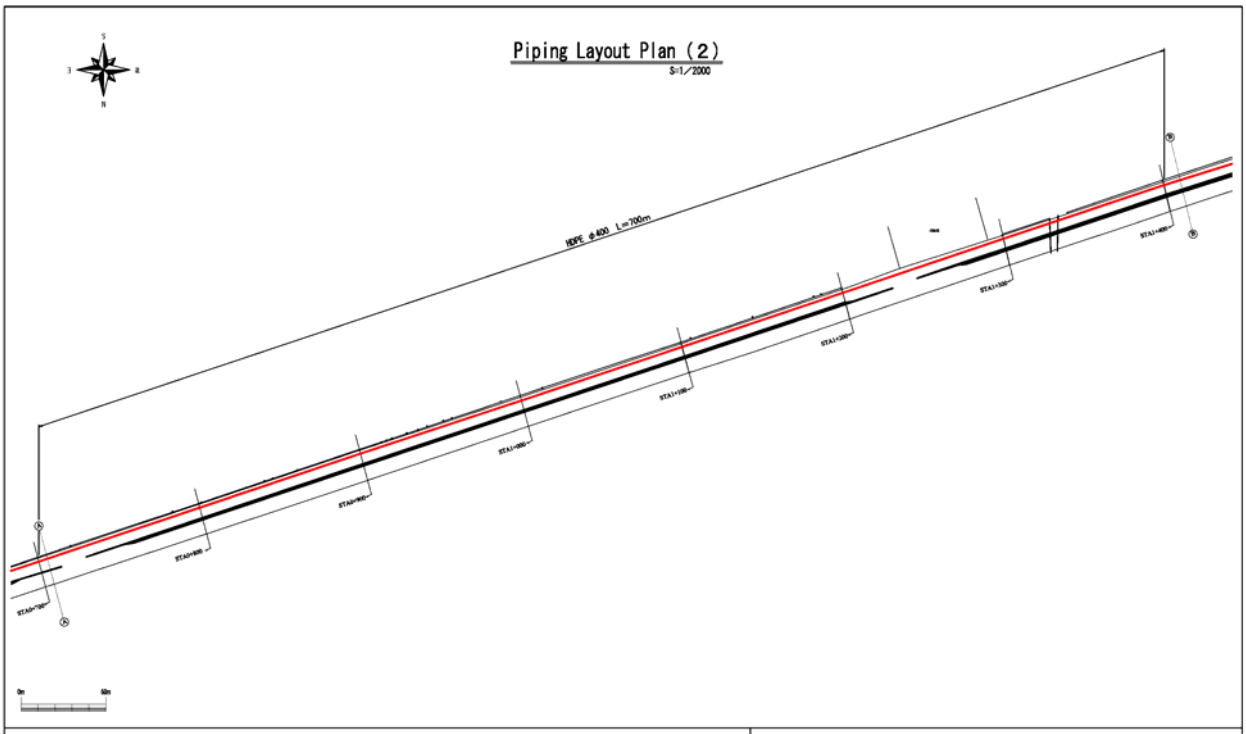
Piping Layout Plan (1)

S=1/2000

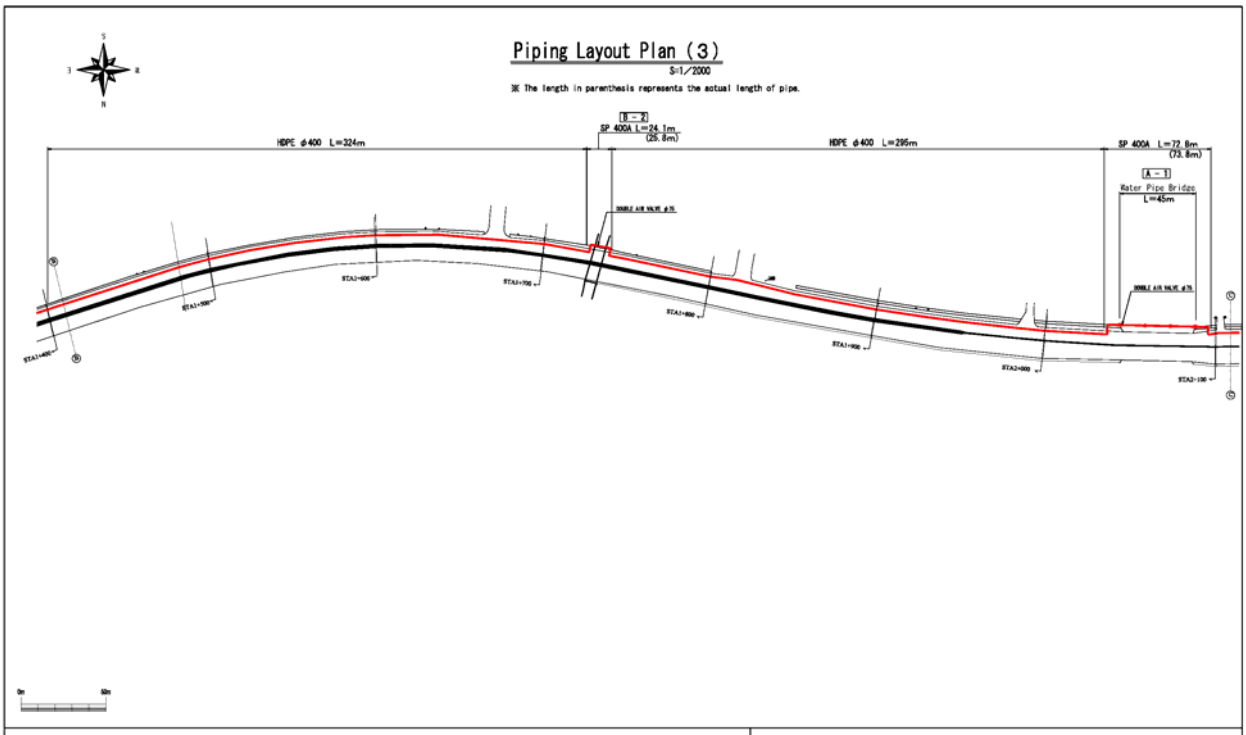
※ The length in parenthesis represents the actual length of pipe.



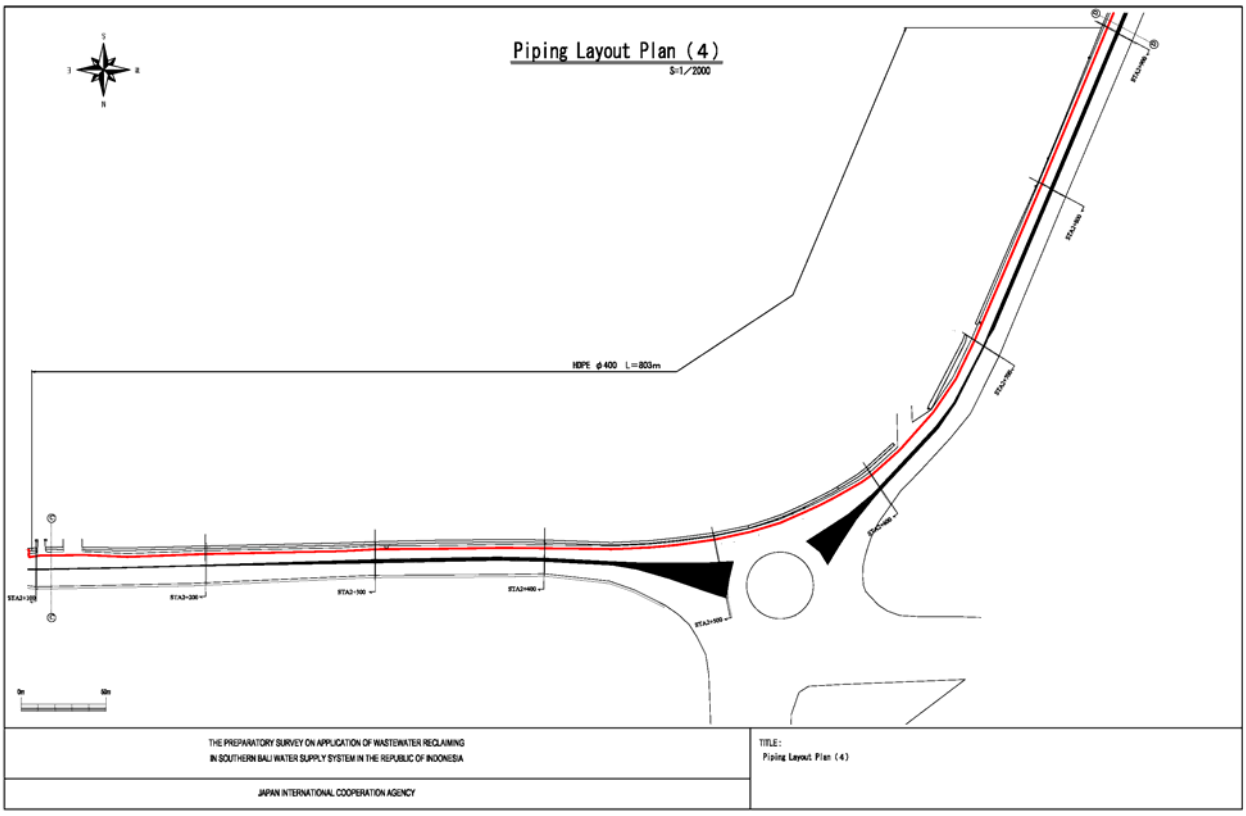
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Piping Layout Plan (1)
JAPAN INTERNATIONAL COOPERATION AGENCY	

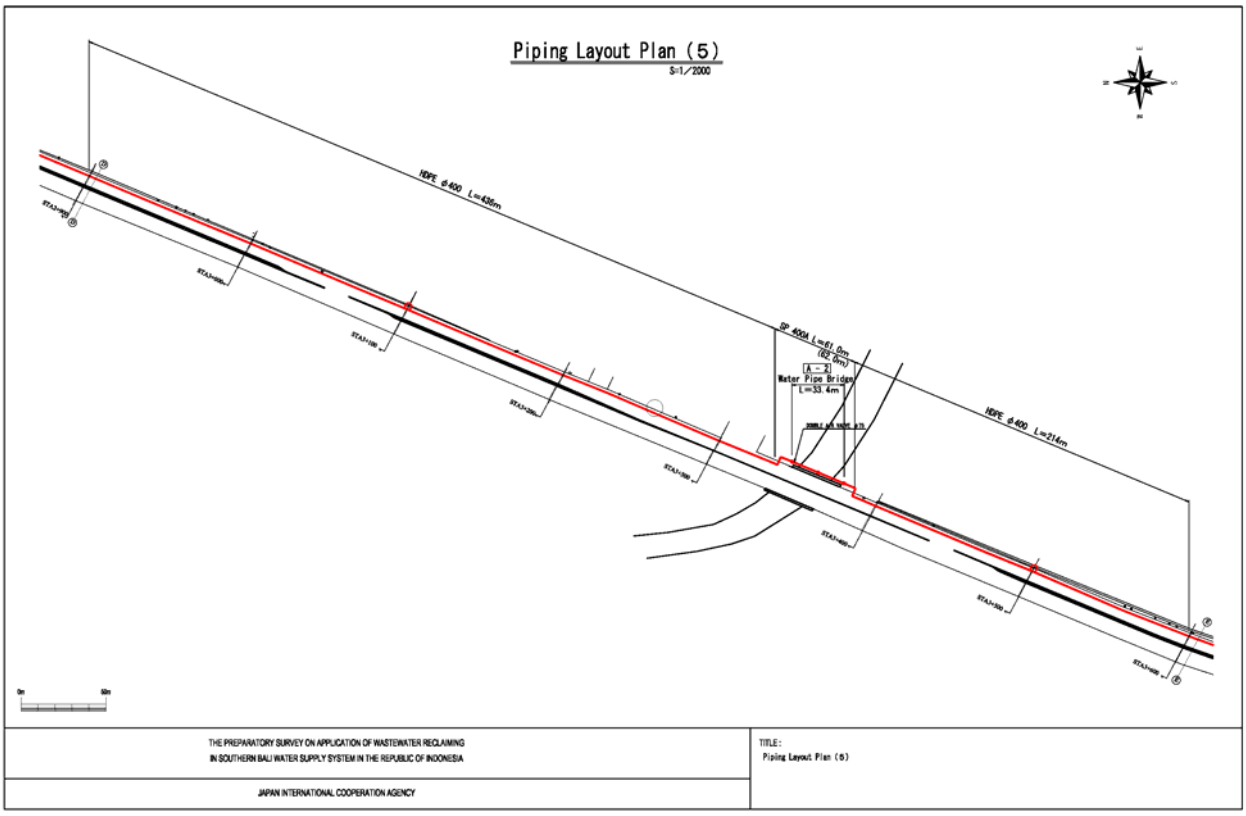


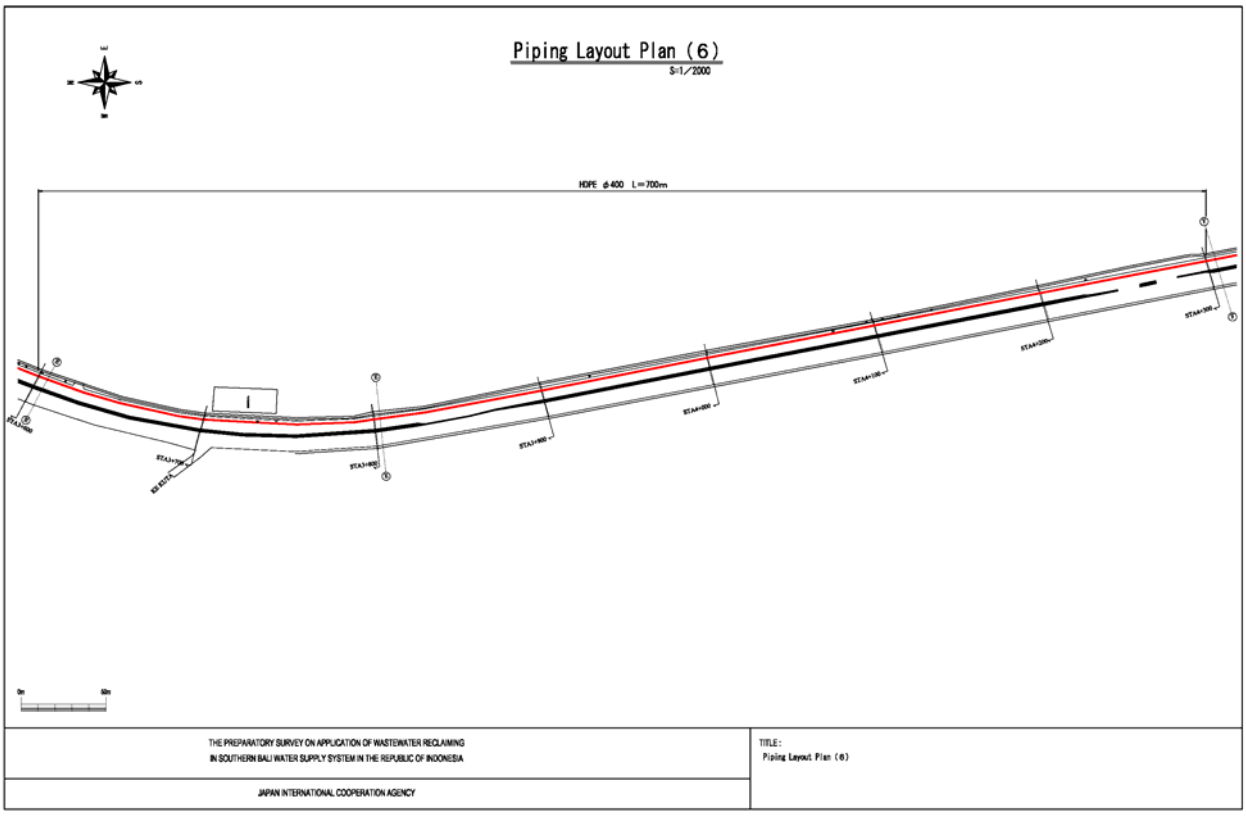
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Piping Layout Plan (2)
JAPAN INTERNATIONAL COOPERATION AGENCY	

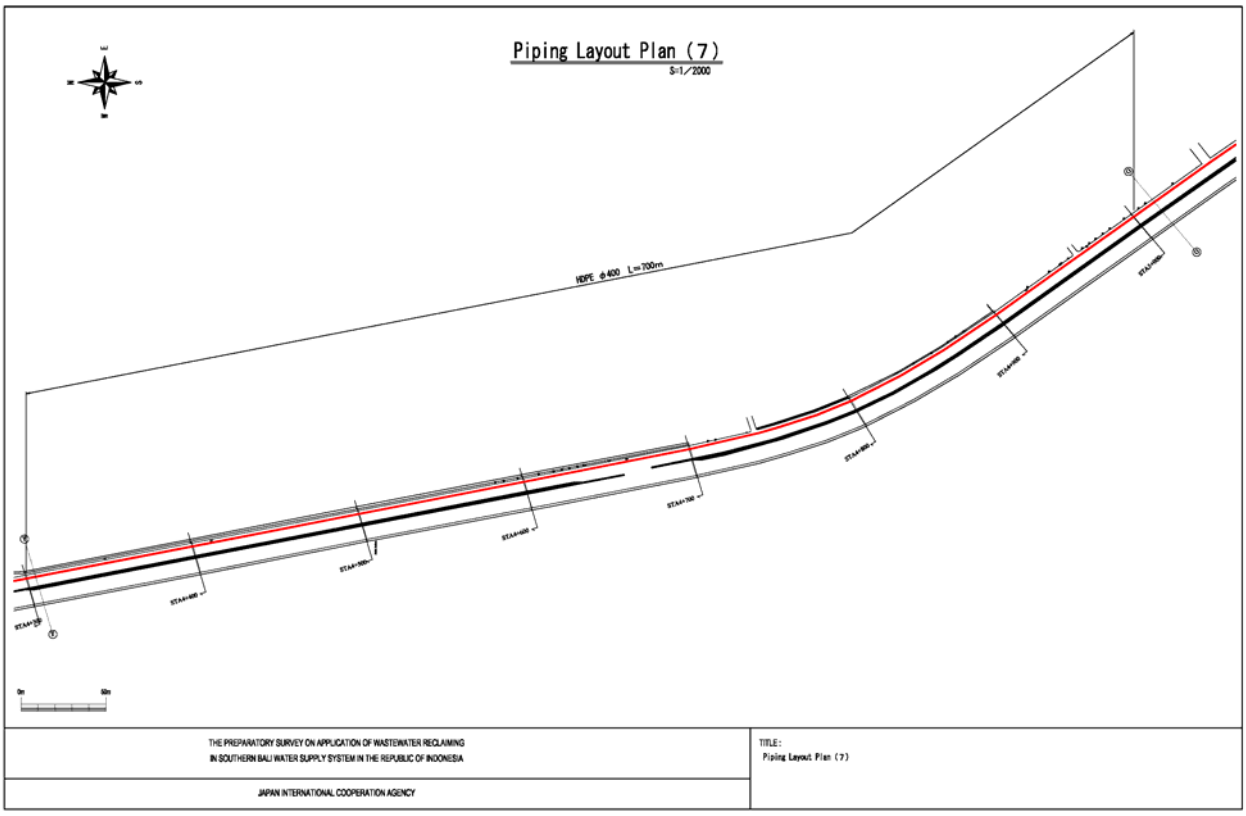


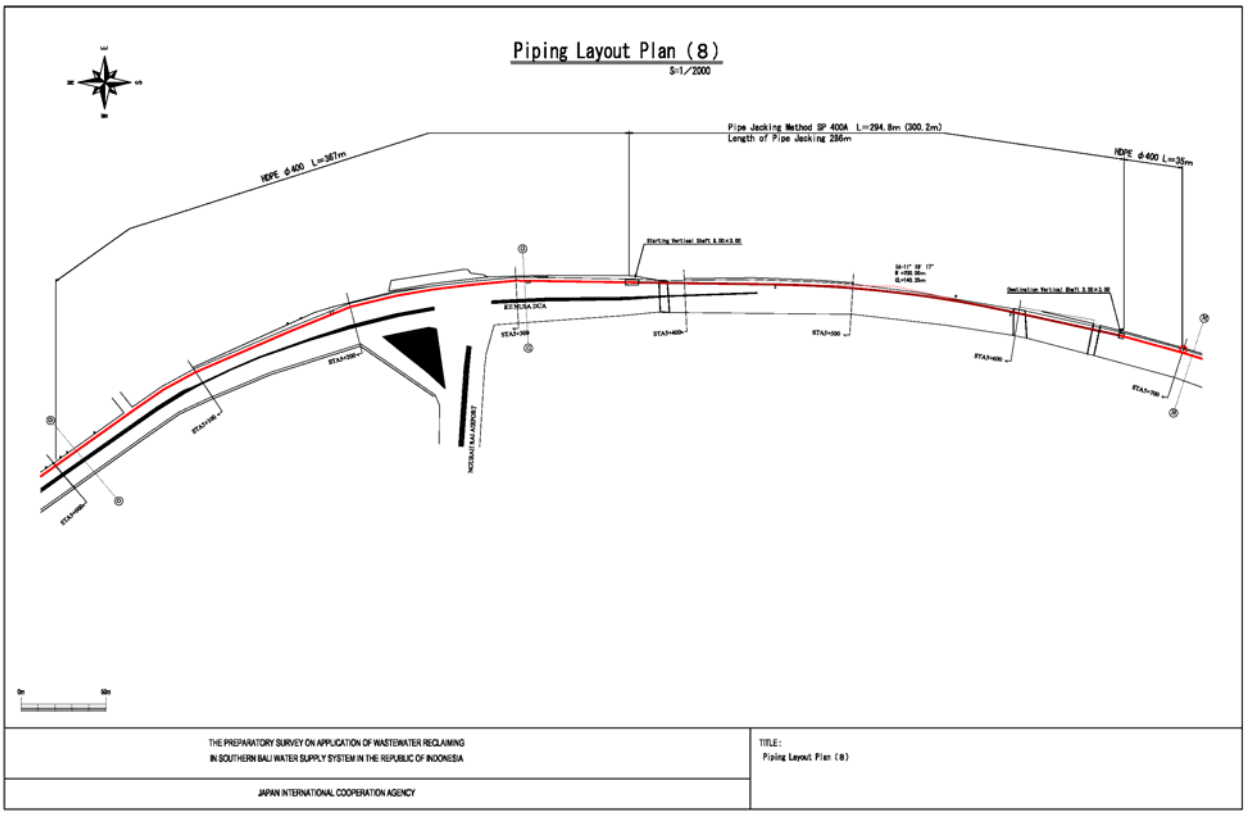
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Piping Layout Plan (3)
JAPAN INTERNATIONAL COOPERATION AGENCY	

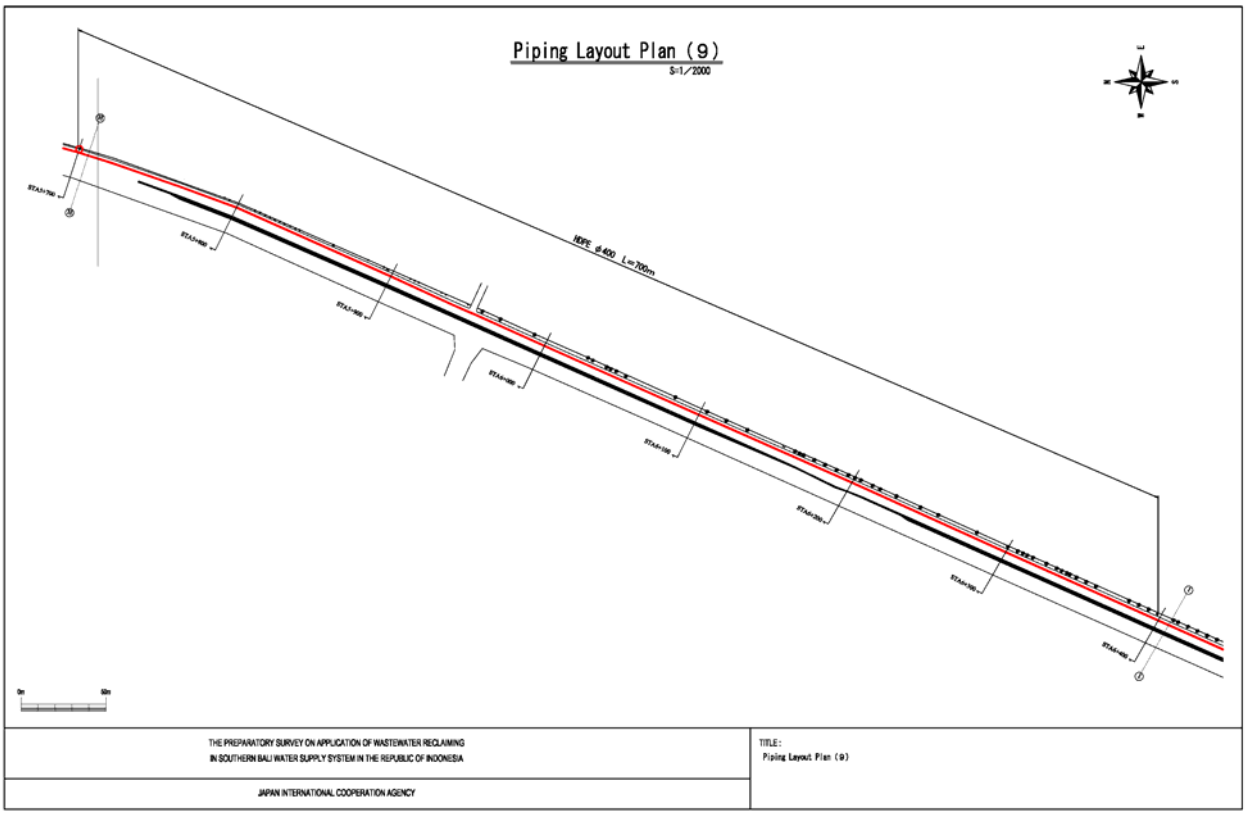

Piping Layout Plan (4)
S=1/2000
HDPE φ400 L=803m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (4)


Piping Layout Plan (5)
S=1/2000
HDPE φ400 L=436m
SP 400A L=61.0m
(GF 2m)
A - A'
Water Pipe Bridge
L=33.4m
HDPE φ400 L=214m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (5)


Piping Layout Plan (6)
S=1/2000
HDPE φ400 L=700m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (6)

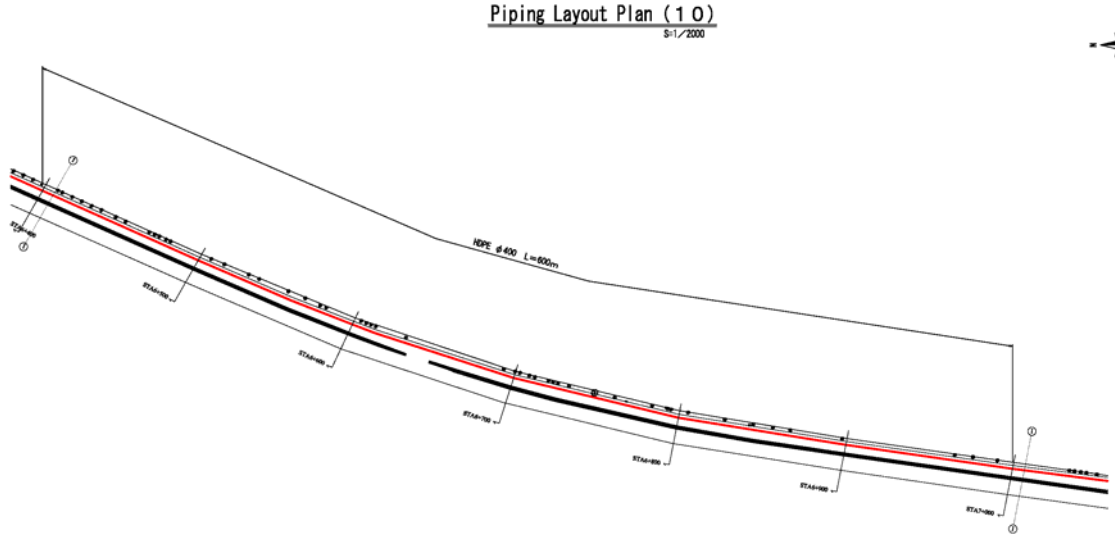

Piping Layout Plan (7)
S=1/2000
HDPE φ400 L=700m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (7)


Piping Layout Plan (8)
S=1/2000
Pipe Jacking Method SP 400A L=294.8m (300.2m)
Length of Pipe Jacking 286m
HDPE φ400 L=367m
HDPE φ400 L=35m
NGURAH RAI AIRPORT
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (8)


Piping Layout Plan (9)
S=1/2000
HDPE φ400 L=700m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (9)

Piping Layout Plan (10)

S=1/2000

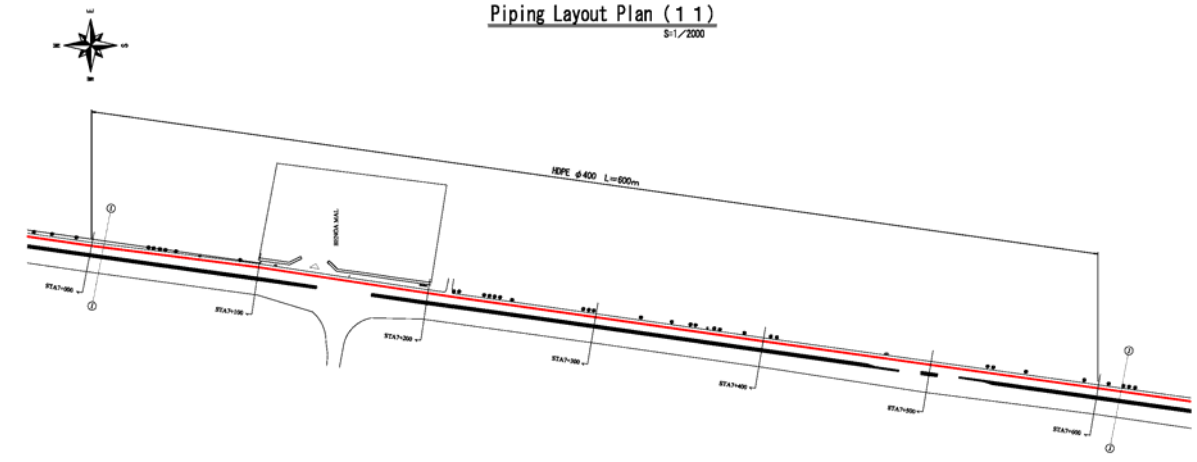


0m 50m

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Piping Layout Plan (10)
JAPAN INTERNATIONAL COOPERATION AGENCY	

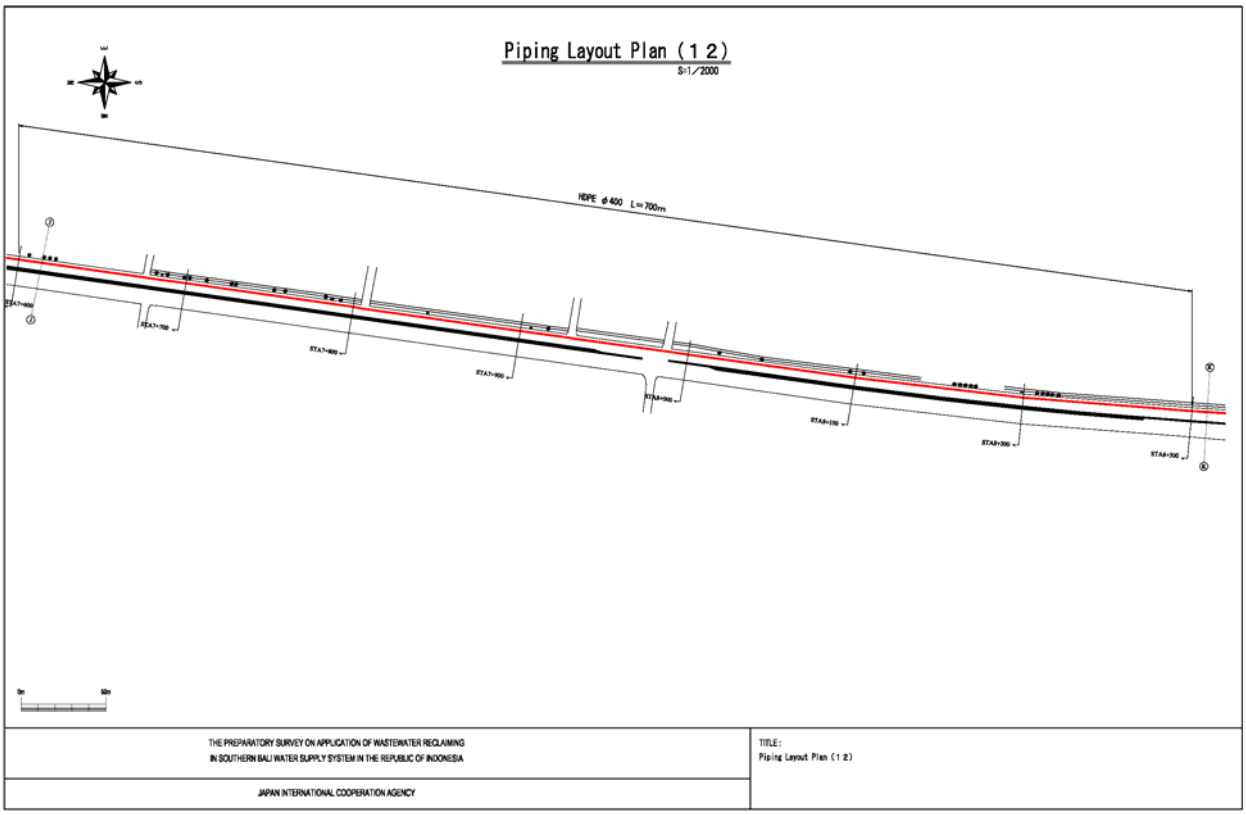
Piping Layout Plan (11)

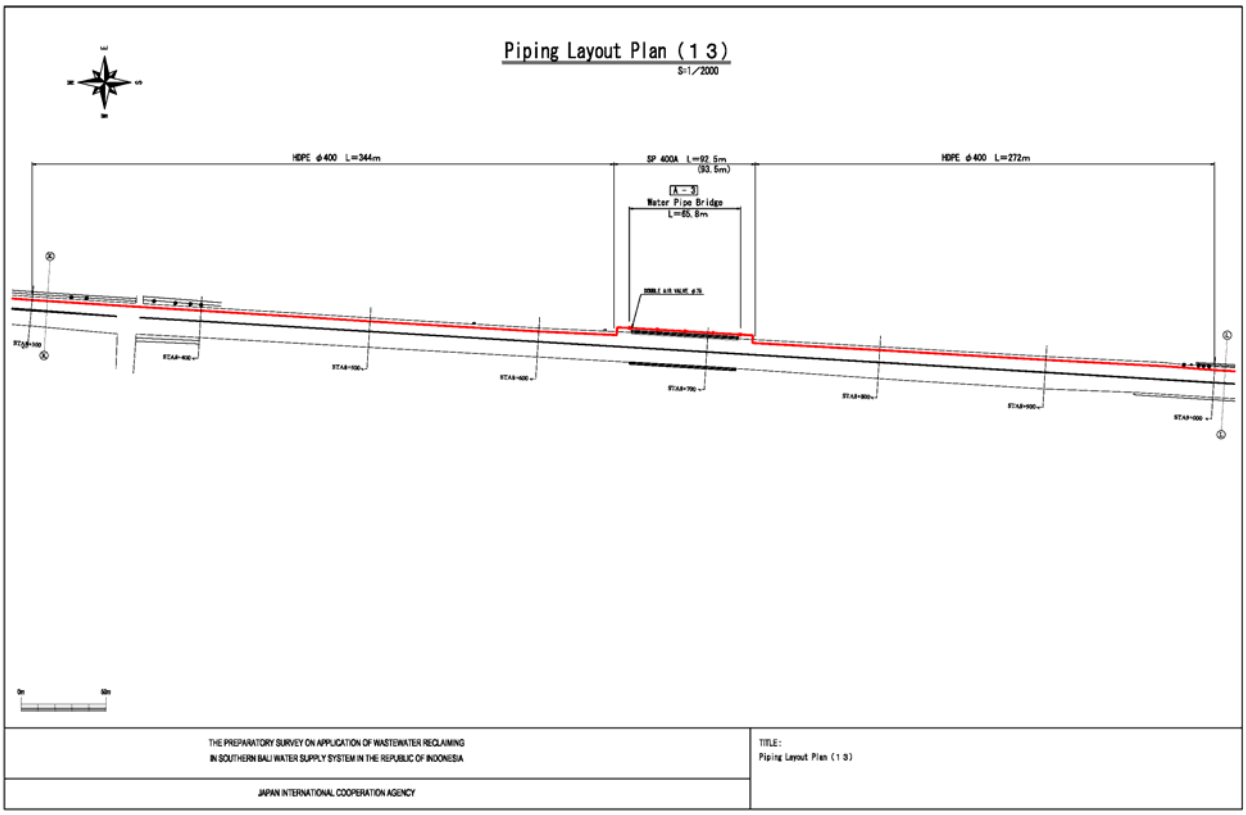
S=1/2000

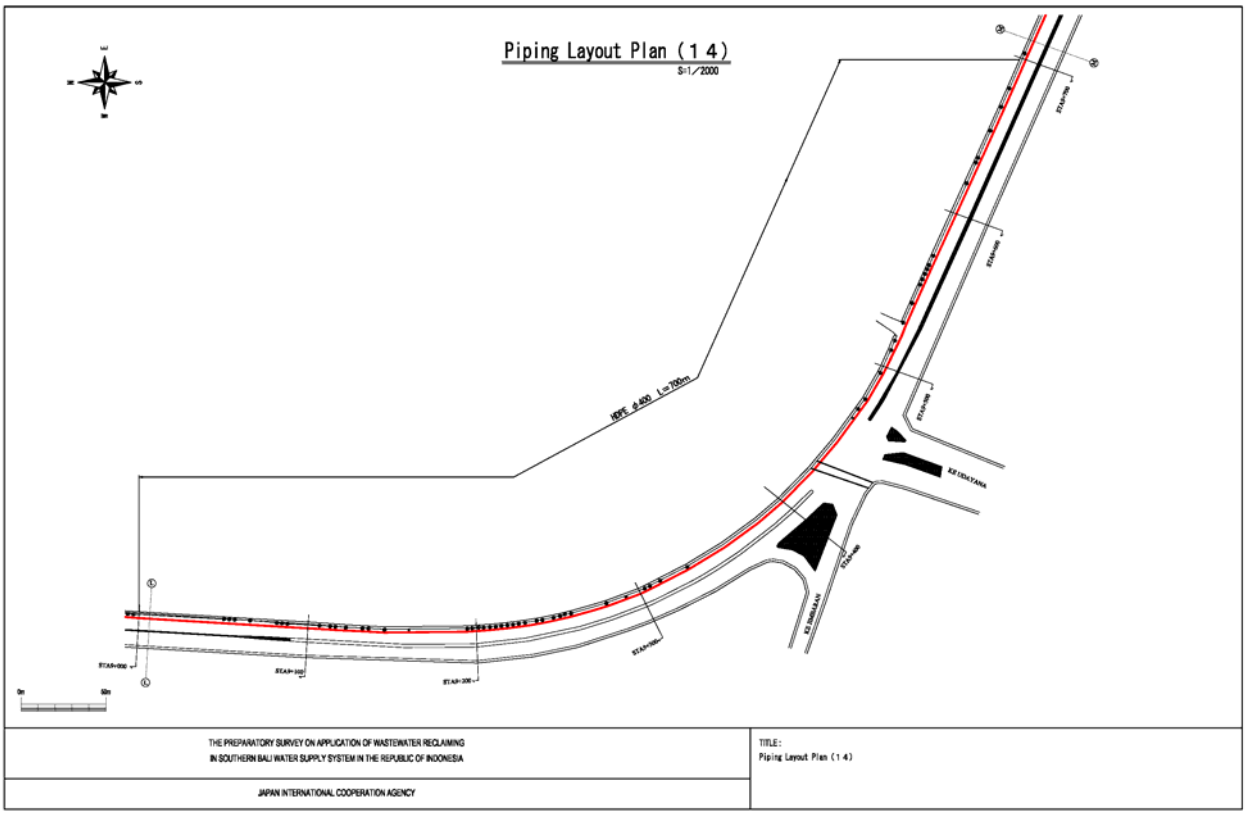


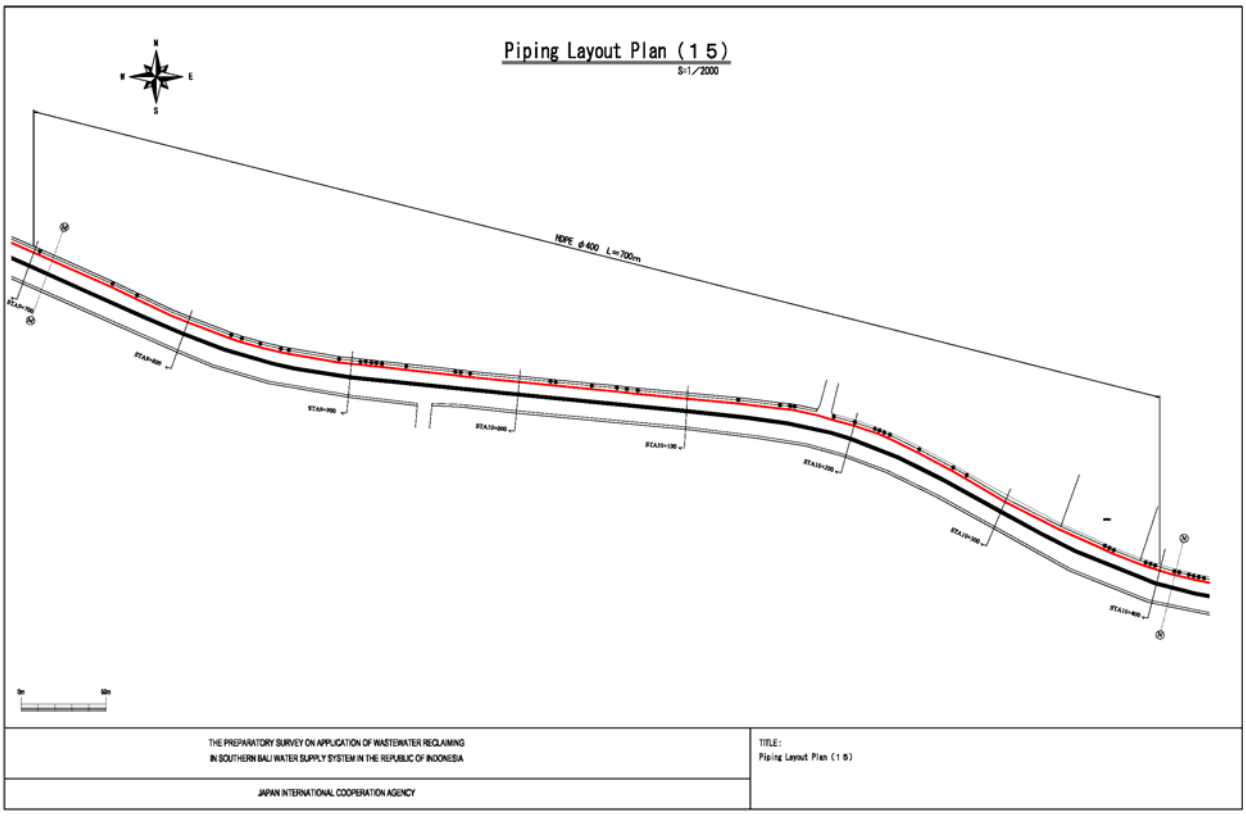
0m 50m

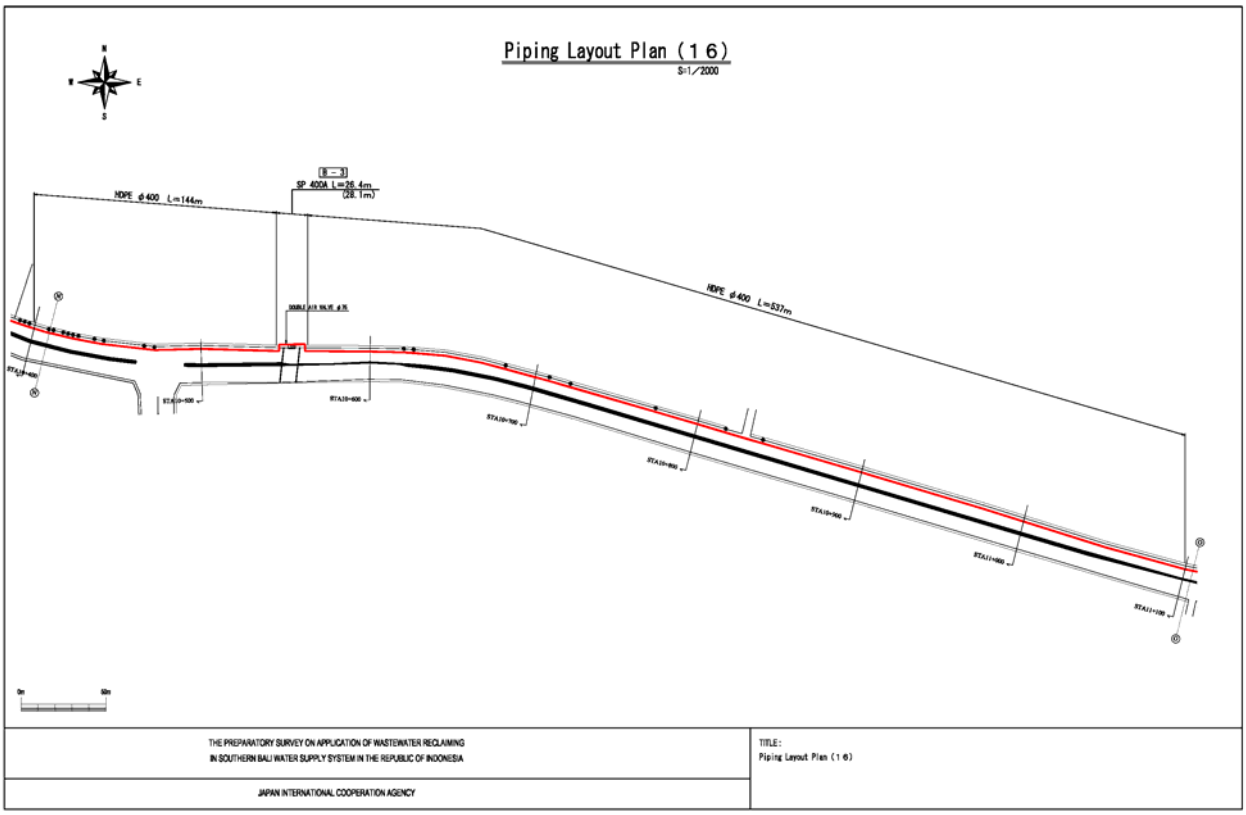
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Piping Layout Plan (11)
JAPAN INTERNATIONAL COOPERATION AGENCY	

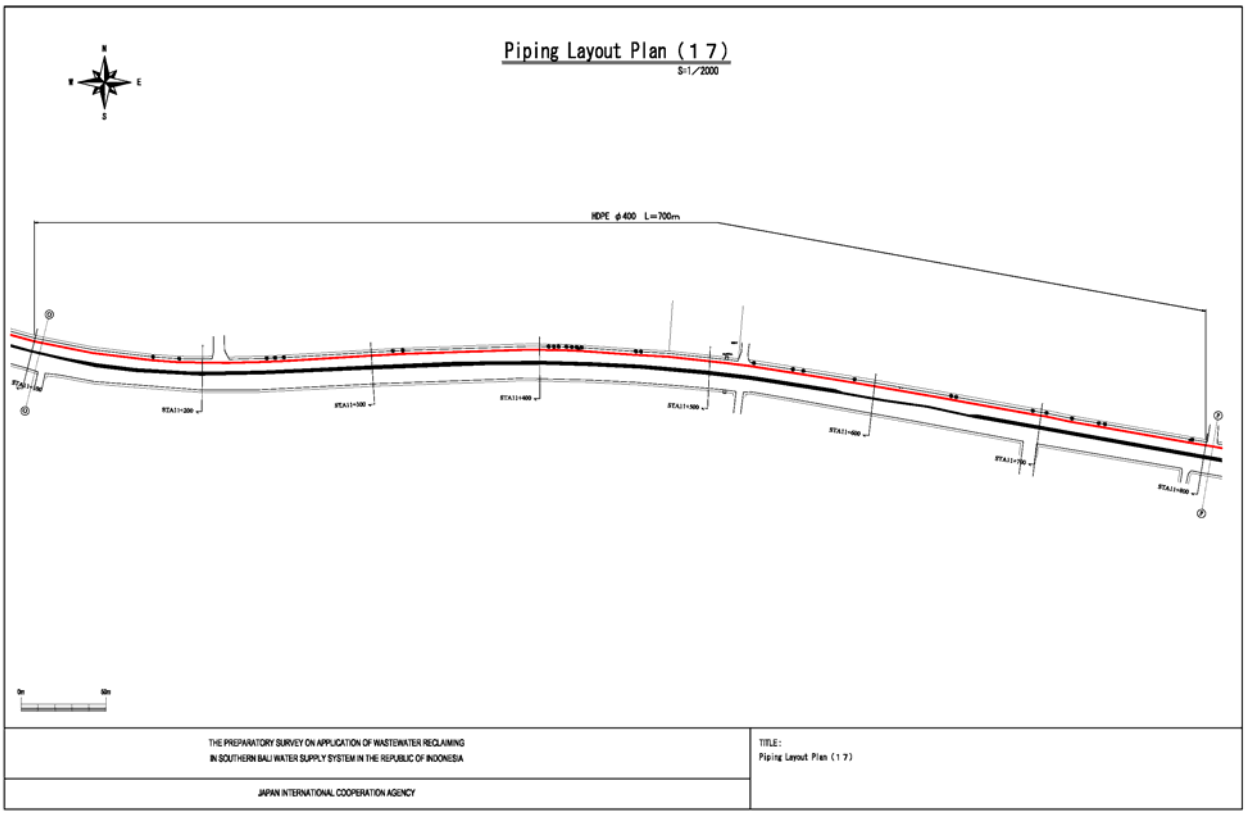

Piping Layout Plan (12)
S=1/2000
HDPE φ400 L=700m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (12)

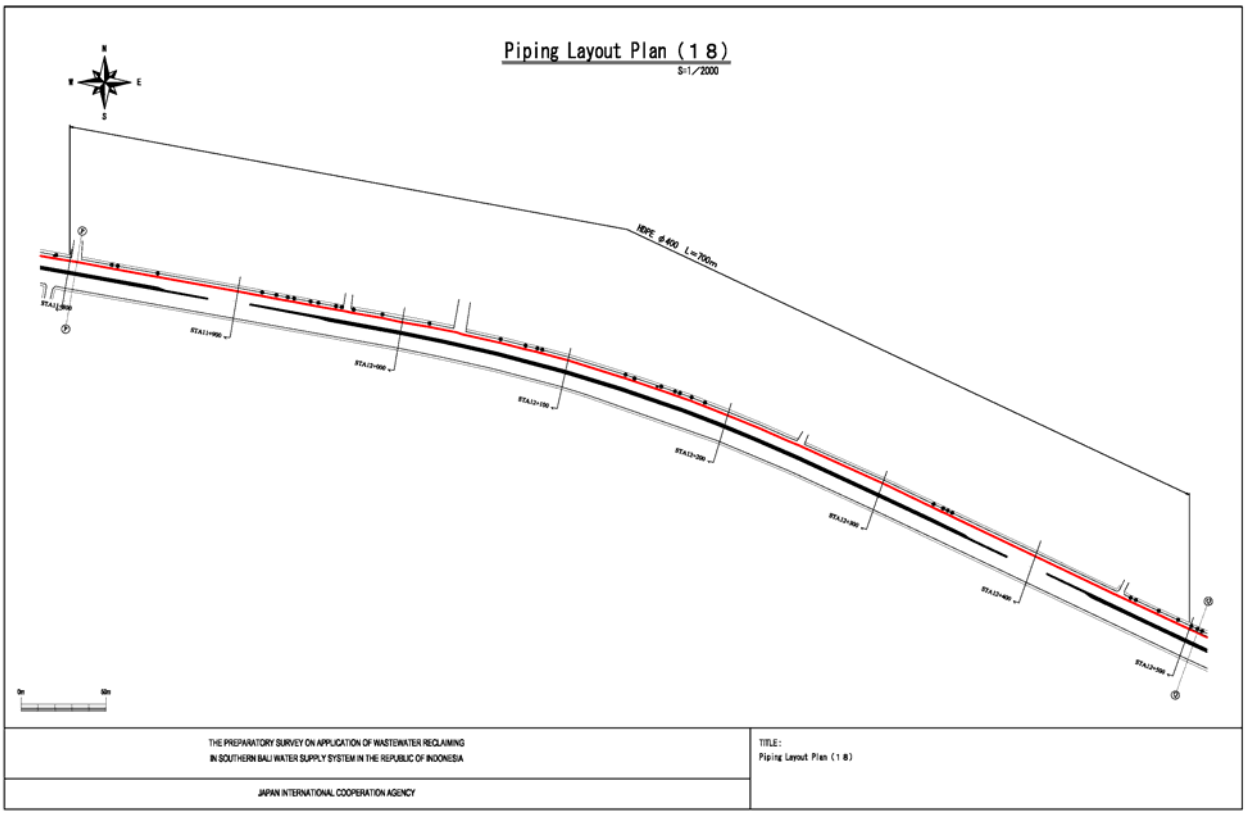

Piping Layout Plan (13)
S=1/2000
HDPE φ400 L=344m
SP 400A L=92.5m
(93.5m)
A-3
Water Pipe Bridge
L=65.8m
HDPE φ400 L=272m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (13)

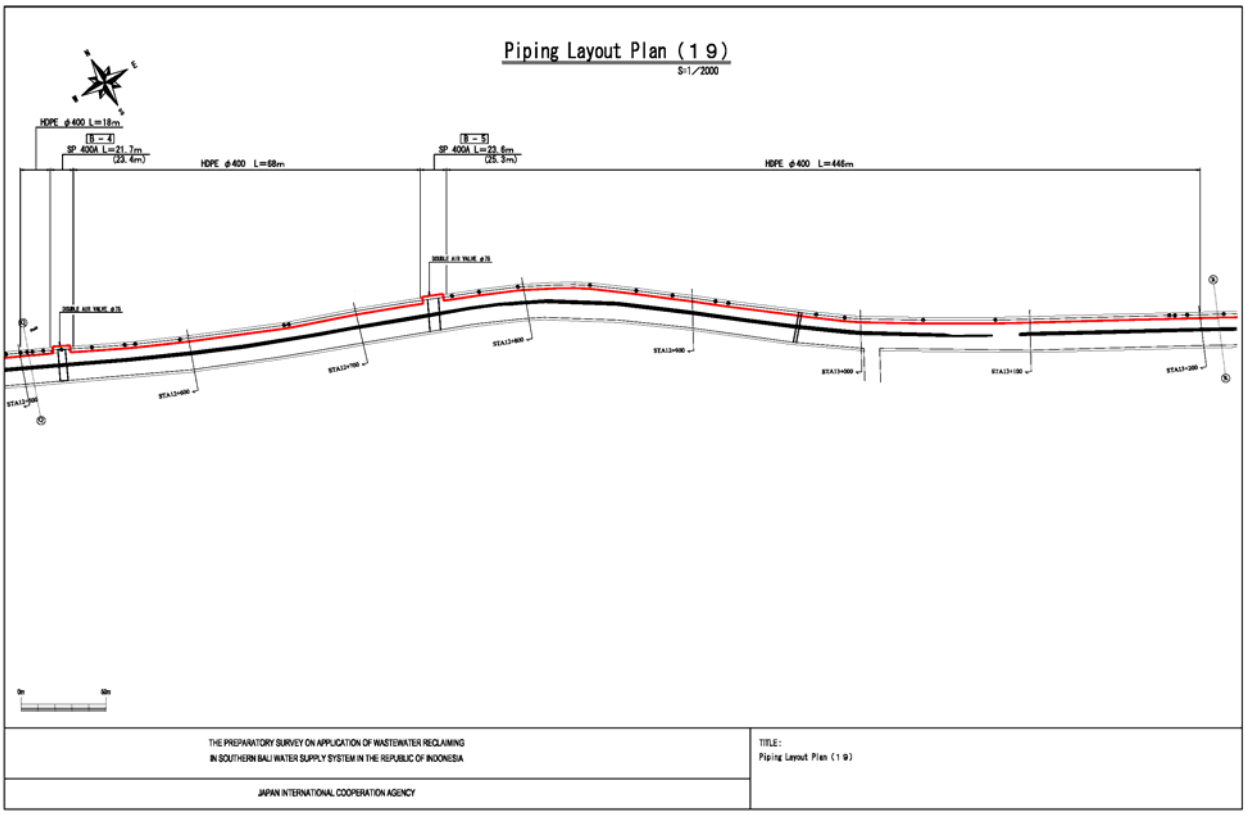

Piping Layout Plan (14)
S=1/2000
HDPE φ400 L=700m
JL.SUNSET ROAD
JL.BYPASS NGURAH RAI
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (14)

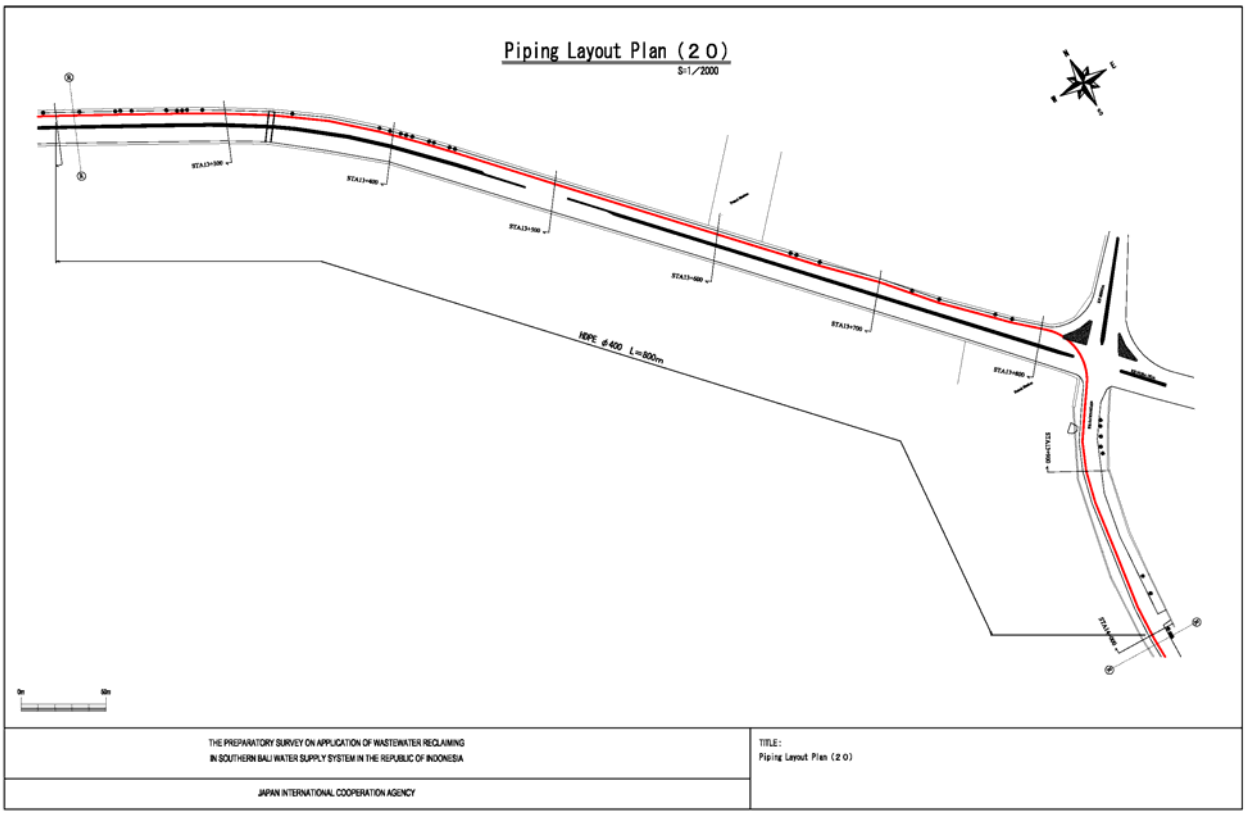

Piping Layout Plan (15)
S=1/2000
HDPE φ400 L=700m
0m
50m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (15)

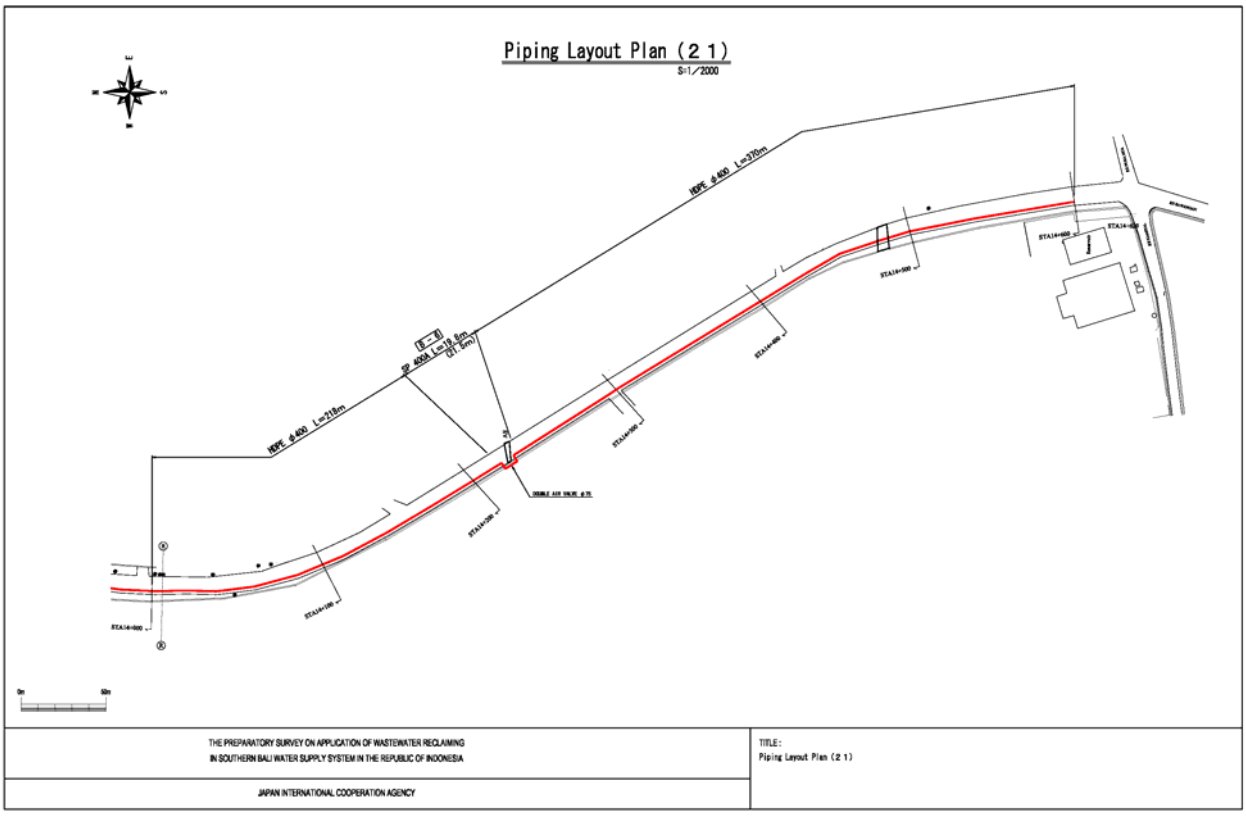

Piping Layout Plan（１６）
S=1／2000
HDPE φ400 L=144m
B－3
SP 400A L=26.4m
(28.1m)
HDPE φ400 L=537m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan（１６）


Piping Layout Plan（１７）
S=1／2000
HDPE φ400 L=700m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan（１７）


Piping Layout Plan (18)
S=1/2000
HDPE φ400 L=700m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (18)

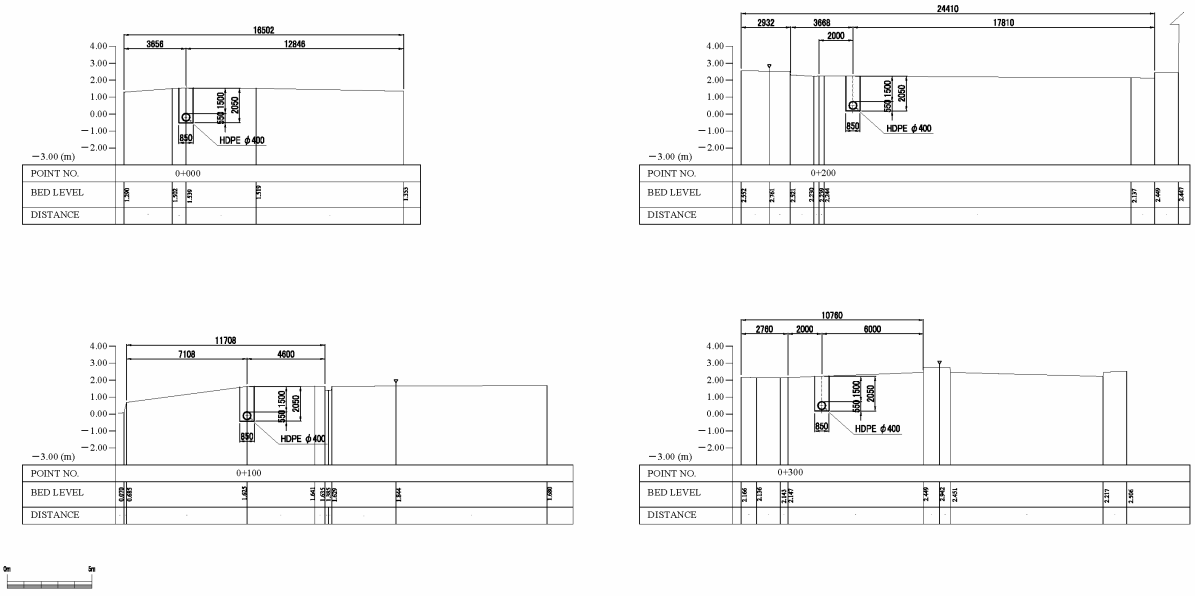

Piping Layout Plan (19)
S=1/2000
HDPE φ400 L=18m
HDPE φ400 L=58m
HDPE φ400 L=446m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (19)


Piping Layout Plan (２０)
S=1／2000
HDPE φ400 L=800m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (２０)


Piping Layout Plan (２１)
S=1／2000
HDPE φ400 L=370m
HDPE φ400 L=218m
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING
IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA
JAPAN INTERNATIONAL COOPERATION AGENCY
TITLE:
Piping Layout Plan (２１)

Cross-sectional View of Piping (1)

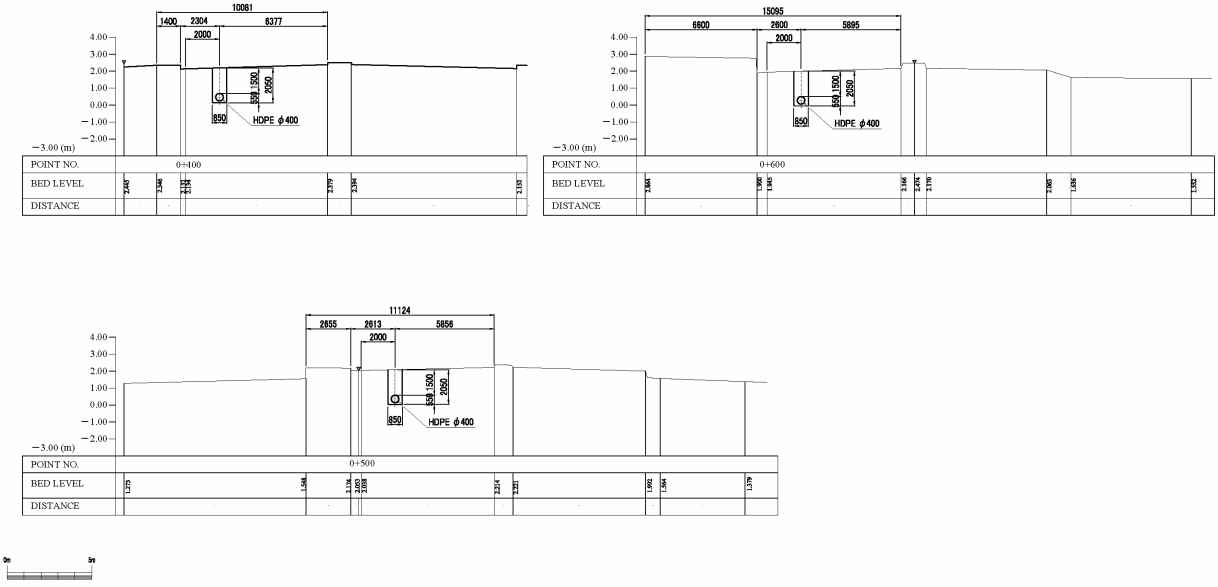
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (1)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (2)

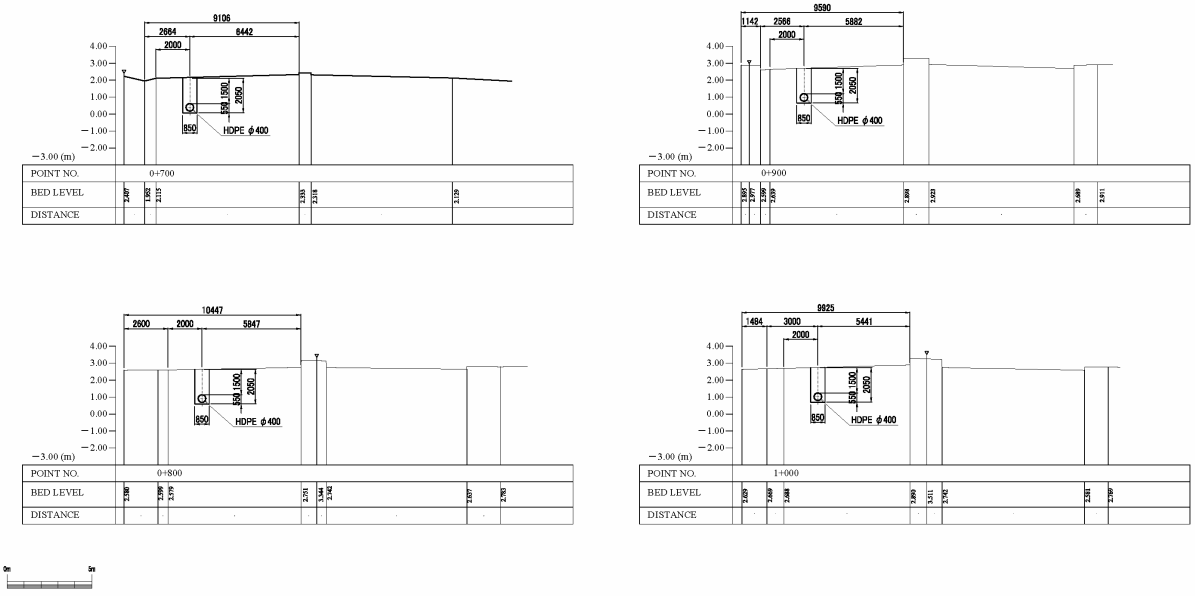
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (2)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (3)

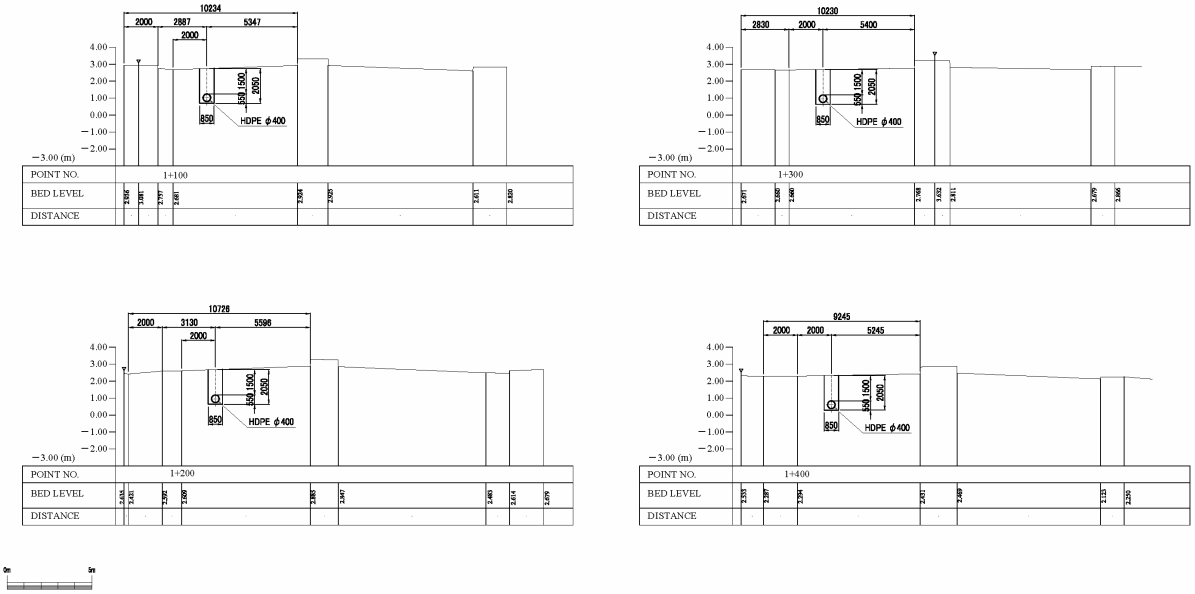
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (3)
JAPAN INTERNATIONAL COOPERATION AGENCY	

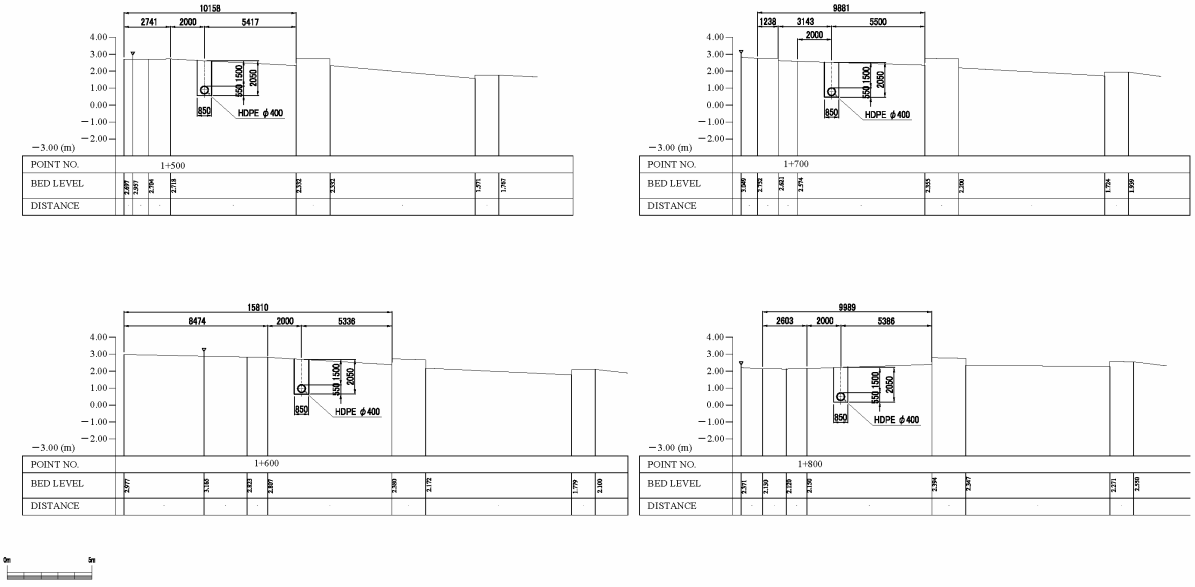
Cross-sectional View of Piping (4)

S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (4)
JAPAN INTERNATIONAL COOPERATION AGENCY	

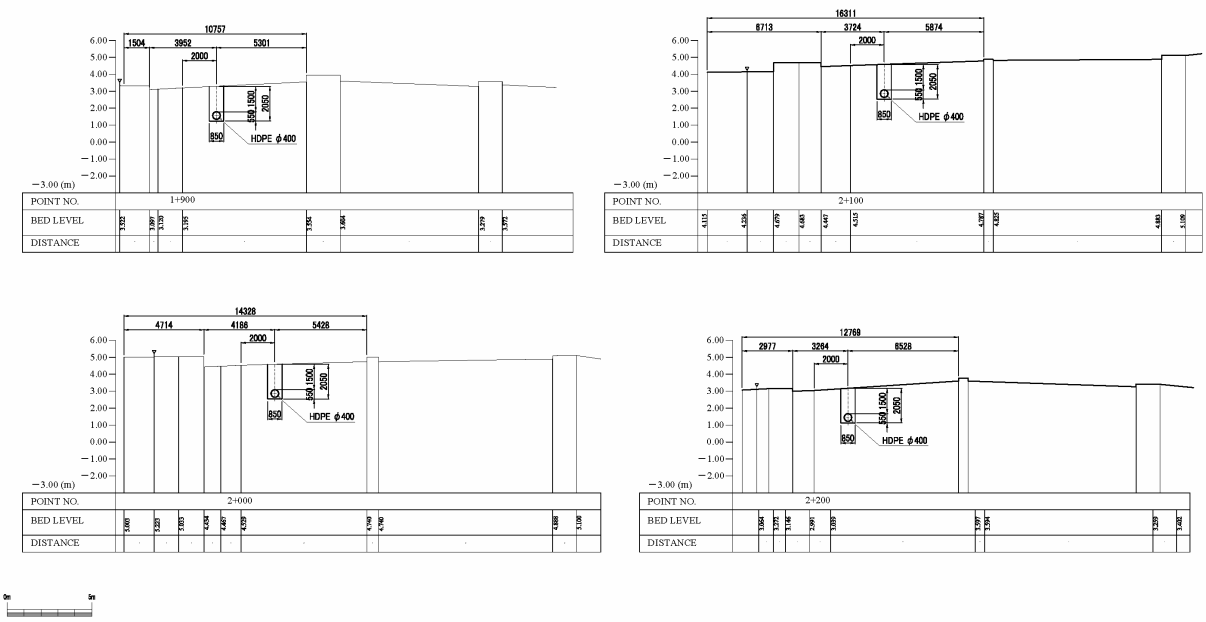
Cross-sectional View of Piping (5)



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (5)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (6)

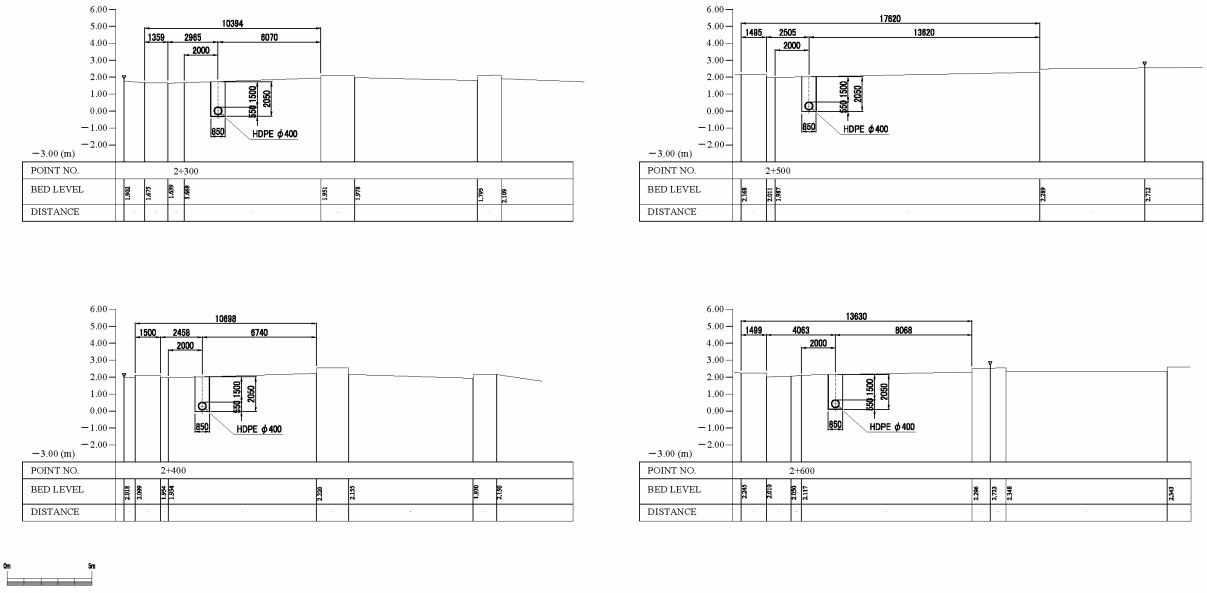
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (6)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (7)

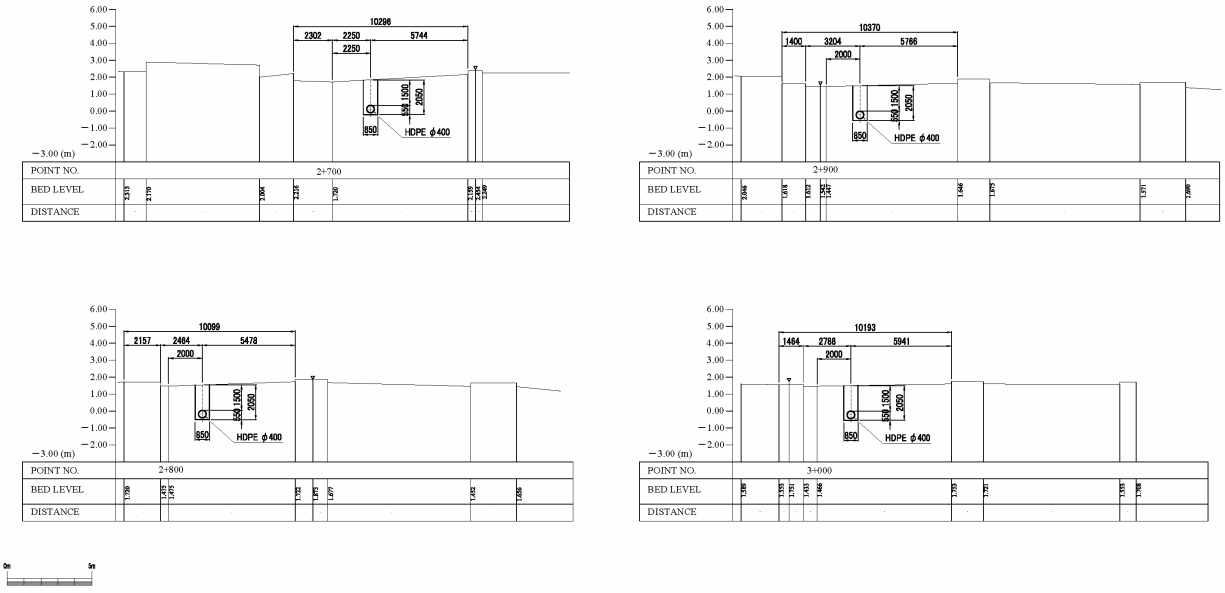
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (7)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (8)

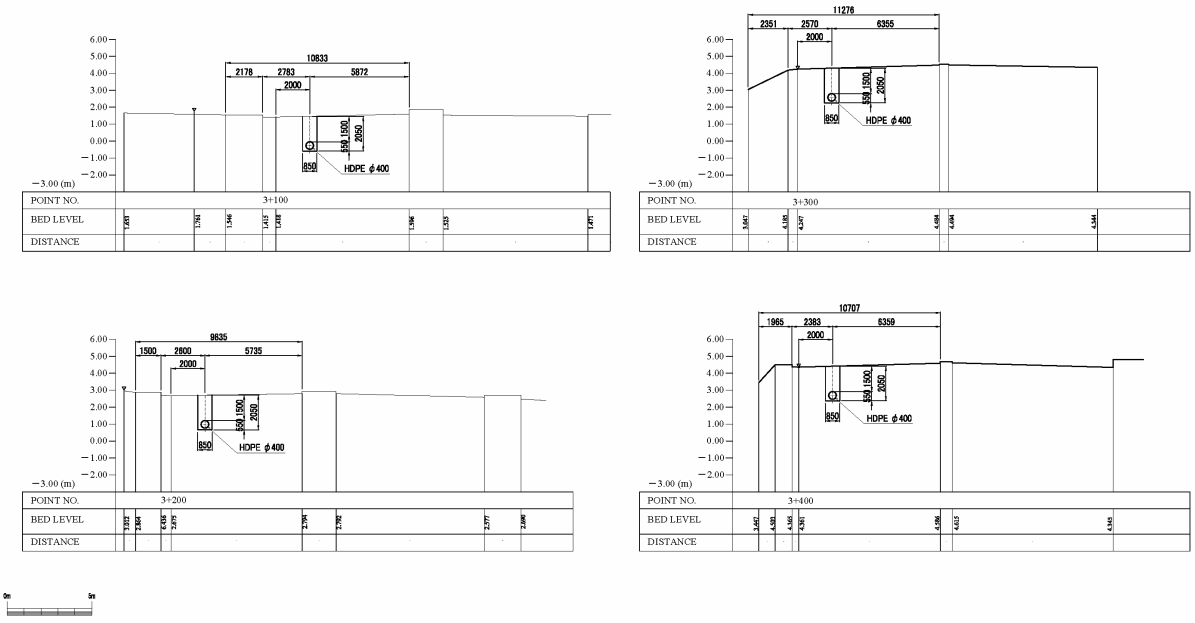
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (8)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (9)

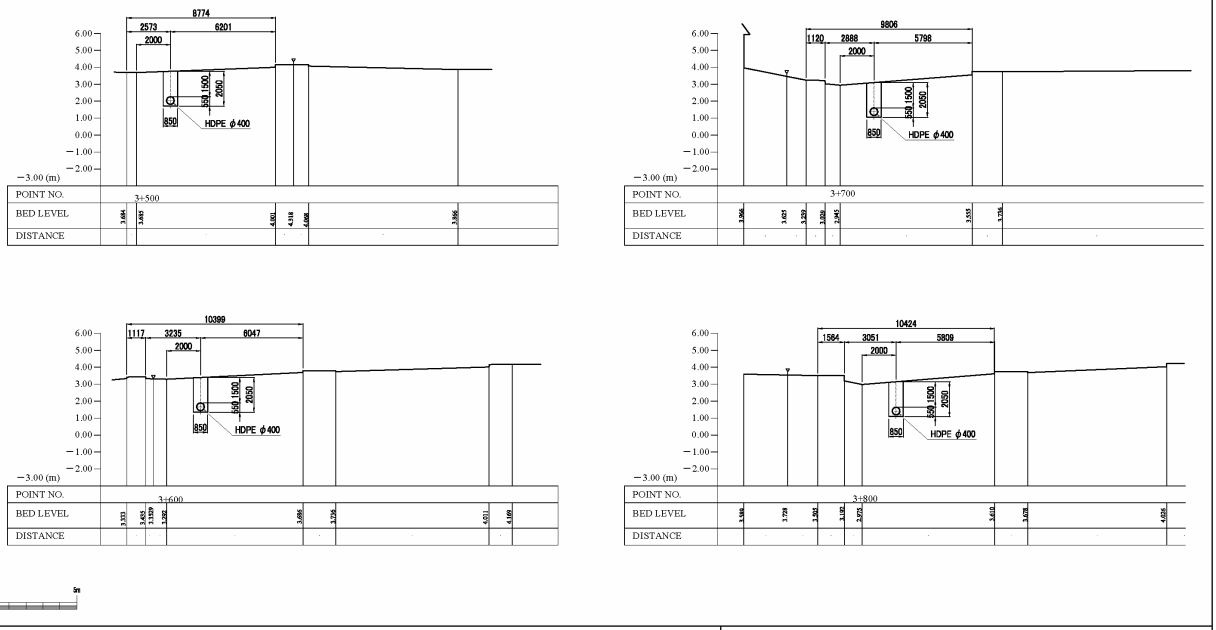
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (9)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (10)

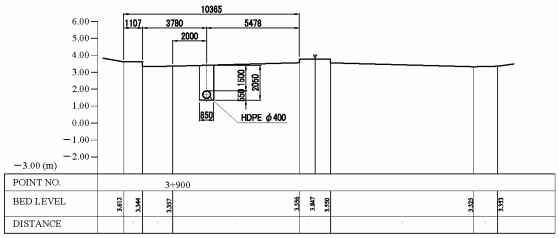
S=1/100

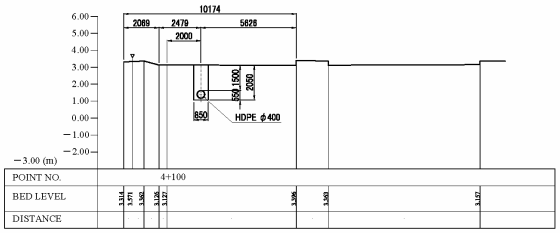


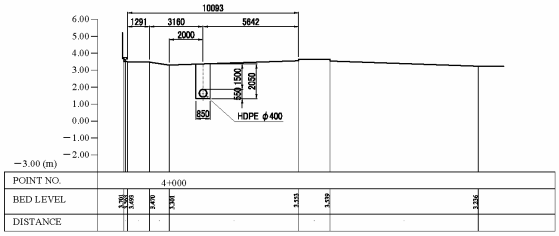
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (10)
JAPAN INTERNATIONAL COOPERATION AGENCY	

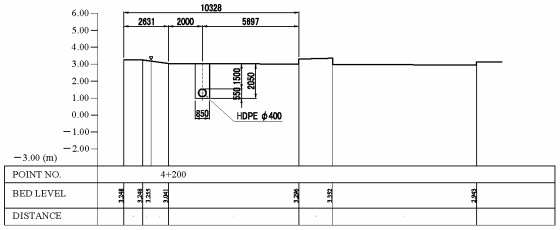
Cross-sectional View of Piping (１１)

S=1／100





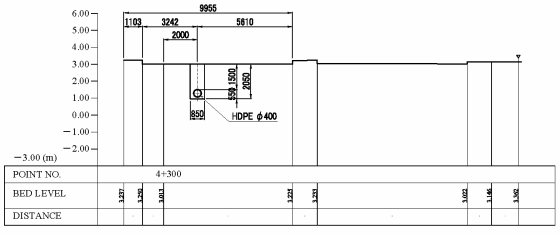


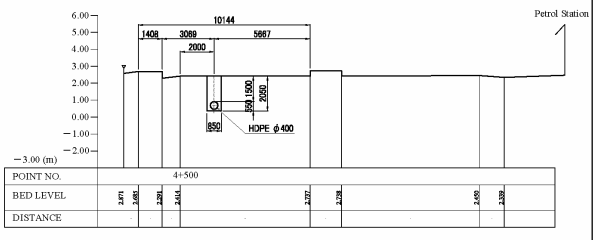


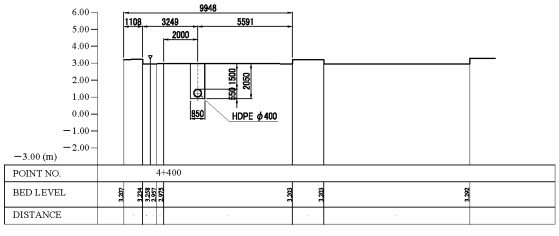
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (１１)
JAPAN INTERNATIONAL COOPERATION AGENCY	

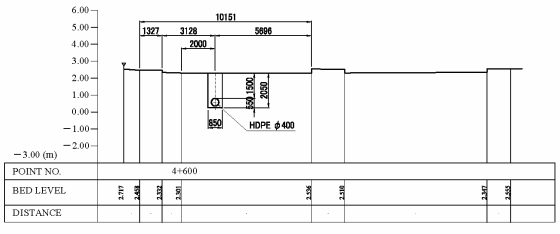
Cross-sectional View of Piping (１２)

S=1／100





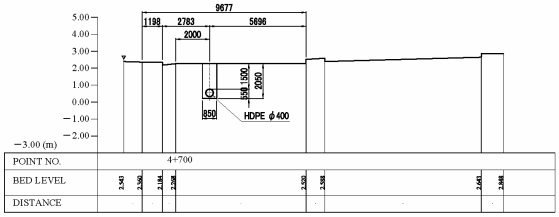


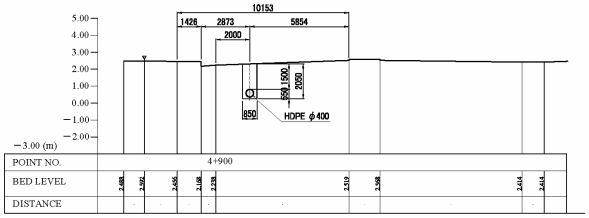


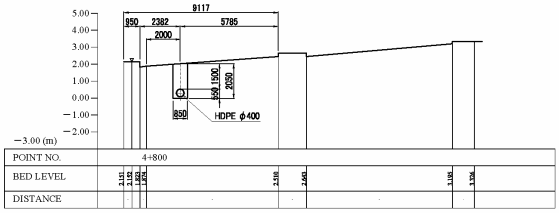
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (１２)
JAPAN INTERNATIONAL COOPERATION AGENCY	

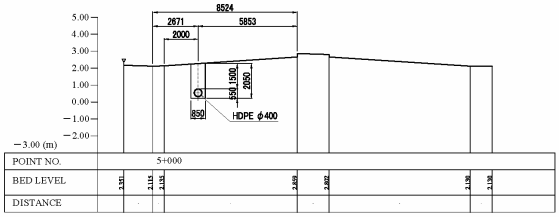
Cross-sectional View of Piping (１３)

S=1／100





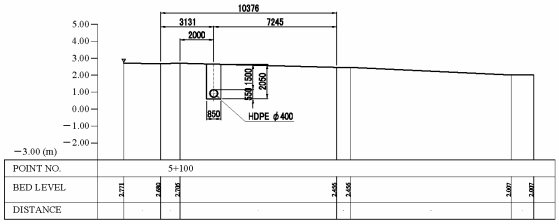


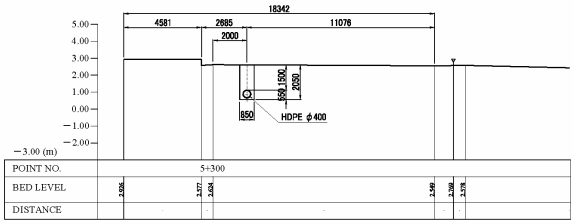


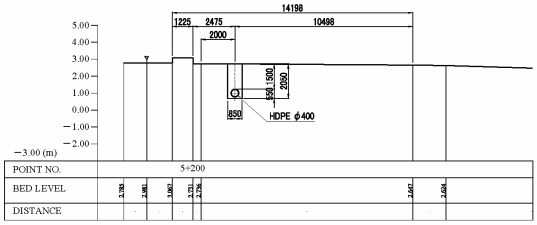
THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (１３)
JAPAN INTERNATIONAL COOPERATION AGENCY	

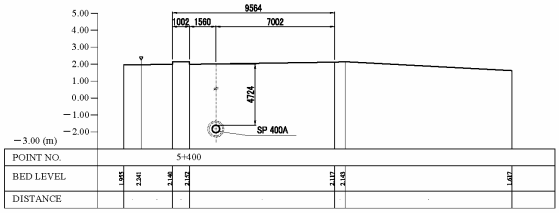
Cross-sectional View of Piping (１４)

S=1／100





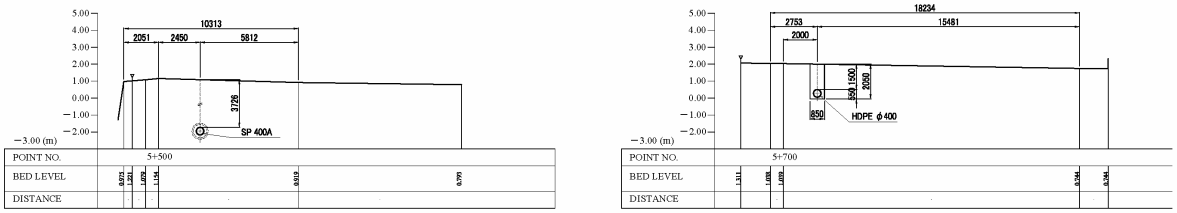




THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (１４)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (15)

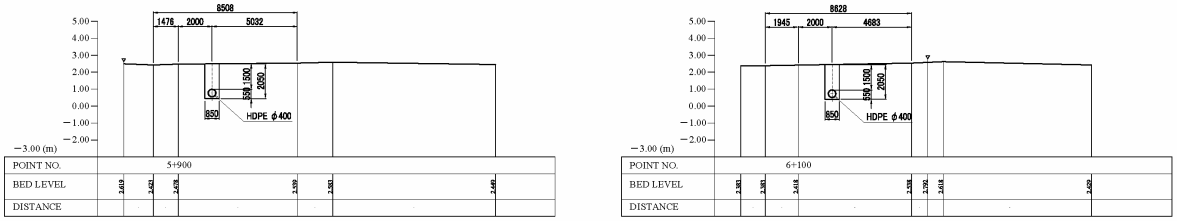
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (15)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (16)

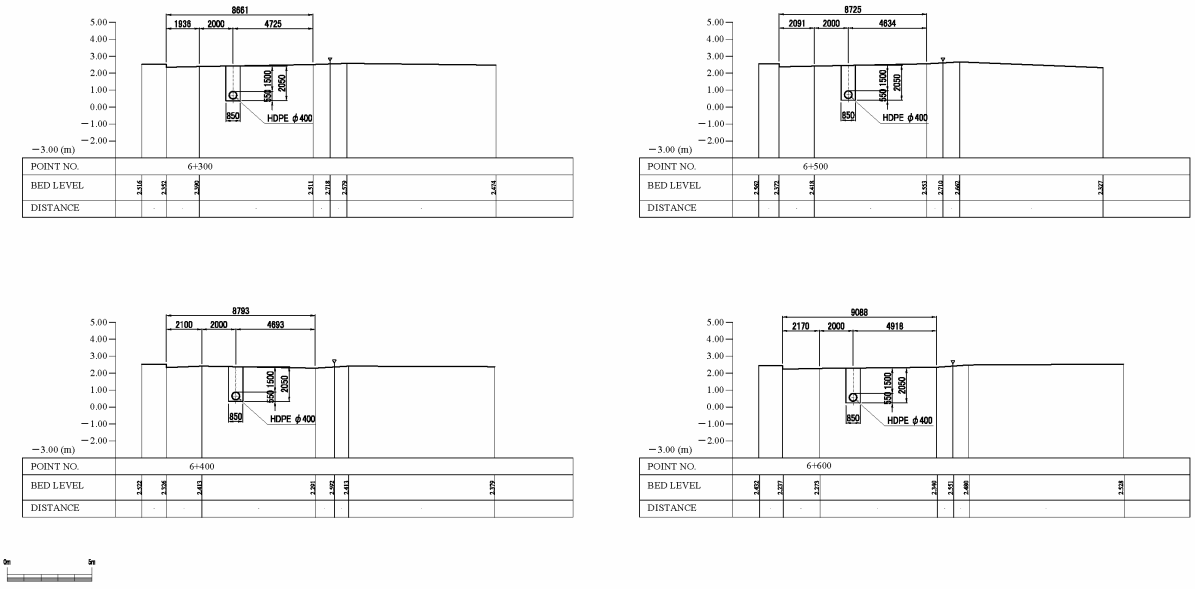
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (16)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (17)

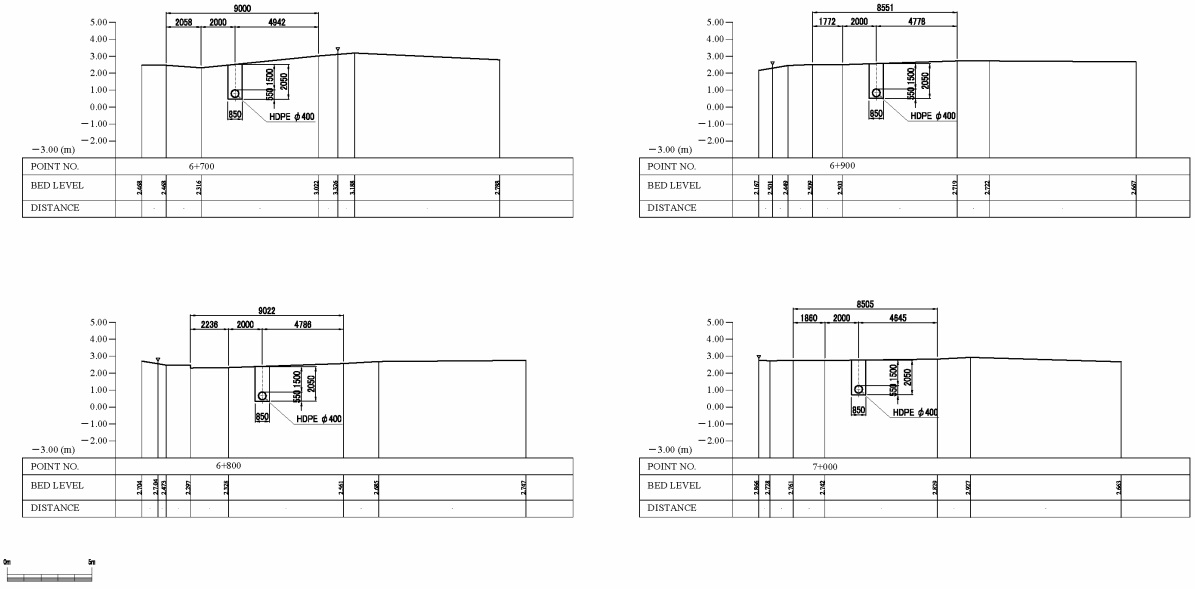
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (17)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (18)

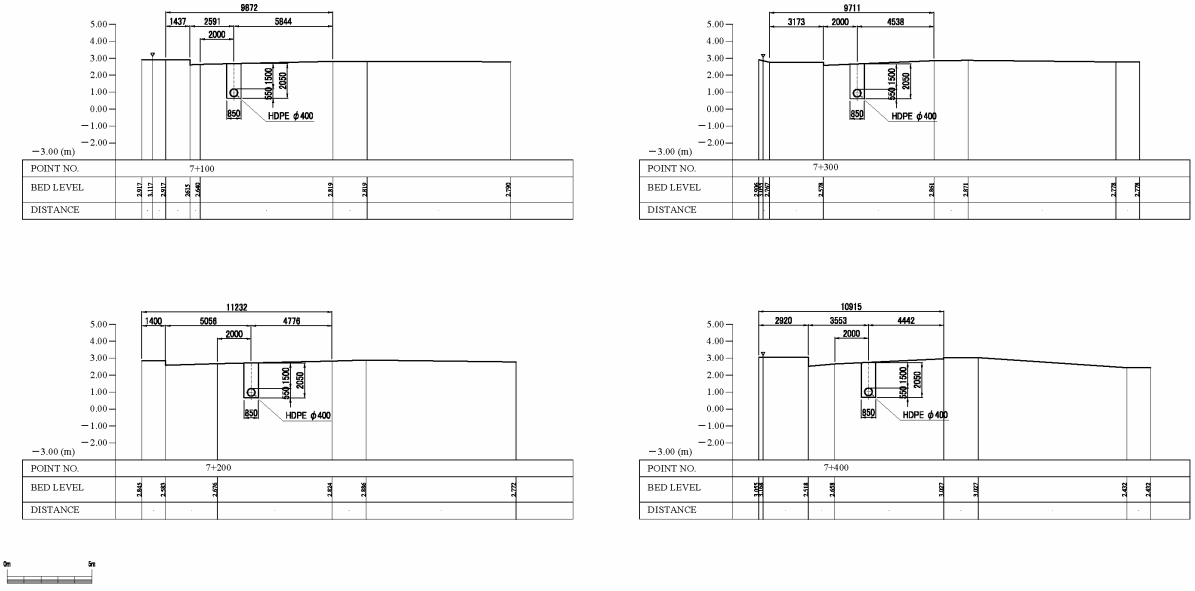
S=1/100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (18)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (１９)

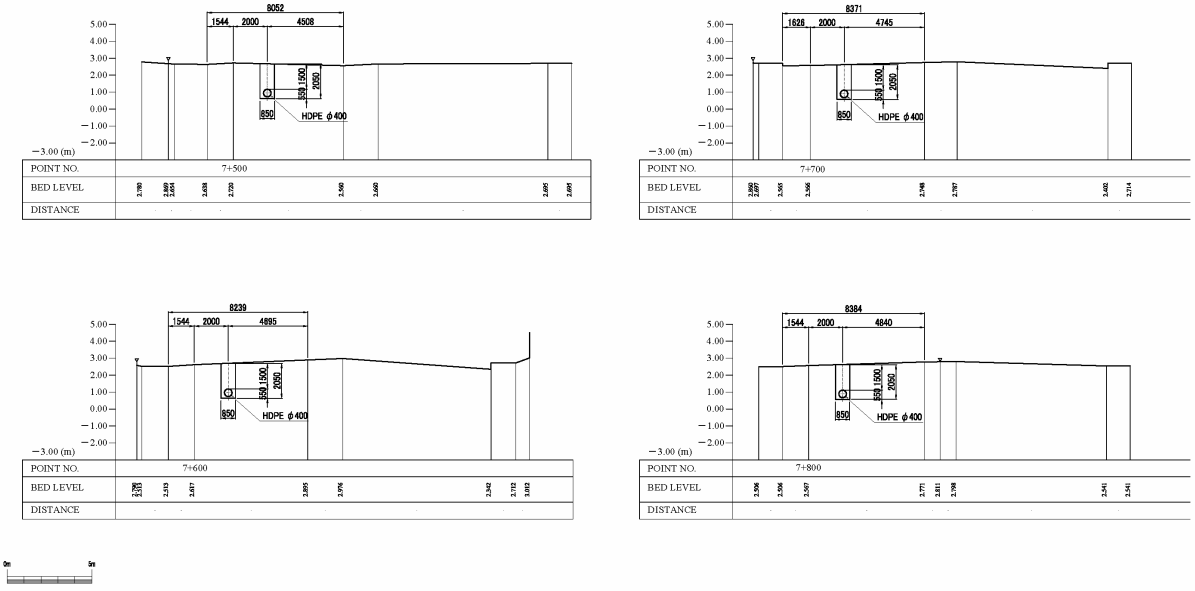
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (１９)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２０)

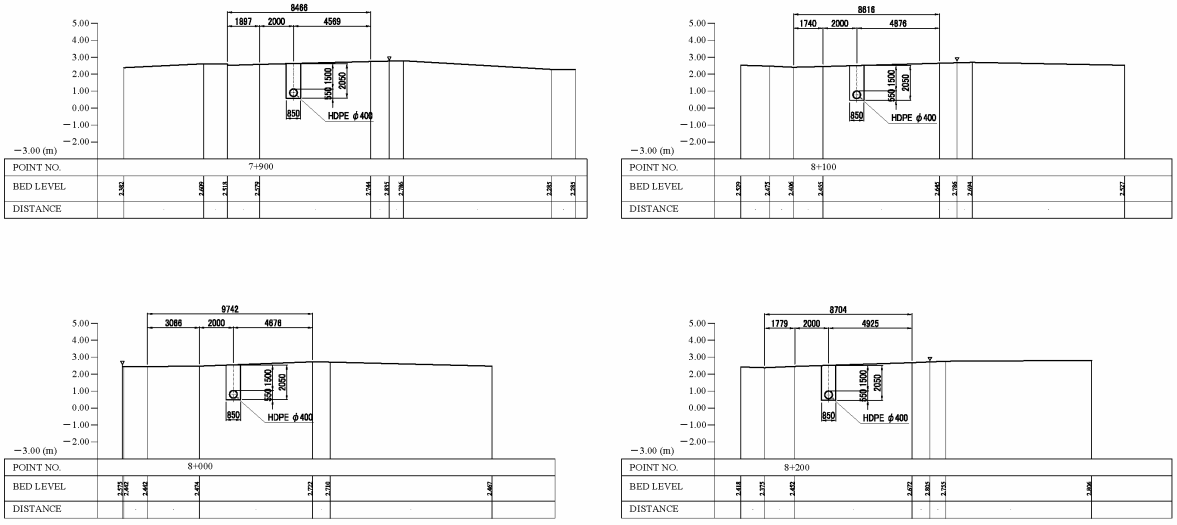
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２０)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２１)

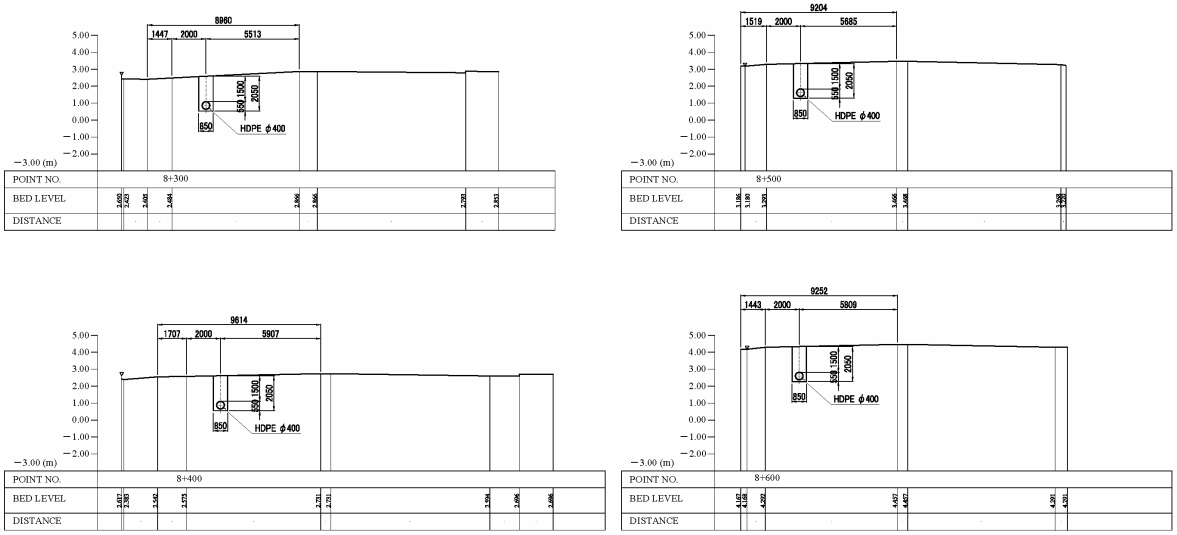
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２１)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２２)

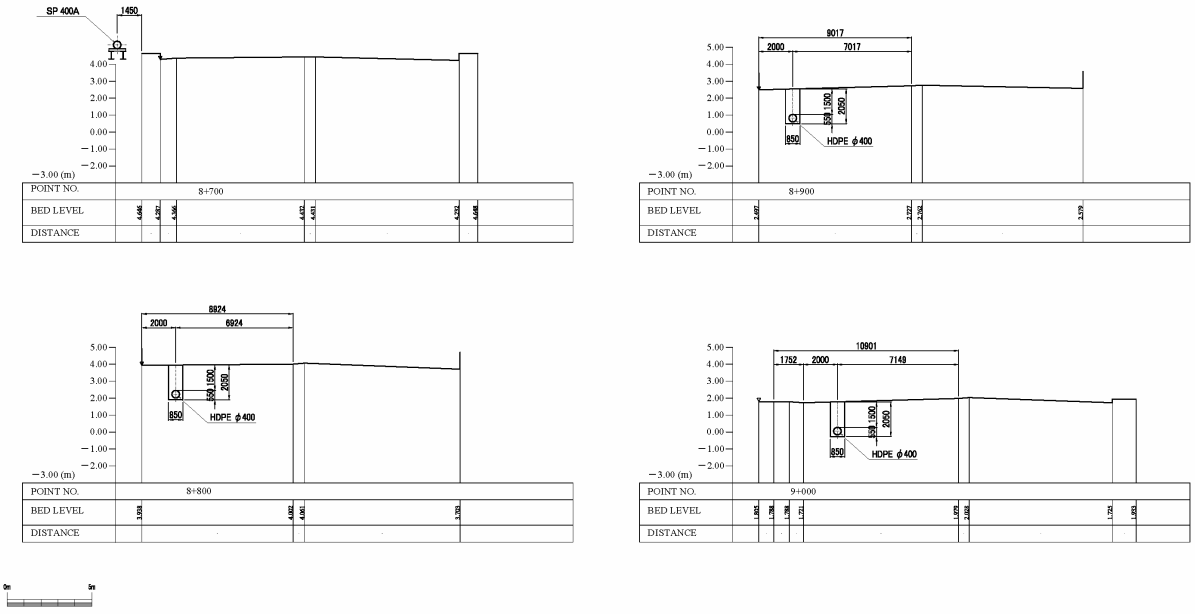
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２２)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２３)

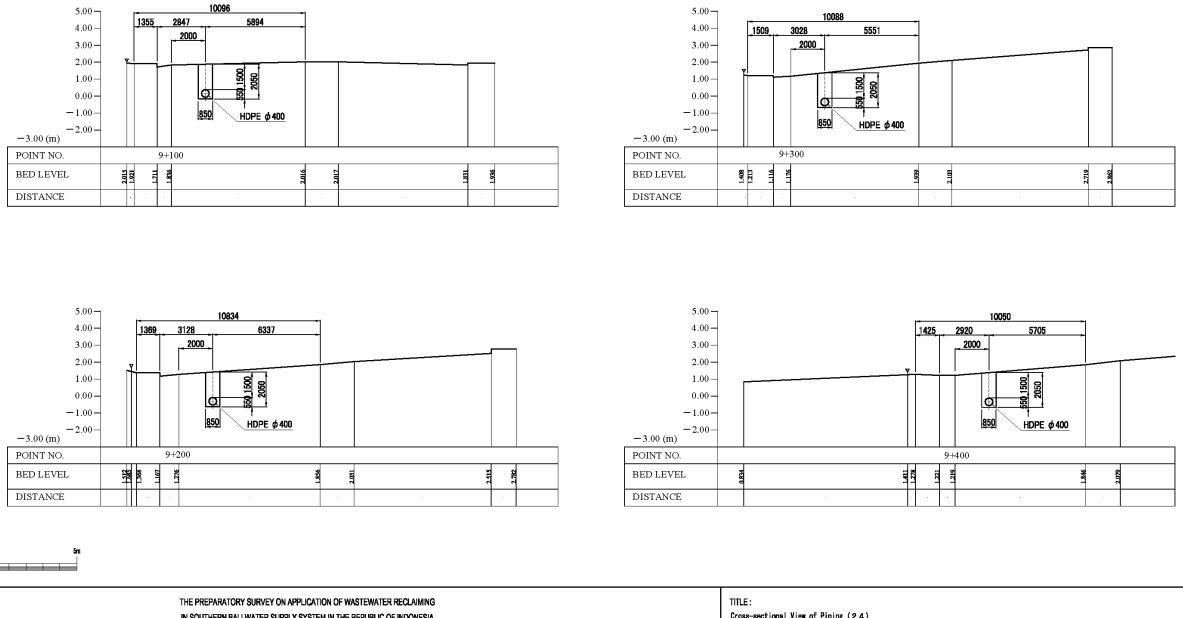
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２３)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２４)

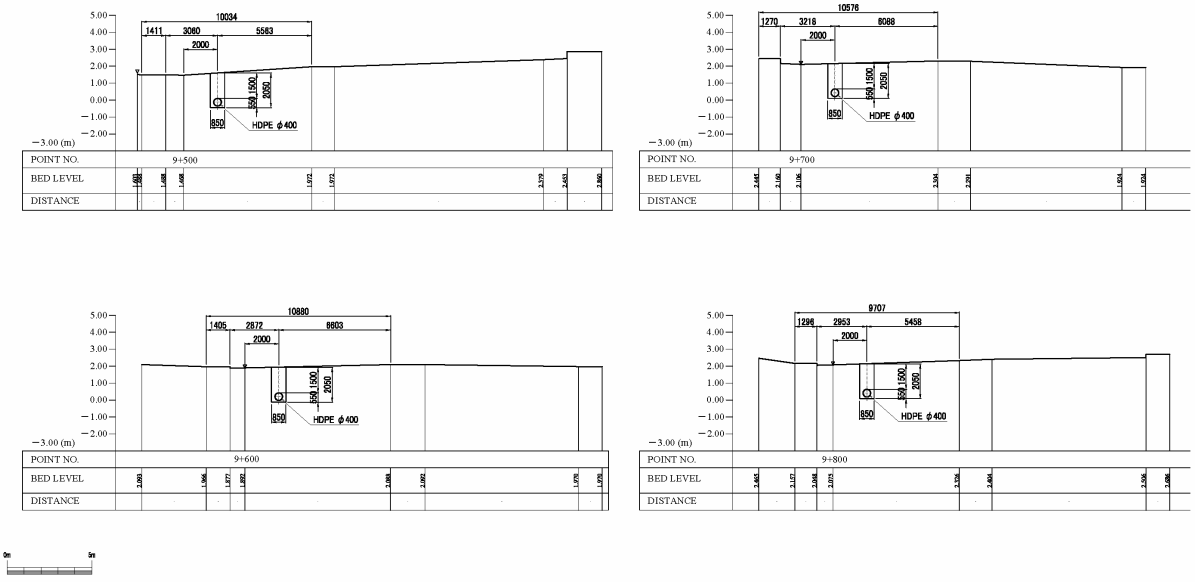
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２４)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２５)

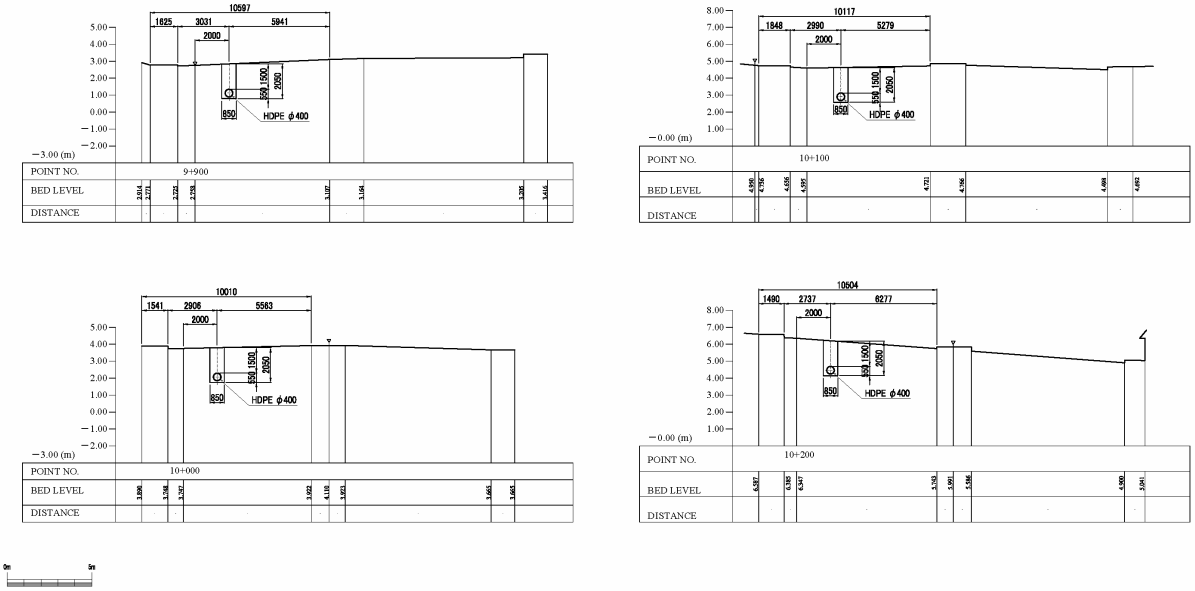
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２５)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２６)

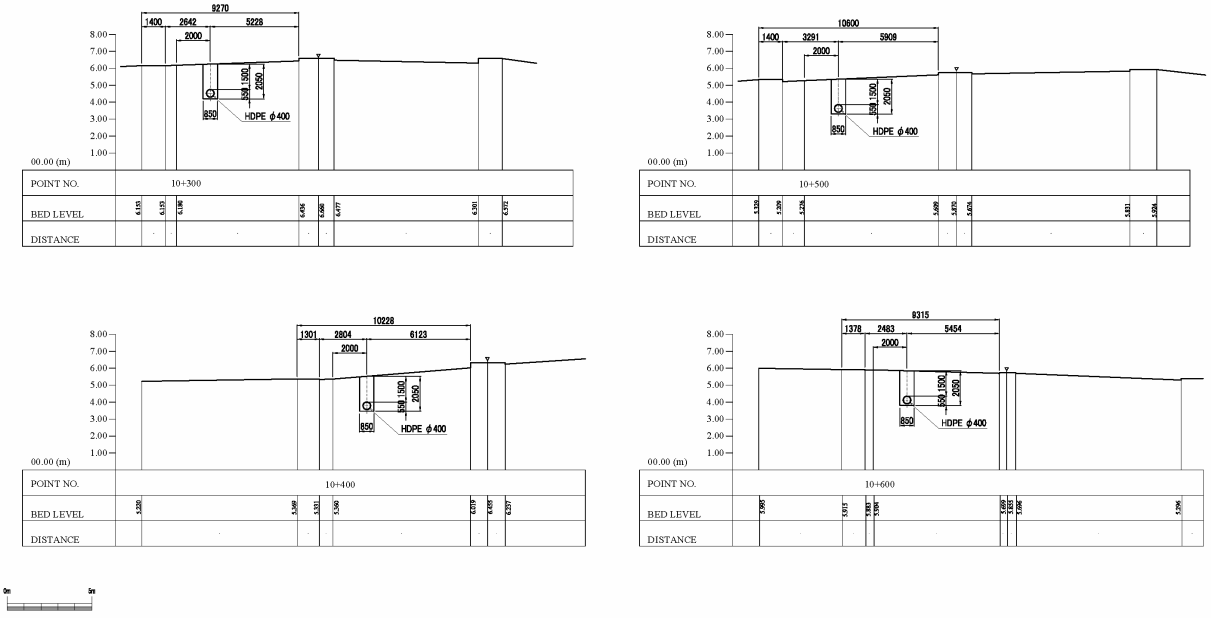
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２６)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２７)

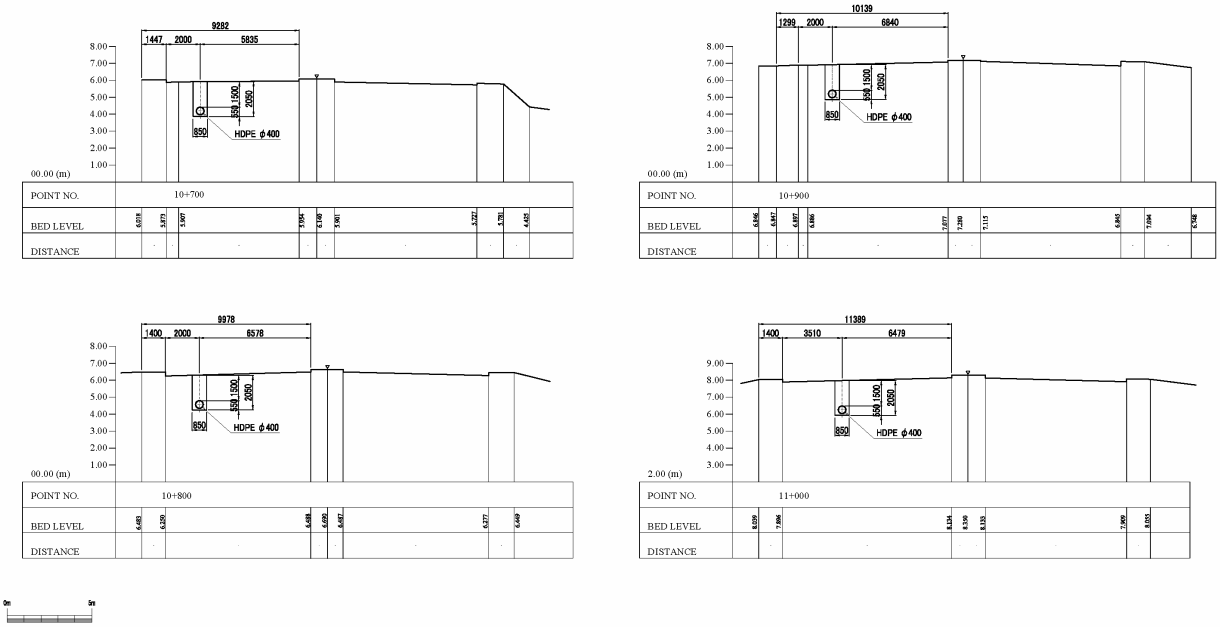
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２７)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２８)

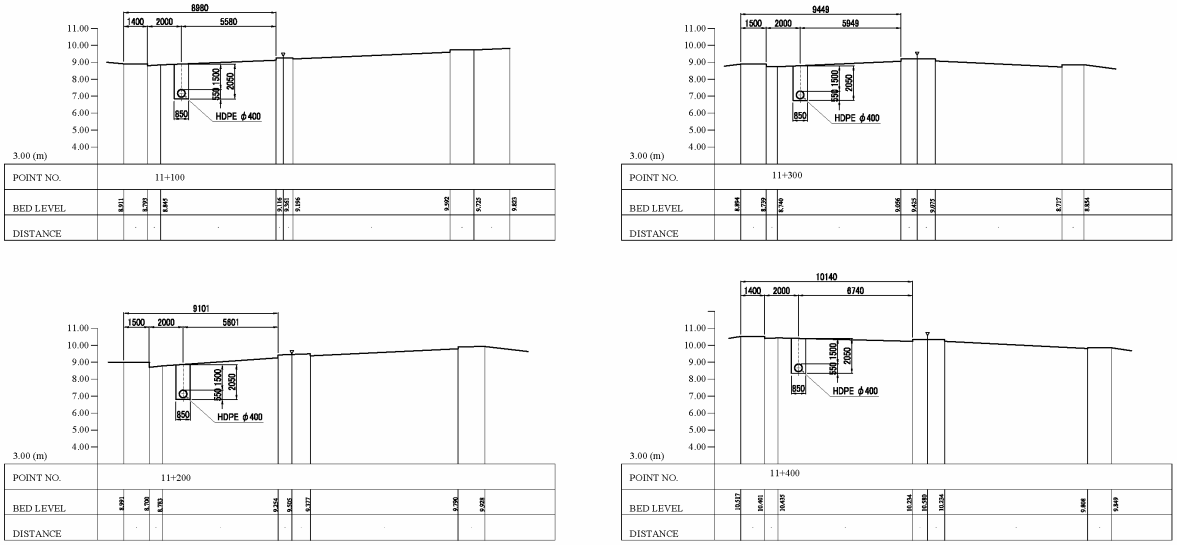
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２８)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (２９)

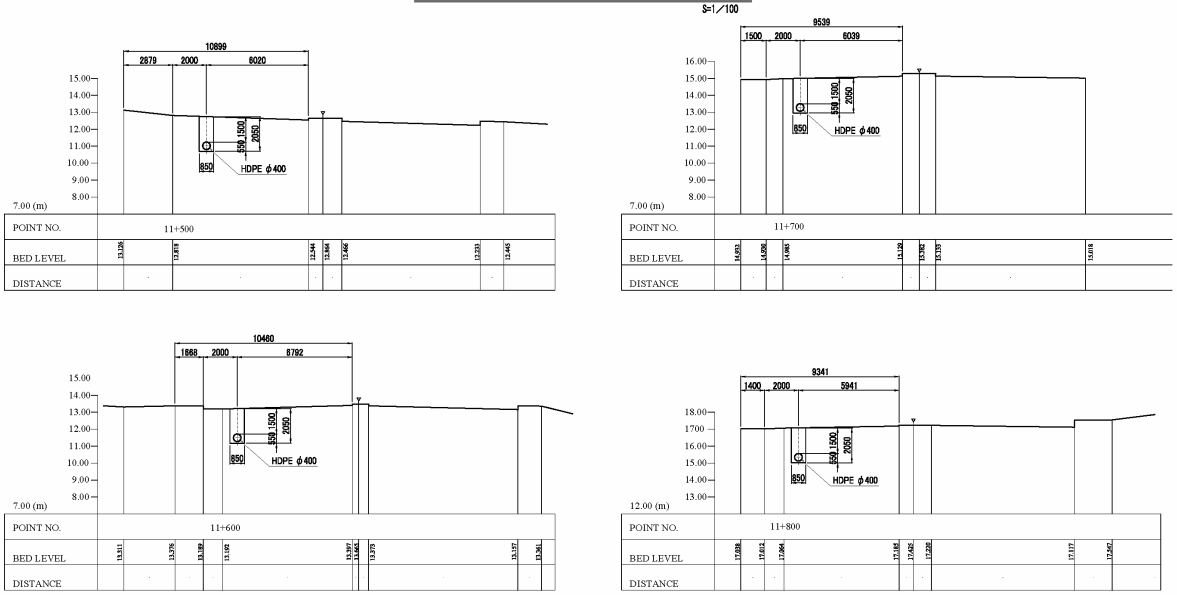
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (２９)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３０)

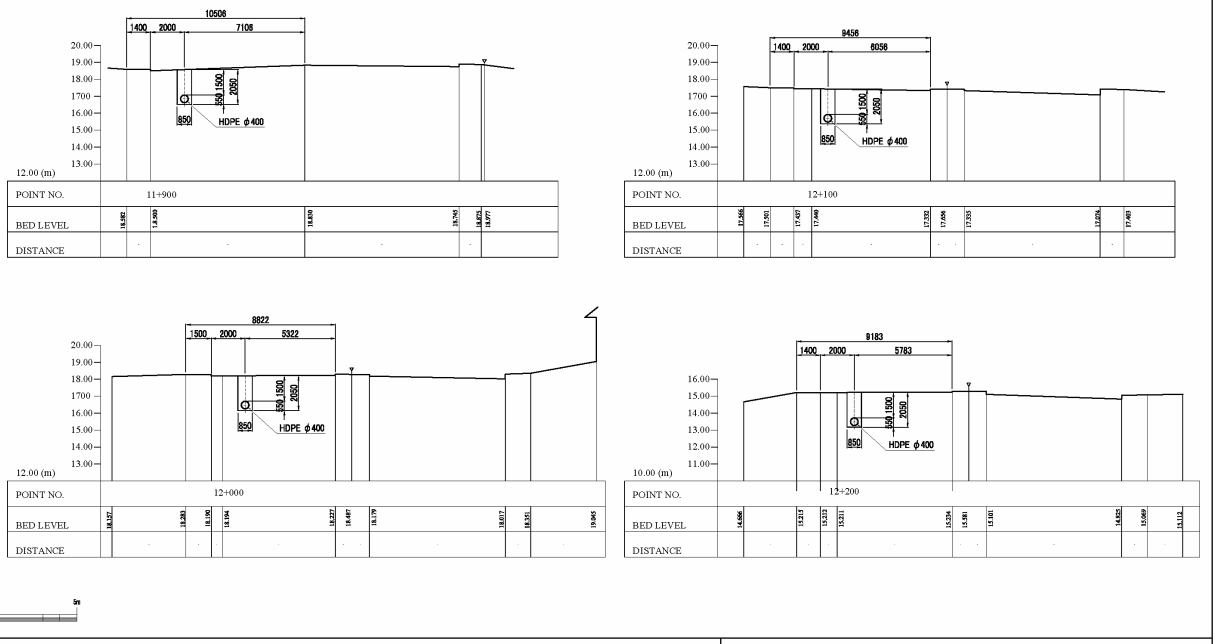
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３０)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３１)

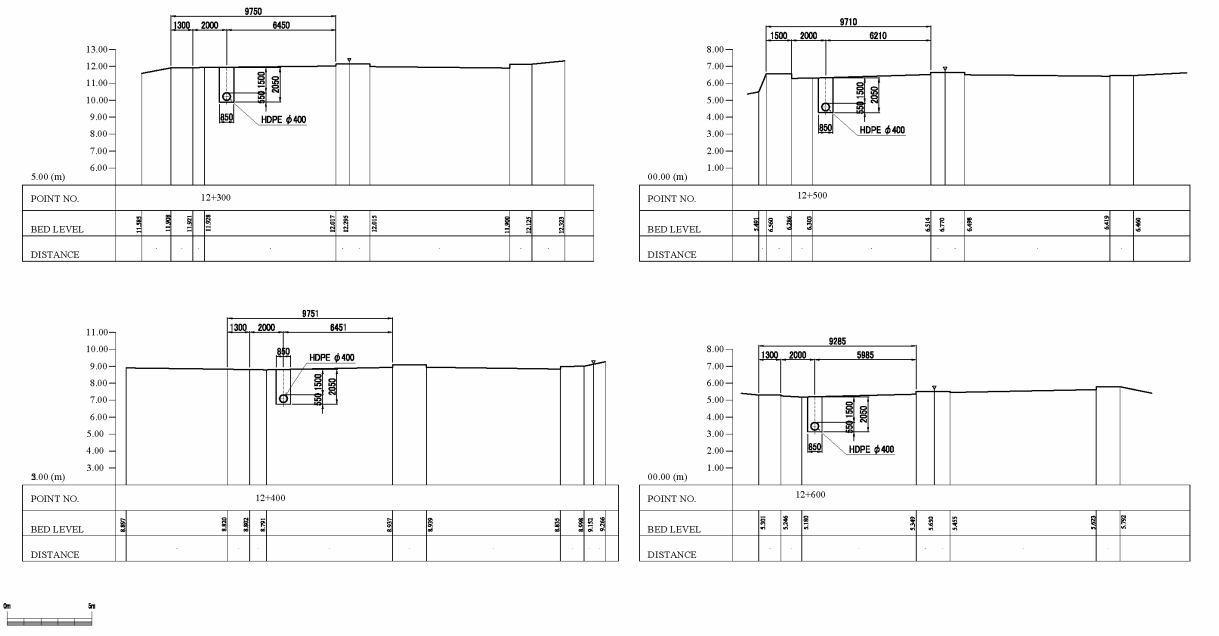
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３１)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３２)

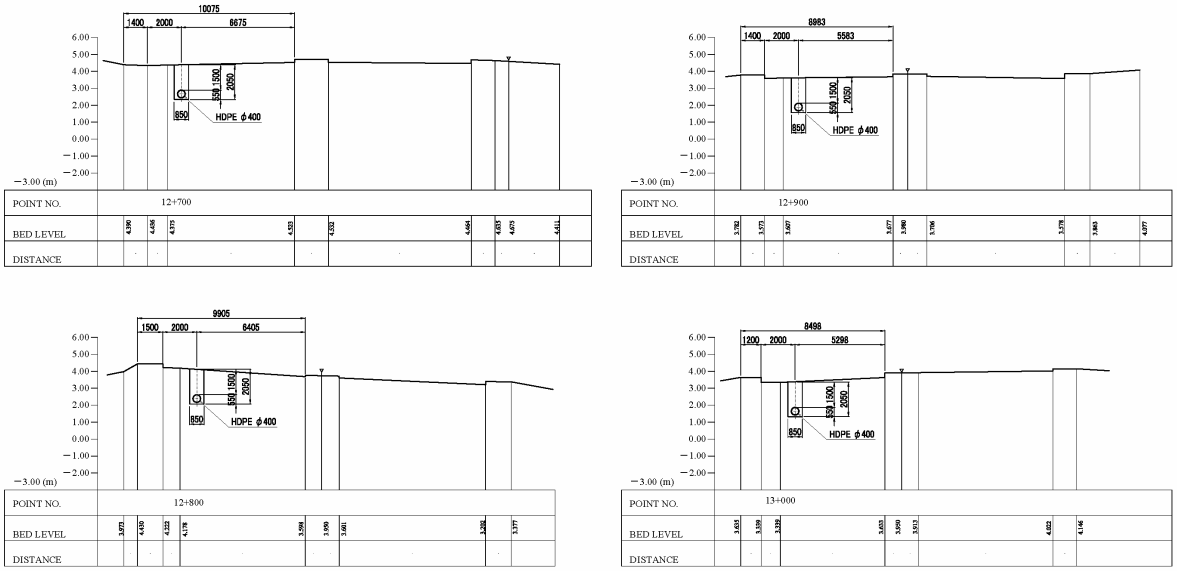
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３２)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３３)

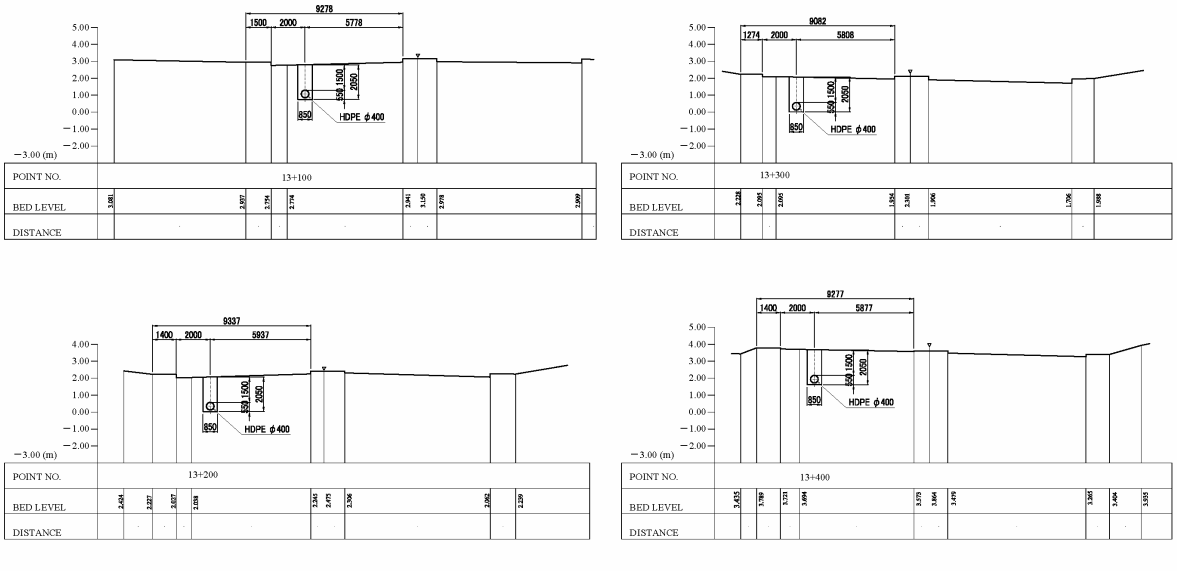
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３３)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３４)

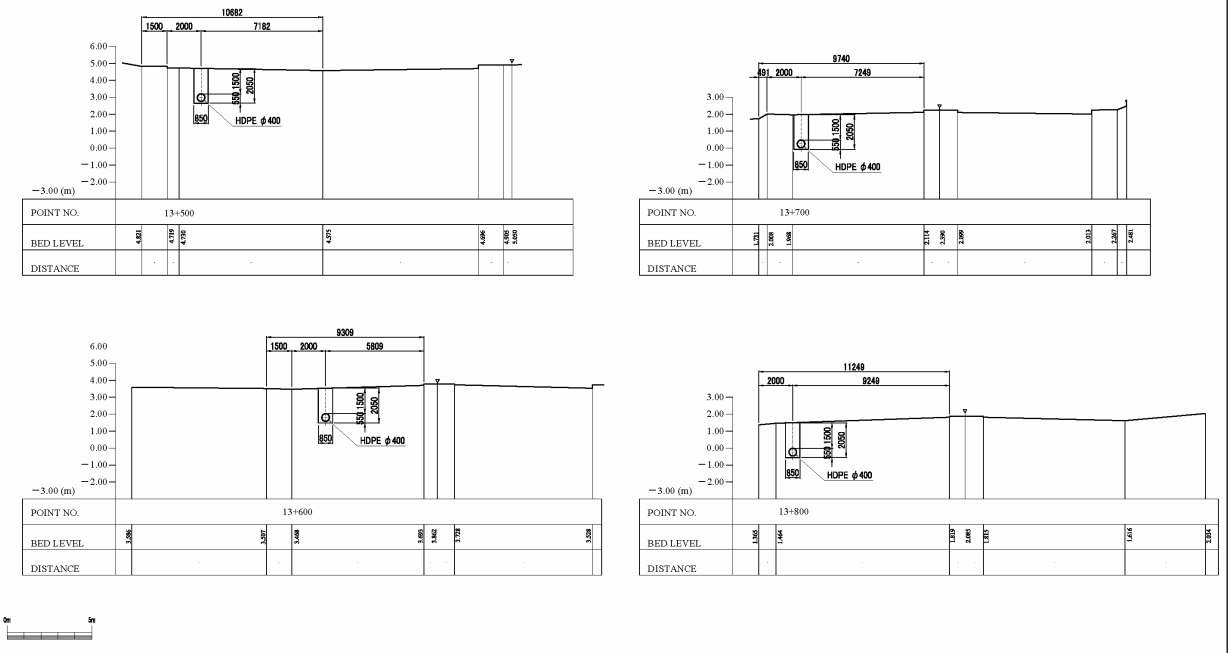
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３４)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３５)

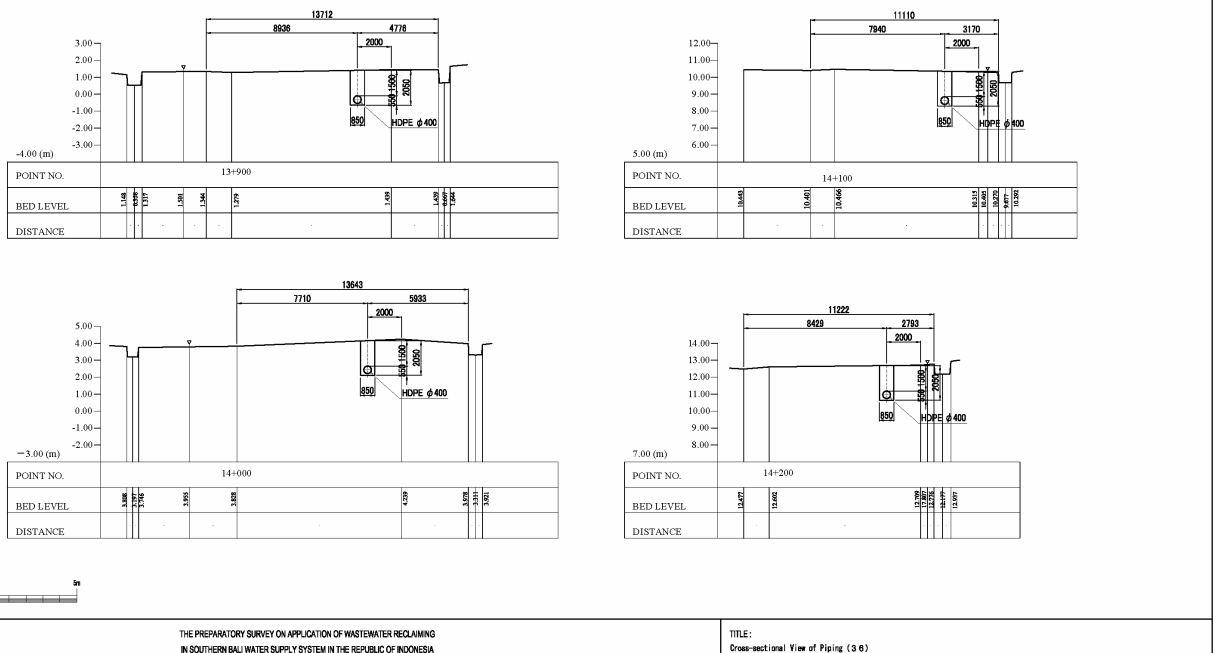
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３５)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３６)

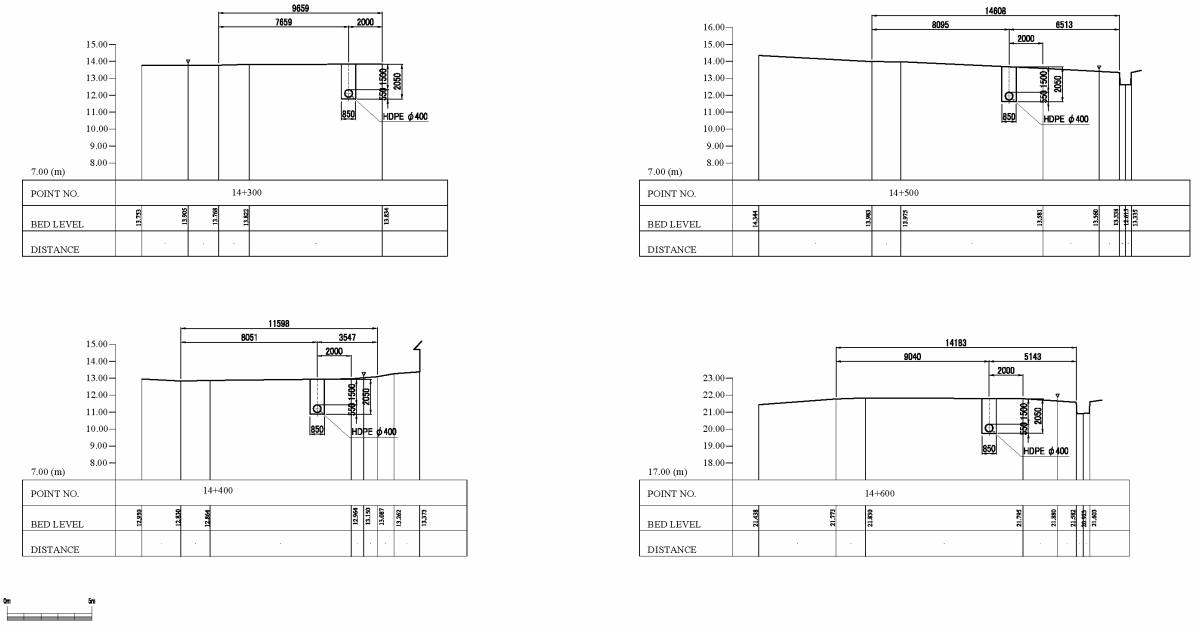
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３６)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Cross-sectional View of Piping (３７)

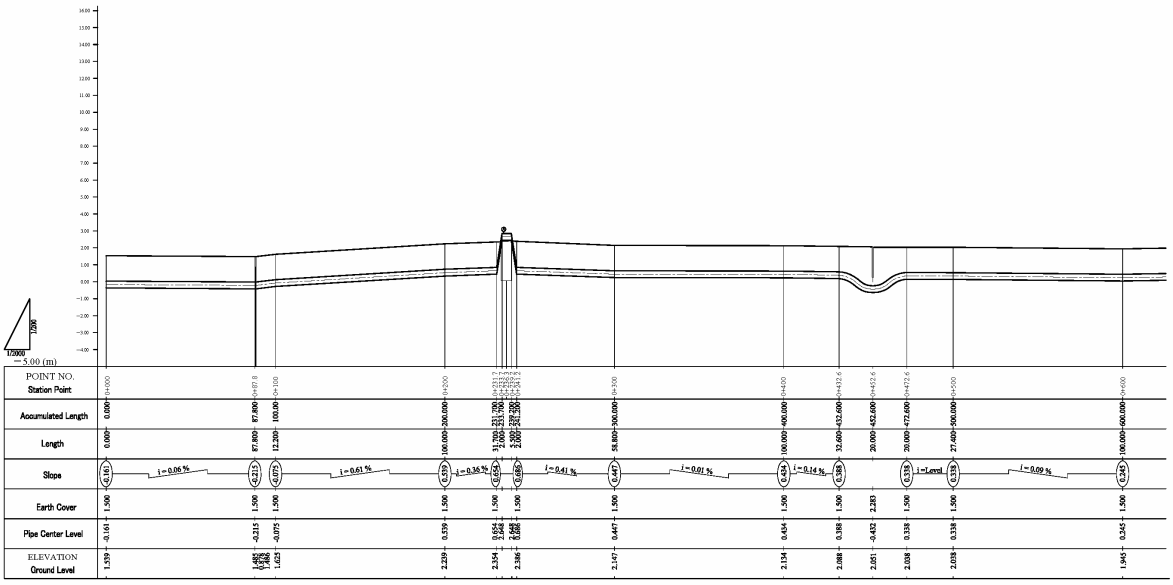
S=1／100



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Cross-sectional View of Piping (３７)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１)

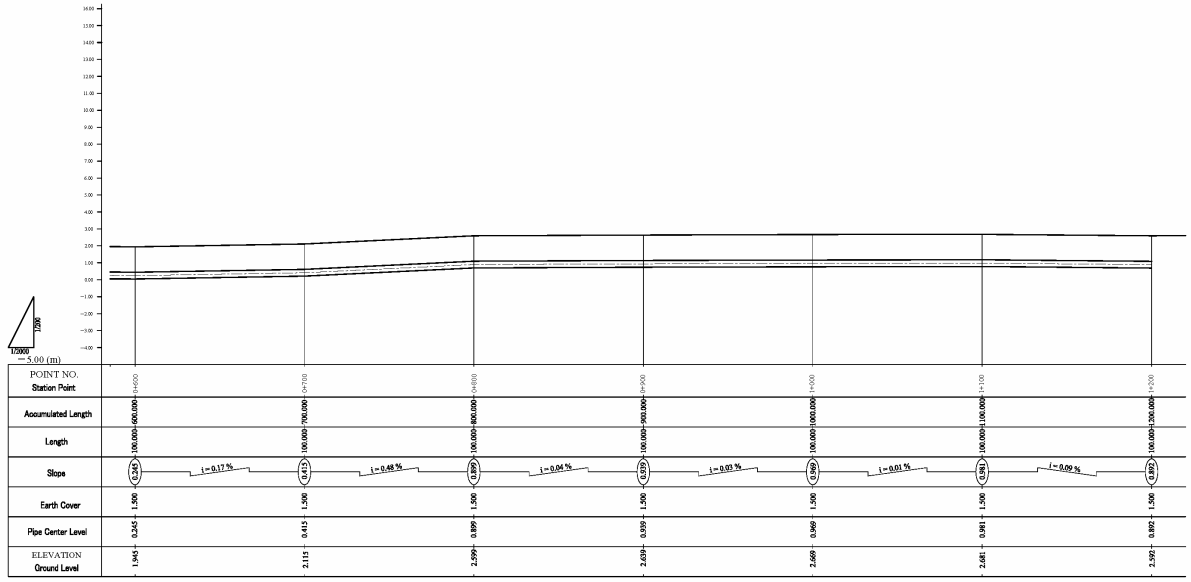
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (2)

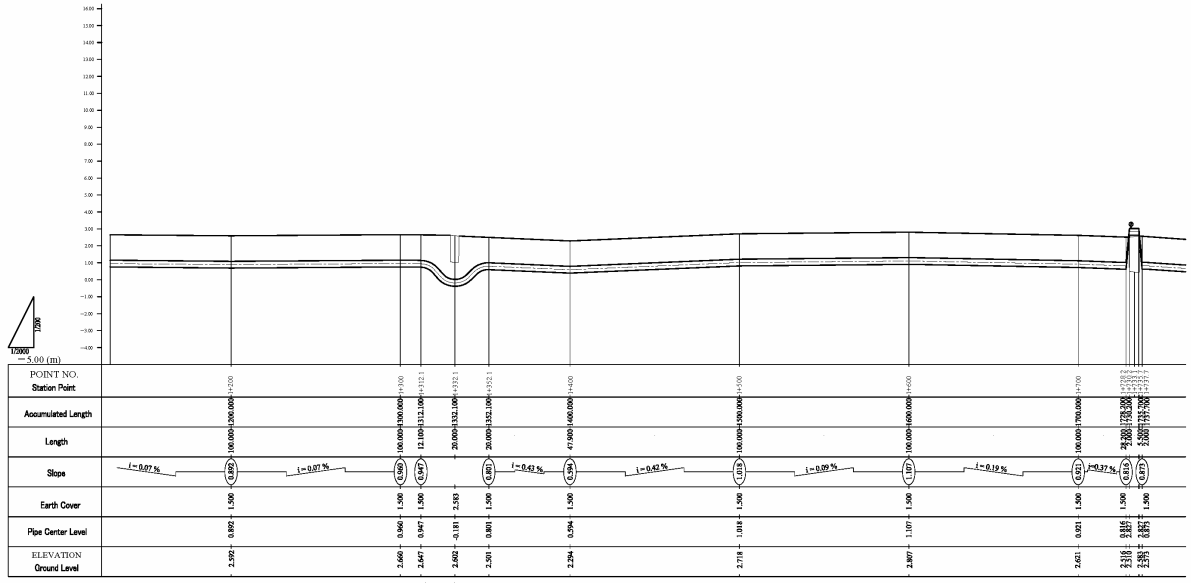
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (2)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (3)

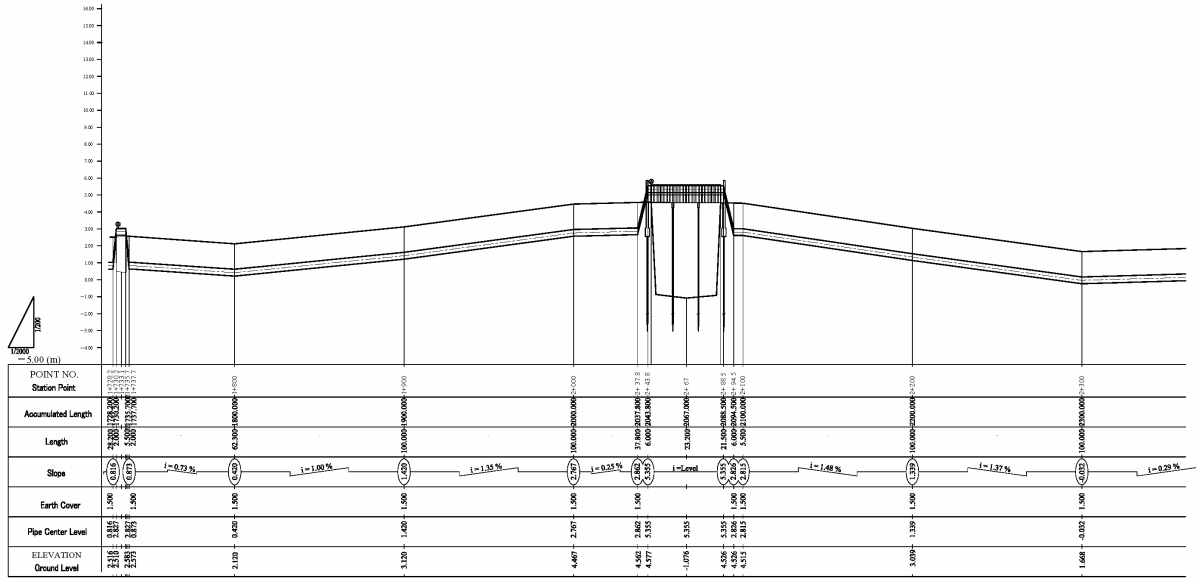
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (3)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (4)

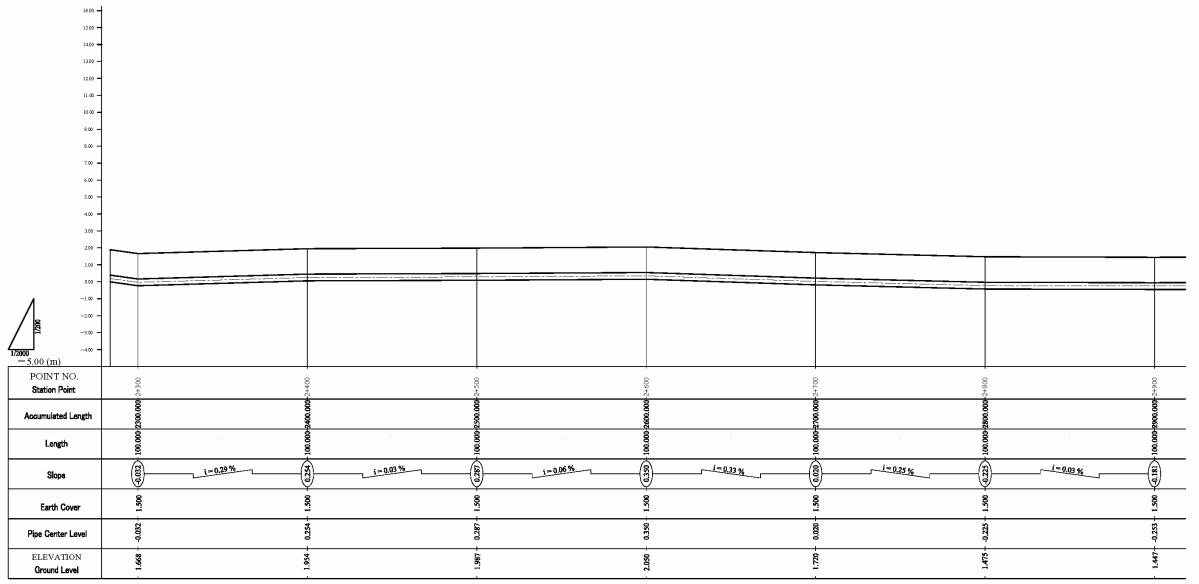
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (4)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (5)

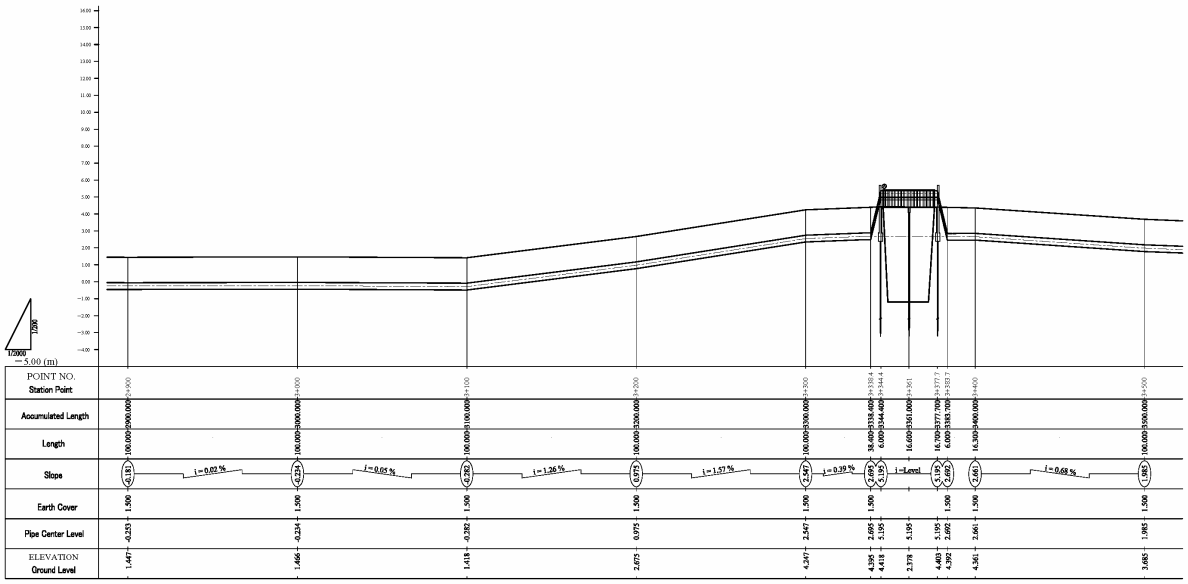
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (5)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (6)

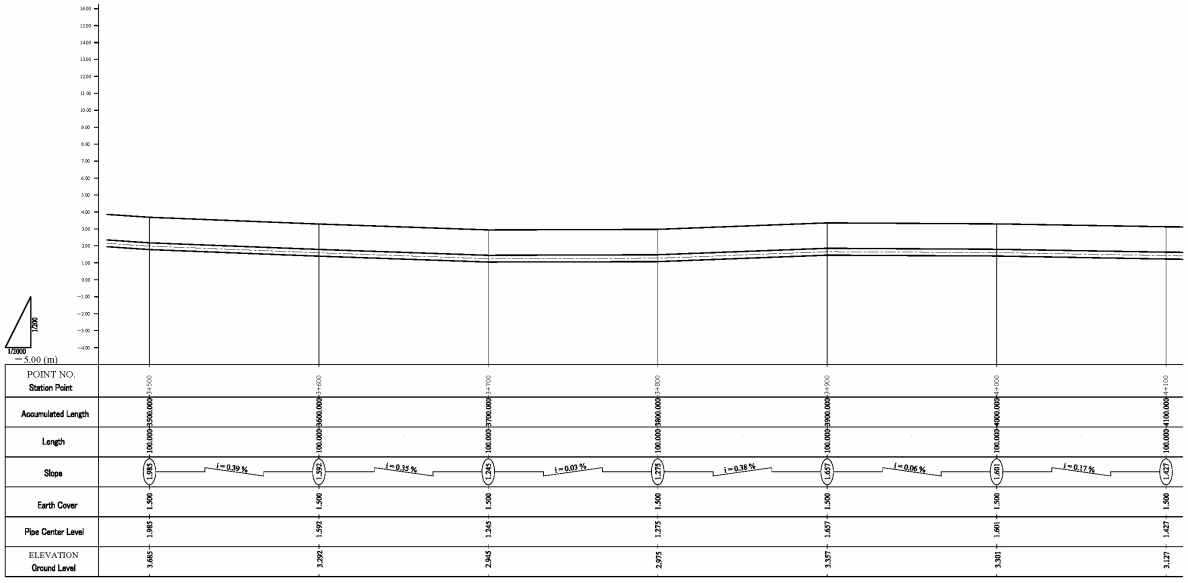
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (6)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (7)

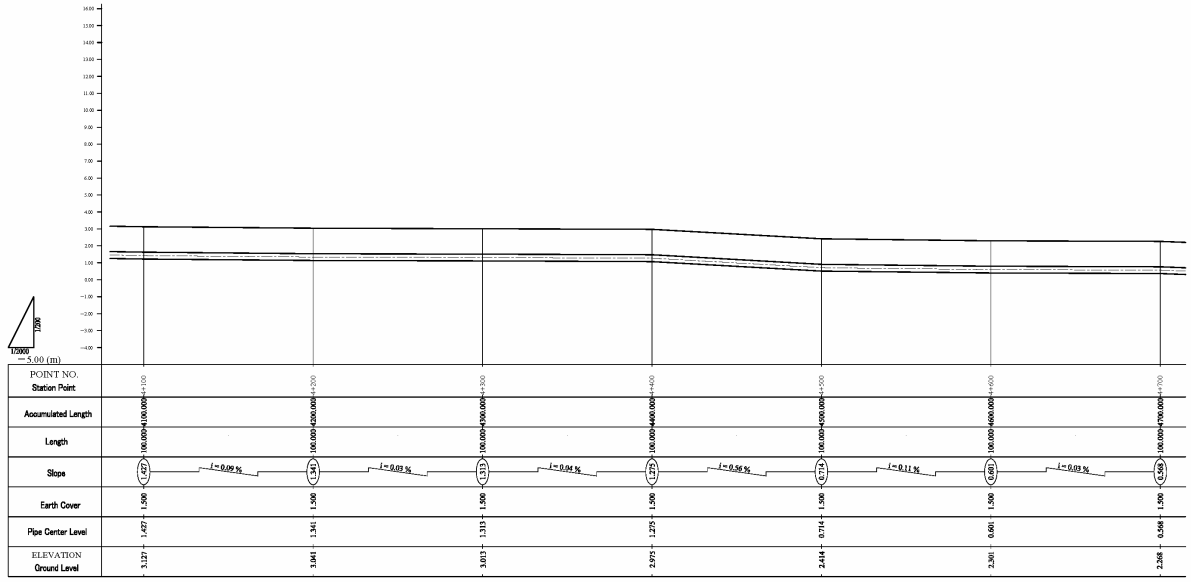
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (7)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (8)

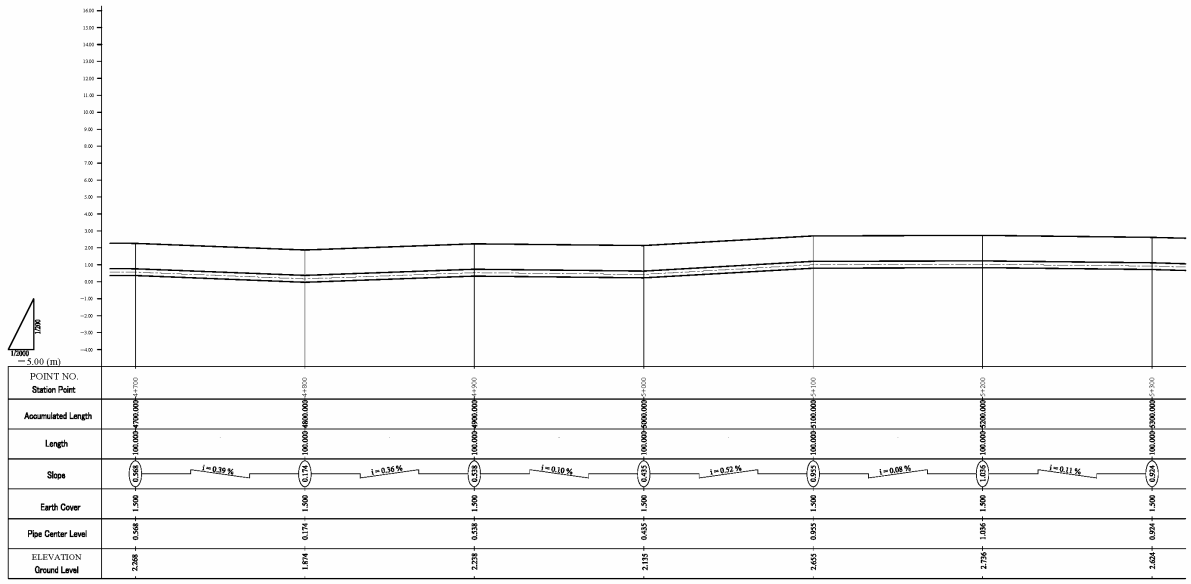
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (8)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (9)

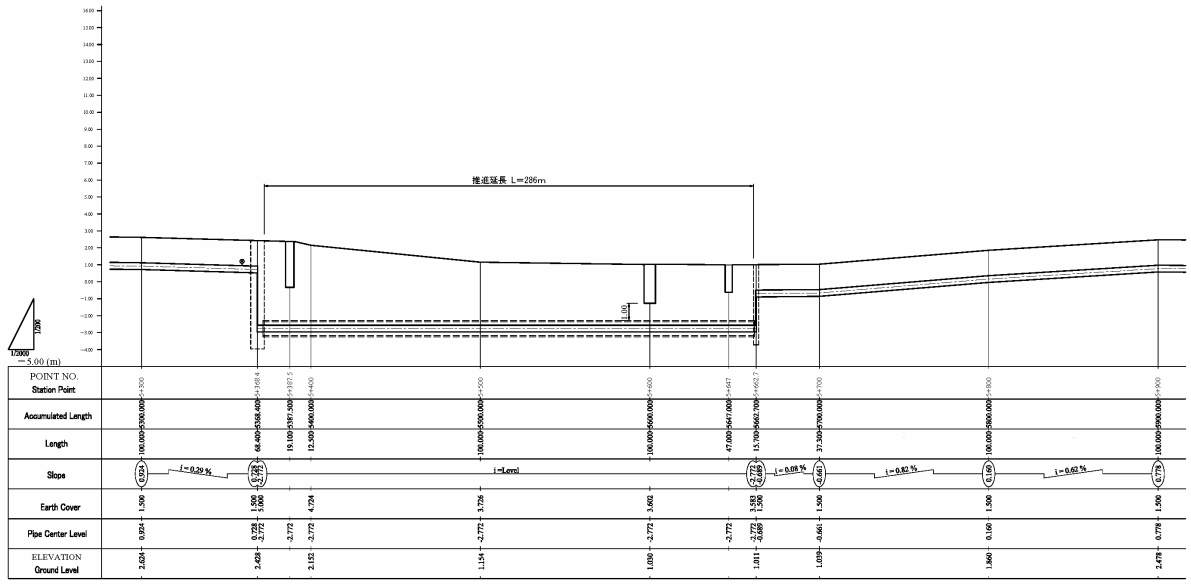
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (9)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１０)

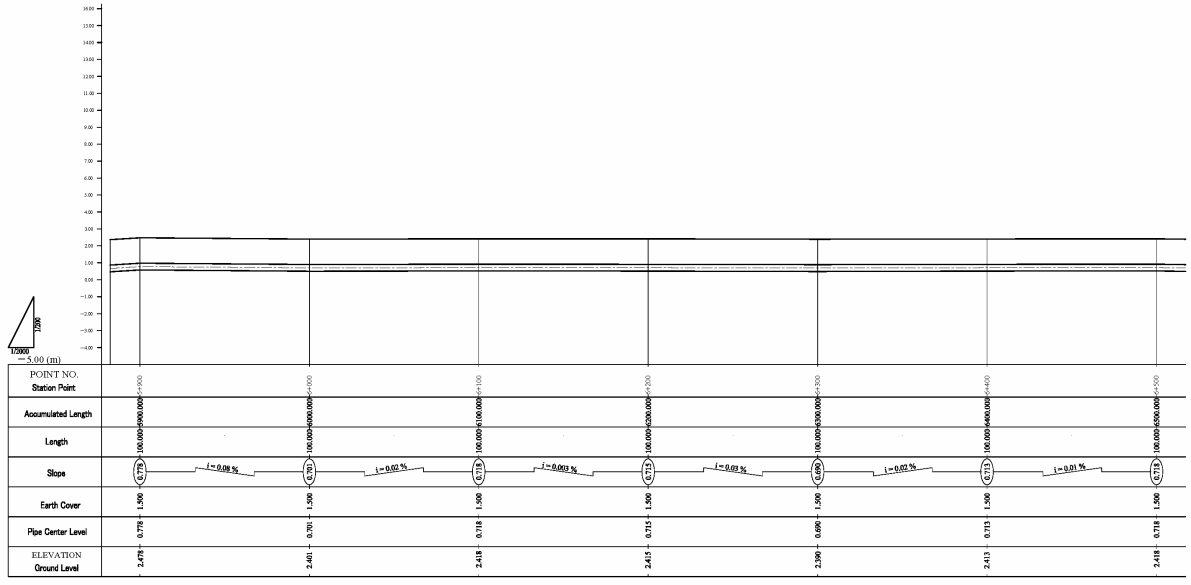
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１０)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１１)

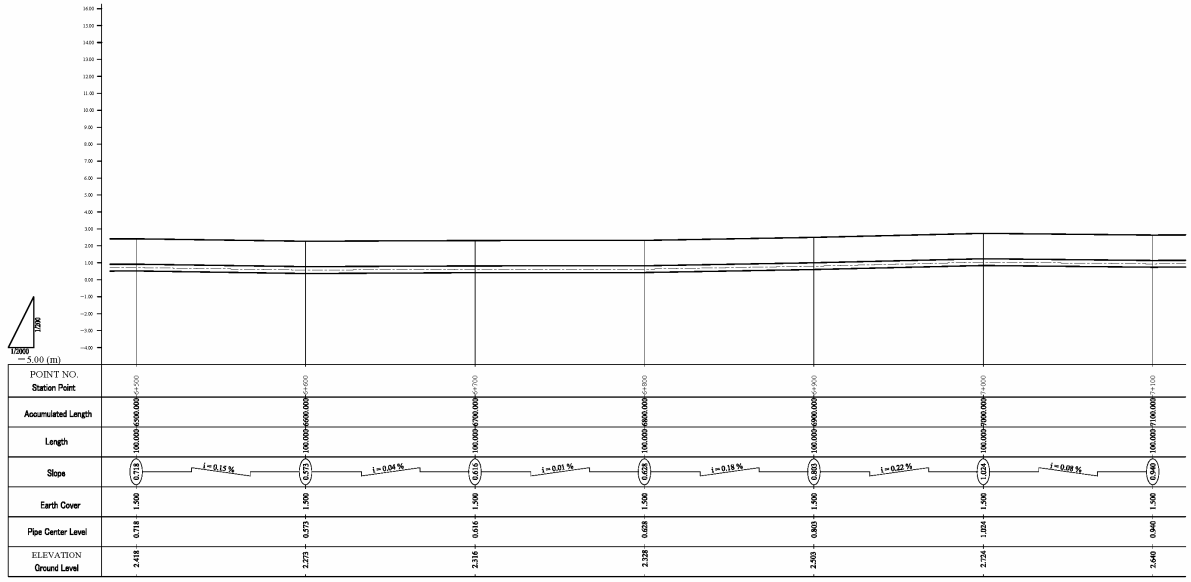
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１１)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１２)

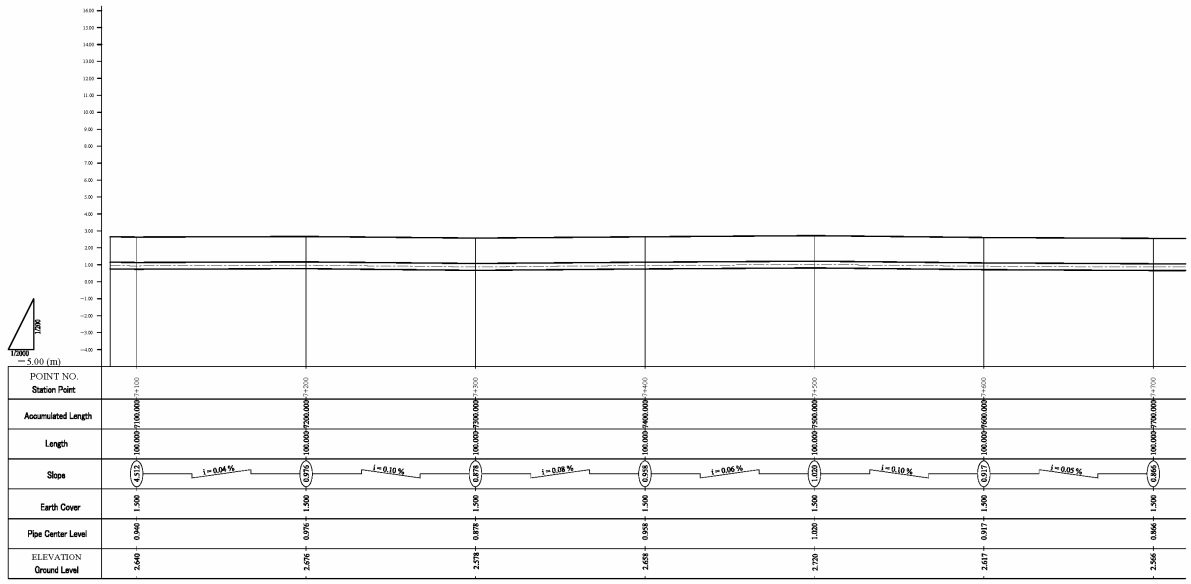
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１２)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１３)

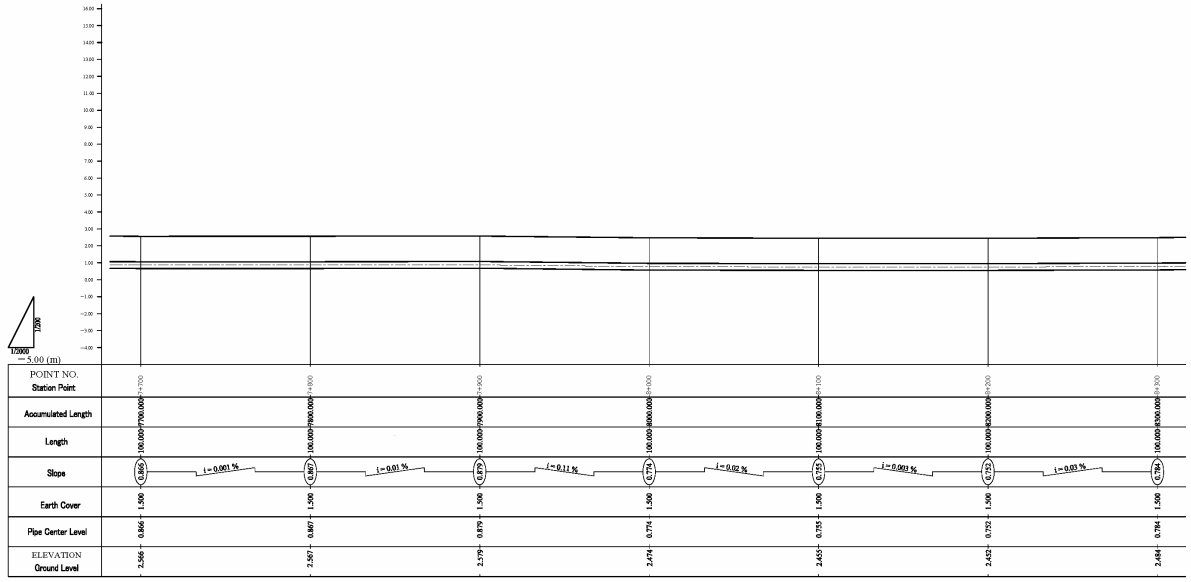
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１３)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１４)

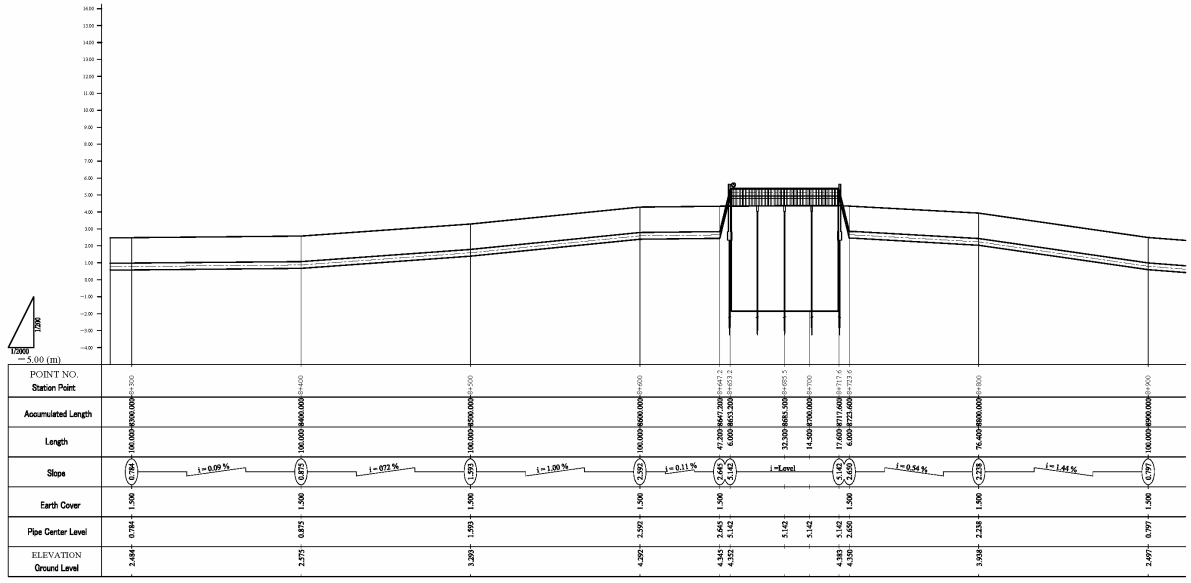
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１４)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１５)

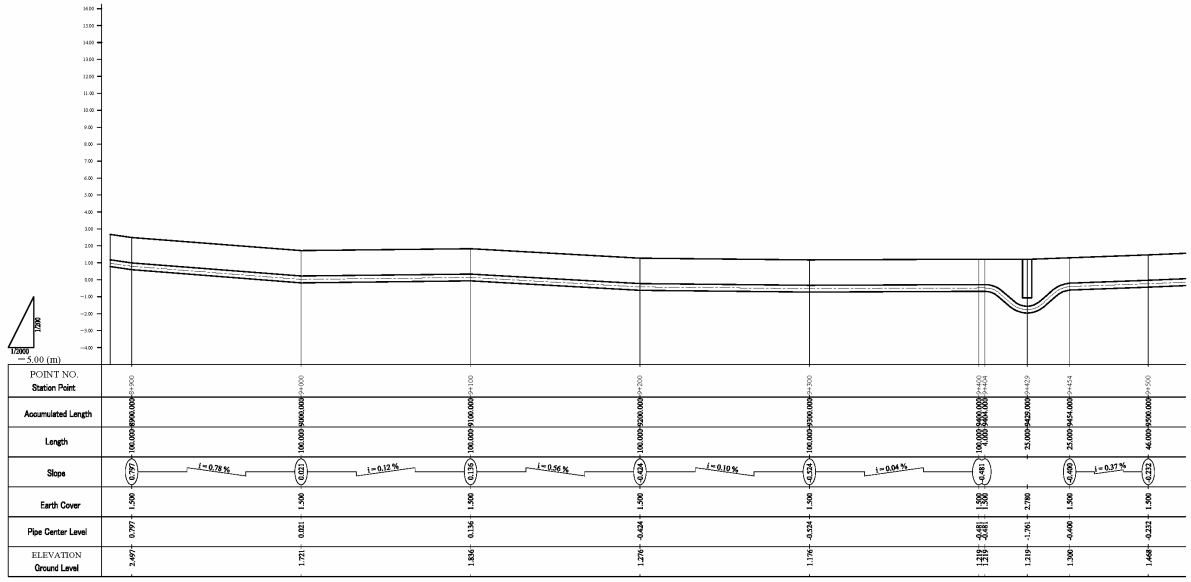
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１５)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (16)

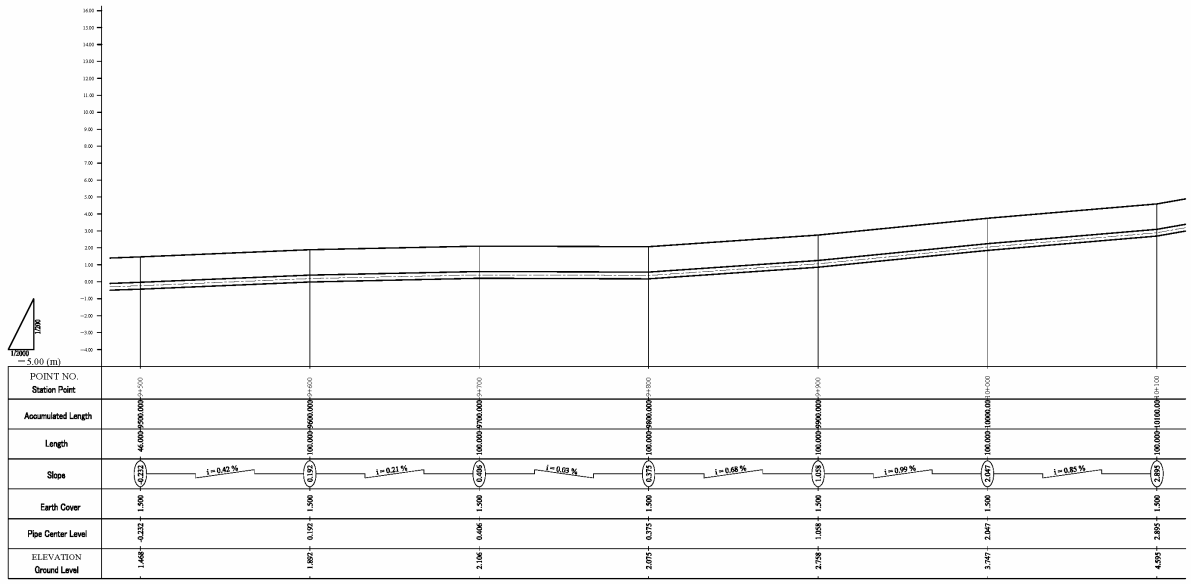
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (16)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (17)

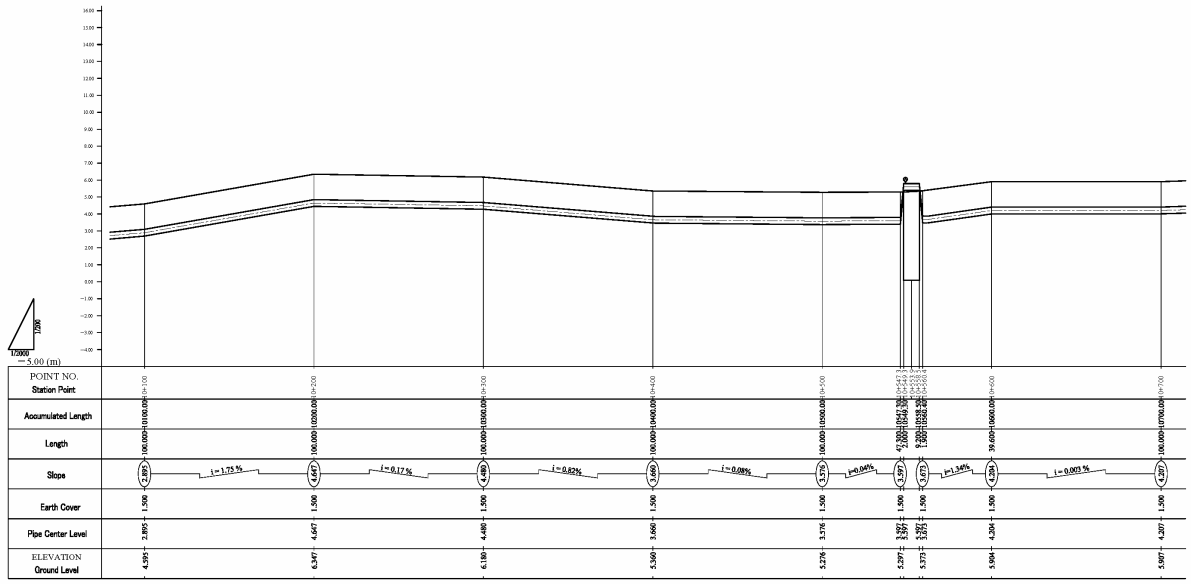
S=1/2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (17)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１８)

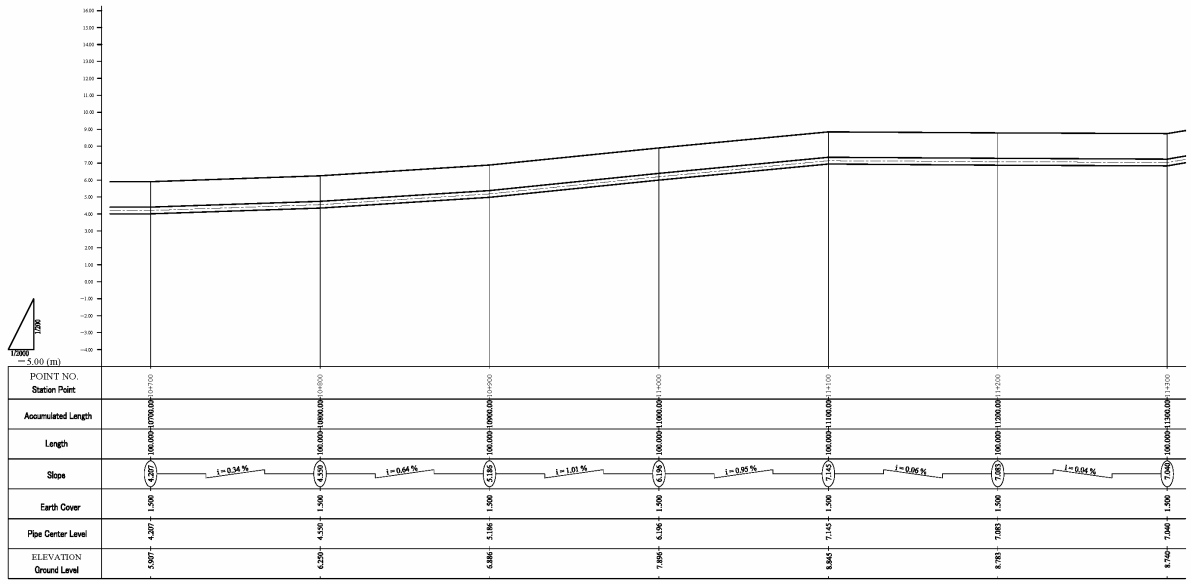
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１８)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (１９)

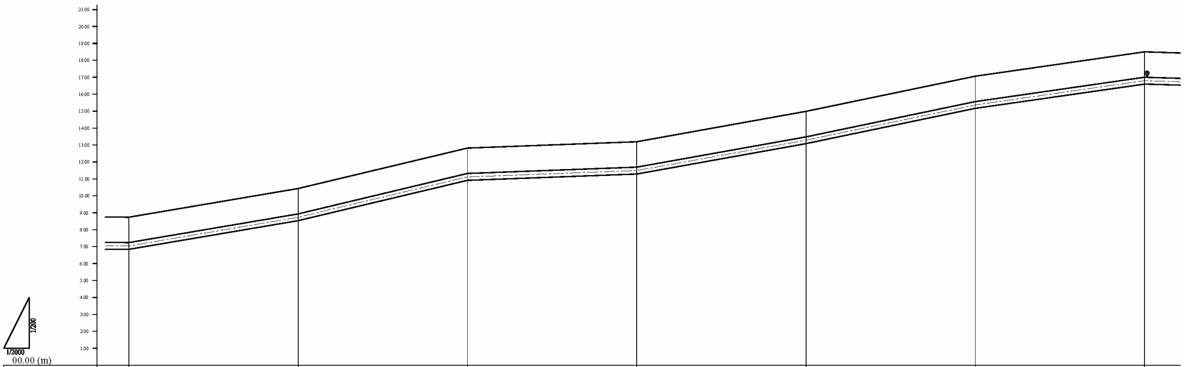
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (１９)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping（２０）

S=1／2000



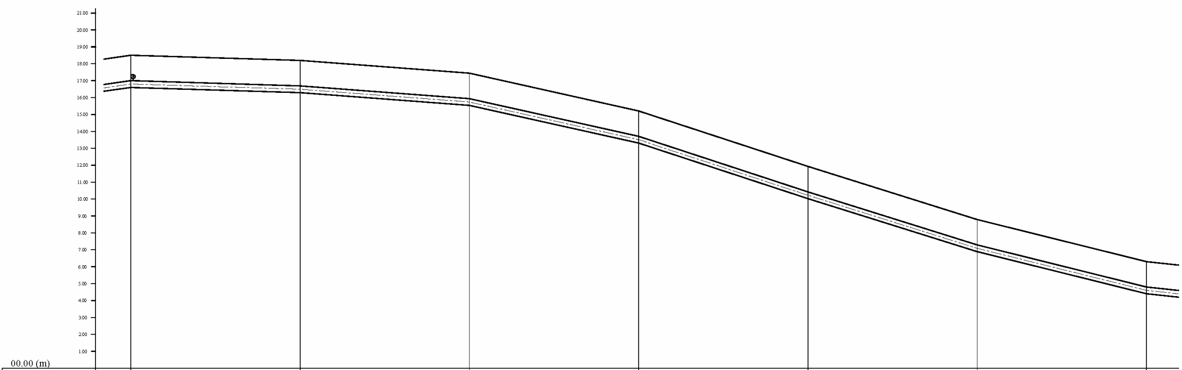
POINT NO. Station Point	1+300	1+400	1+500	1+600	1+700	1+800	1+900
Accumulated Length	1300.00	1400.00	1500.00	1600.00	1700.00	1800.00	1900.00
Length	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Slope	7.040	8.753	11.118	11.492	13.285	15.364	16.800
Earth Cover	1.500	1.500	1.500	1.500	1.500	1.500	1.500
Pipe Center Level	7.040	8.753	11.118	11.492	13.285	15.364	16.800
ELEVATION Ground Level	8.740	10.453	12.818	13.192	14.985	17.064	18.500

Slope: i＝1.71 % / i＝2.37 % / i＝0.37 % / i＝1.79 % / i＝2.08 % / i＝1.44 %

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping（２０）
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping（２１）

S=1／2000



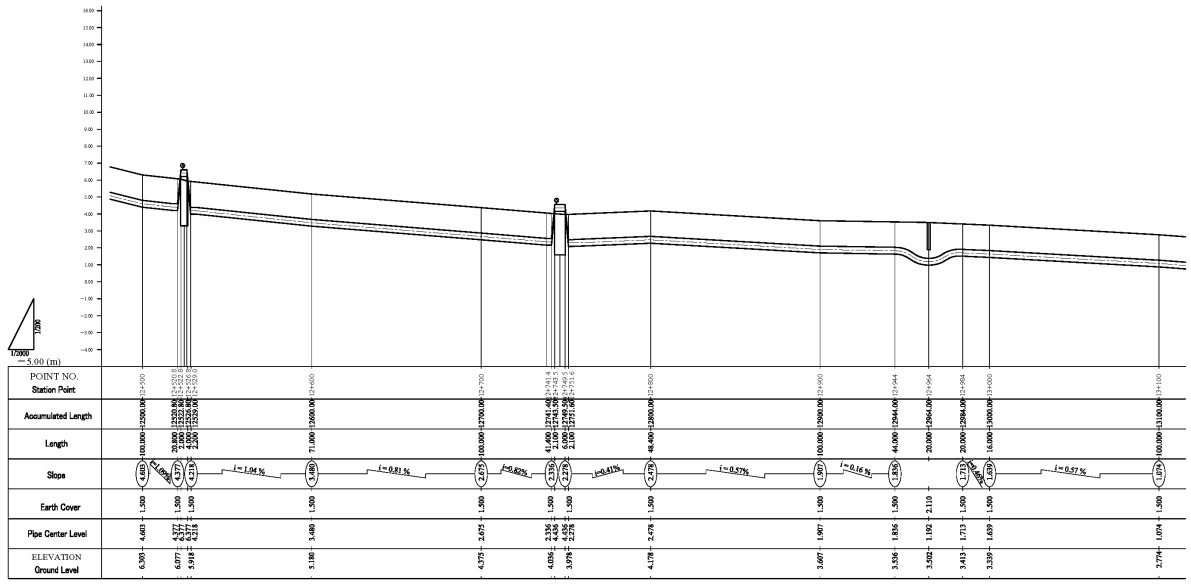
POINT NO. Station Point	1+900	2+000	2+100	2+200	2+300	2+400	2+500
Accumulated Length	1900.00	2000.00	2100.00	2200.00	2300.00	2400.00	2500.00
Length	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Slope	16.800	16.494	15.740	13.511	10.228	7.091	4.603
Earth Cover	1.500	1.500	1.500	1.500	1.500	1.500	1.500
Pipe Center Level	16.800	16.494	15.740	13.511	10.228	7.091	4.603
ELEVATION Ground Level	18.500	18.194	17.440	15.211	11.928	8.791	6.303

Slope: i＝0.31 % / i＝0.75 % / i＝2.23 % / i＝3.28 % / i＝3.14 % / i＝2.49 %

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping（２１）
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (２２)

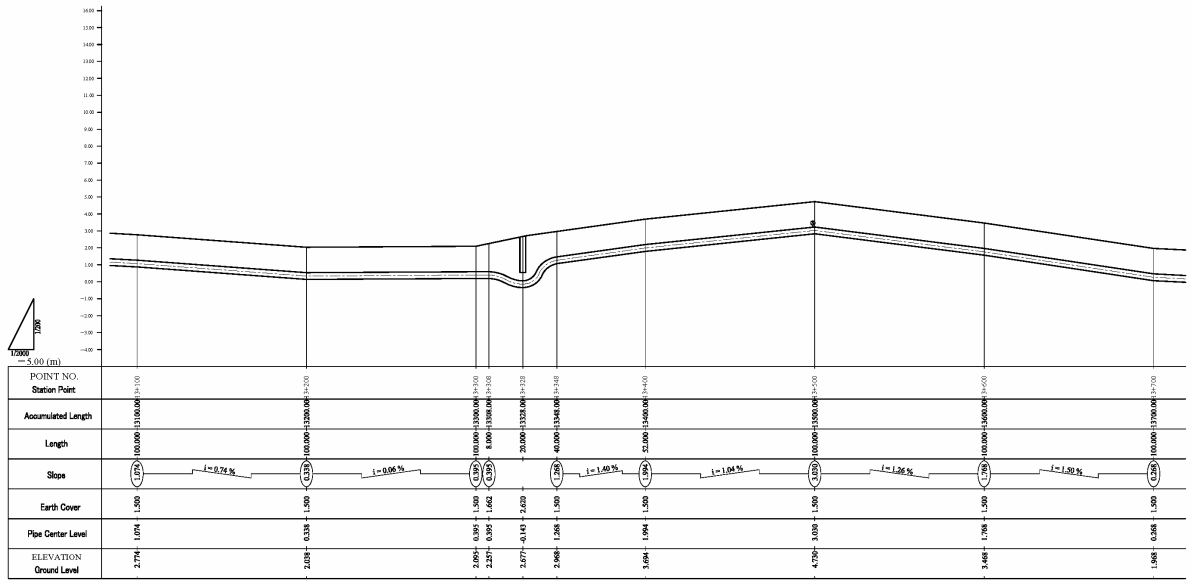
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (２２)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (２３)

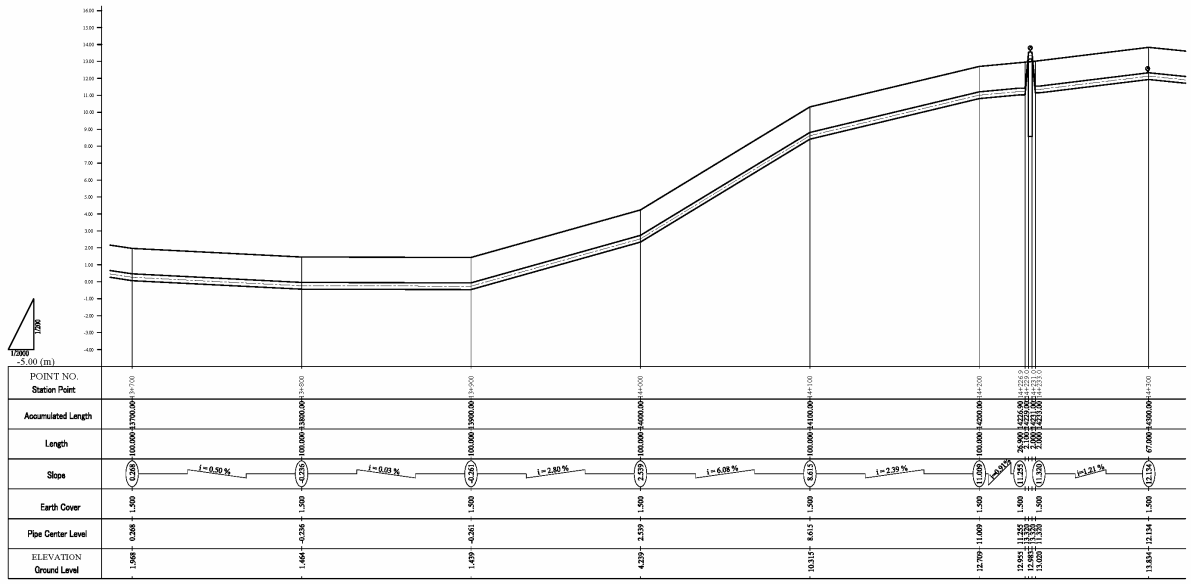
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (２３)
JAPAN INTERNATIONAL COOPERATION AGENCY	

Longitudinal Sectional View of Piping (２４)

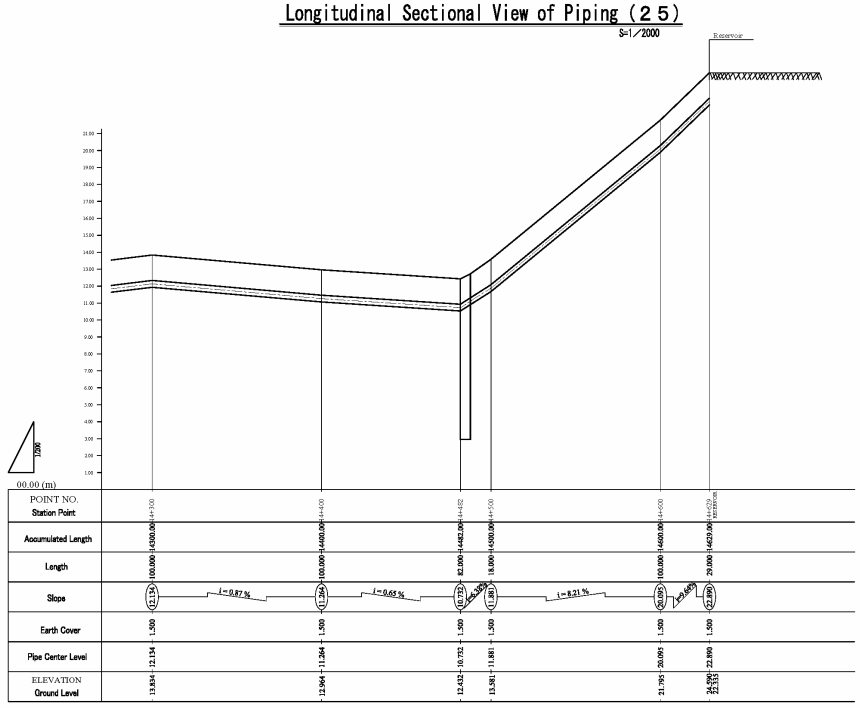
S=1／2000



THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (２４)
JAPAN INTERNATIONAL COOPERATION AGENCY	

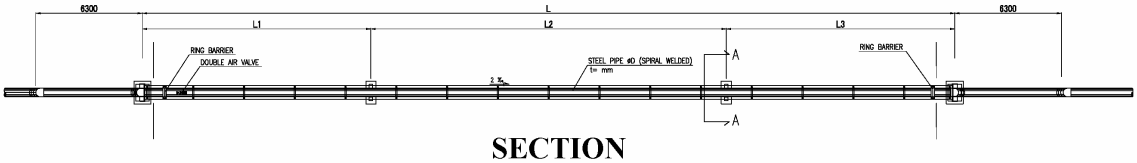
Longitudinal Sectional View of Piping (２５)

S=1／2000

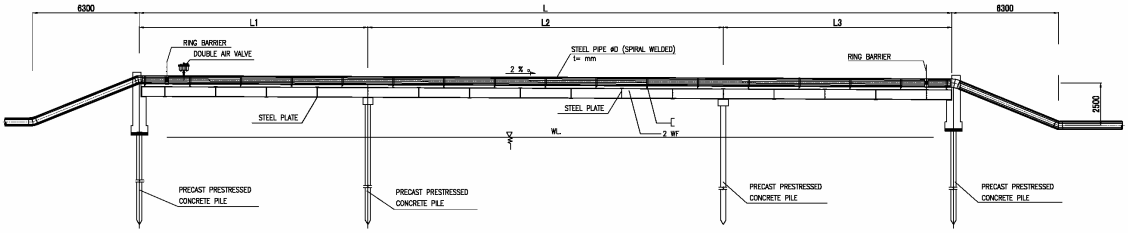


THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA	TITLE: Longitudinal Sectional View of Piping (２５)
JAPAN INTERNATIONAL COOPERATION AGENCY	

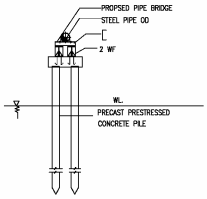
PLAN



SECTION



SECTION A - A



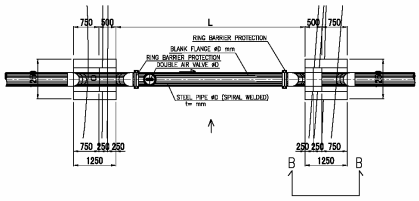
TYPE	D	t	L	L1	L2	L3
A-1	406.4	6.0	45 000	15 000	15 000	15 000
A-2	406.4	6.0	33 400	9 500	14 400	9 500
A-3	406.4	6.0	65 800	20 000	25 800	20 000

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA

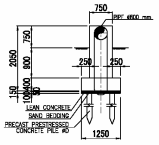
JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE :
Water Pipe Bridge Layout Plan (1)

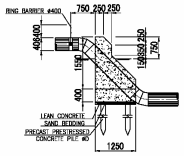
PLAN



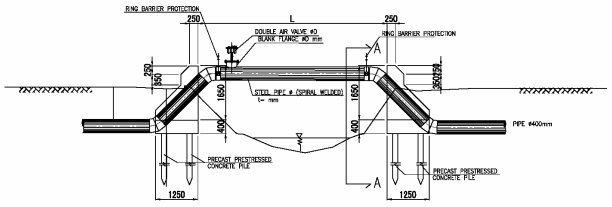
SECTION A-A



SECTION B-B



LONG SECTION



TYPE	D	t	L
B-1	406.4	6.0	21 100
B-2	406.4	6.0	24 100
B-3	406.4	6.0	26 400
B-4	406.4	6.0	21 700
B-5	406.4	6.0	23 600
B-6	406.4	6.0	19 800

THE PREPARATORY SURVEY ON APPLICATION OF WASTEWATER RECLAIMING IN SOUTHERN BALI WATER SUPPLY SYSTEM IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

TITLE :
Water Pipe Bridge Layout Plan (2)

付属資料 7

配水および給水施設の検討資料

付属資料 7　配水および給水施設の検討資料

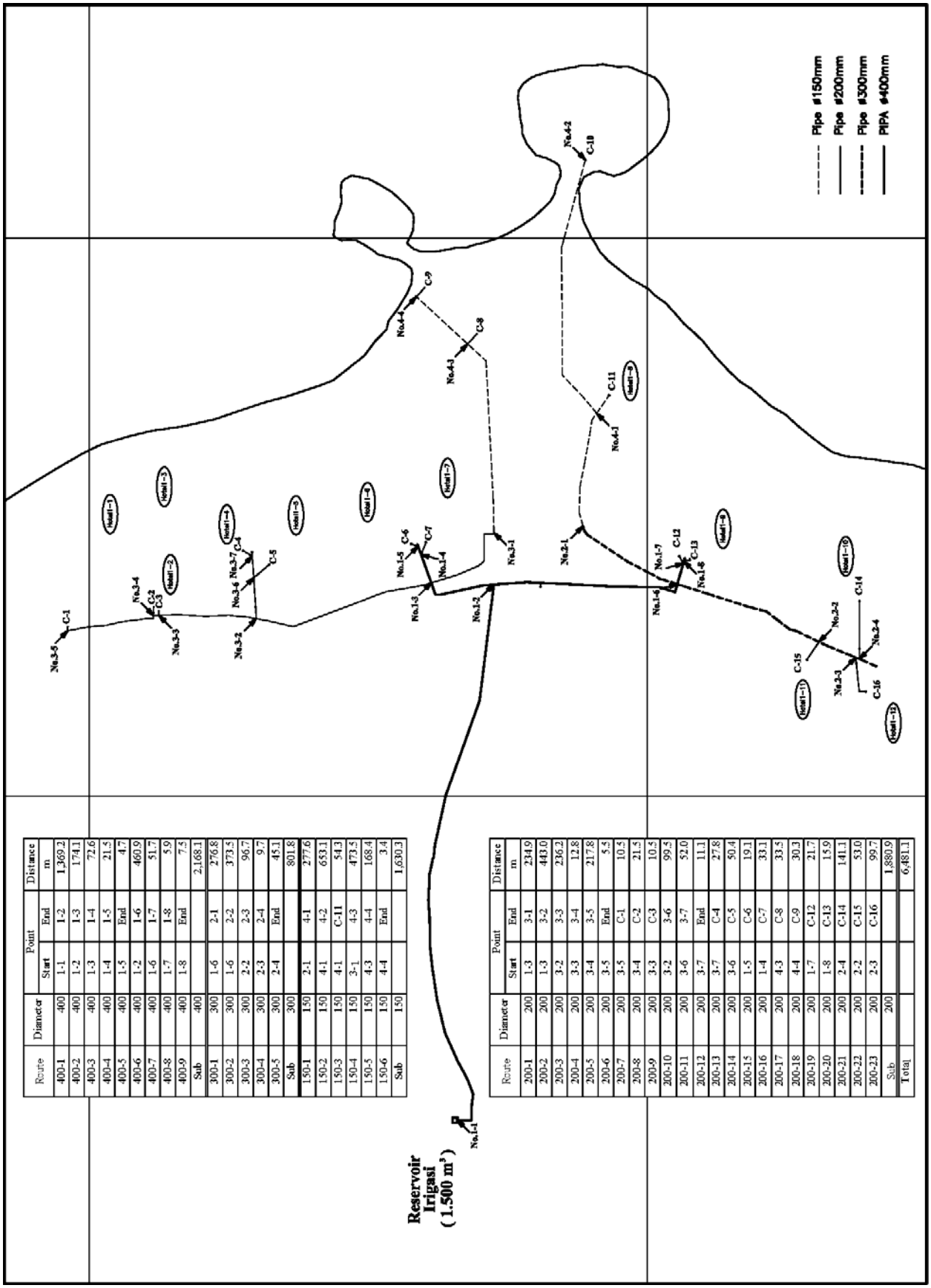
7.a　　既設配水本管の調査および補修計画

既設配水本管ルートを図 7.a.1 に示す。既設配水管の材質は DCIP で、管径毎の配管延長を以下に示す。

φ150mm　：1,630m
φ200mm　：1,880m
φ300mm　：　800m
φ400mm　：2,170m
合計　　：6,480ｍ

既存配水管は、埋設管のため外観調査等で確認することはできなかった。詳細設計時に詳細調査として以下の調査を実施し改築を実施する必要がある。
・既設管の漏水調査と管内洗浄
・止水バルブの更新
・漏水部の配管更新

既設管の漏水部の確認は本調査においては困難であるため、積算上は全管路延長の 1 割を改築更新延長とすることとして配管更新費用を計上した。



Route	Diameter	Point		Distance
		Start	End	m
400-1	400	1-1	1-2	1,369.2
400-2	400	1-2	1-3	174.1
400-3	400	1-3	1-4	72.6
400-4	400	1-4	1-5	21.5
400-5	400	1-5	End	4.7
400-6	400	1-2	1-6	460.9
400-7	400	1-6	1-7	51.7
400-8	400	1-7	1-8	5.9
400-9	400	1-8	End	7.5
Sub	400			2,168.1
300-1	300	1-6	2-1	276.8
300-2	300	1-6	2-2	373.5
300-3	300	2-2	2-3	96.7
300-4	300	2-3	2-4	9.7
300-5	300	2-4	End	45.1
Sub	300			801.8
150-1	150	2-1	4-1	277.6
150-2	150	4-1	4-2	653.1
150-3	150	4-1	C-11	54.3
150-4	150	3-1	4-3	473.5
150-5	150	4-3	4-4	168.4
150-6	150	4-4	End	3.4
Sub	150			1,630.3

Route	Diameter	Point		Distance
		Start	End	m
200-1	200	1-3	3-1	234.9
200-2	200	1-3	3-2	443.0
200-3	200	3-2	3-3	236.2
200-4	200	3-3	3-4	12.8
200-5	200	3-4	3-5	217.8
200-6	200	3-5	End	5.5
200-7	200	3-5	C-1	10.5
200-8	200	3-4	C-2	21.5
200-9	200	3-3	C-3	10.5
200-10	200	3-2	3-6	99.5
200-11	200	3-6	3-7	52.0
200-12	200	3-7	End	11.1
200-13	200	3-7	C-4	27.8
200-14	200	3-6	C-5	50.4
200-15	200	1-5	C-6	19.1
200-16	200	1-4	C-7	33.1
200-17	200	4-3	C-8	33.5
200-18	200	4-4	C-9	30.3
200-19	200	1-7	C-12	21.7
200-20	200	1-8	C-13	15.9
200-21	200	2-4	C-14	141.1
200-22	200	2-2	C-15	53.0
200-23	200	2-3	C-16	99.7
Sub	200			1,880.9
Total				6,481.1

図 7.a.1 既設配管ルート図

7.b　ホテルでの給水施設の改築検討

本節では再生水を利用する場合のホテル内の給水施設の改築方法と費用について検討を行う。

ホテル内の建屋配置や構造はホテル毎に異なるが、本調査で給水対象となるすべてのホテルについて検討を行うことは困難であるため、1 例を上げて検討を行うこととする。

検討を行うモデルとしては、N ホテルを以下の理由で選定した。
・平面的また断面的にも比較的複雑な給水システムである。
・給水対象ホテルとしている代表的なホテル規模（部屋数 300~400）のホテルである。
・詳細な配管平面図および断面図を提供してくれた。

表 7.b.1　給水対象ホテルの構成

	ホテル数	合計部屋数
部屋数 401～(750)	4	2,311
部屋数 301～400	**7**	**2,512**
部屋数 201～300	2	526
部屋数 101～200	9	1,407
部屋数 100 以下	19	832
合計	41	7588

なお、ホテル N の給水管の改築費用の検討条件は以下の通りである。

・部屋数　　：約 400 室
・建屋構成　　：本館（3F)、北館（6F)、南館（5F)、海岸タワー（14F）
・レストラン数　：6 箇所
・全使用水量　　：約 1,000 m^3/day
　－トイレ使用水量：約 200 m^3/day（20%）（Case1 新設ポンプ容量）
　－飲用使用水量　：約 200 m^3/day（20%）（Case2 新設ポンプ容量）
　－非飲用使用水量：約 800 m^3/day（40%）（内ケース 2 再生水使用量 400 m^3/day）

ホテル N の平面配置を図 7.b.1、概略断面図を図 7.b.2 に示す。

図 7.b.1 ホテル N の平面配置　（出典：G2011 Google-地図データ）

図 7.b.2 ホテル N 概略断面図（出典：http://www.nikkobali.com/jp/）

改築案については、以下の 2 ケースを設定して検討を行う。

ケース１：従来型の再生水供給システム
ケース２：New Clean Water 供給システム

(1) ケース 1 の改築案

ケース 1 の場合の改築案について、施設改築は図 7.b.3 に示すモデルのようになる。

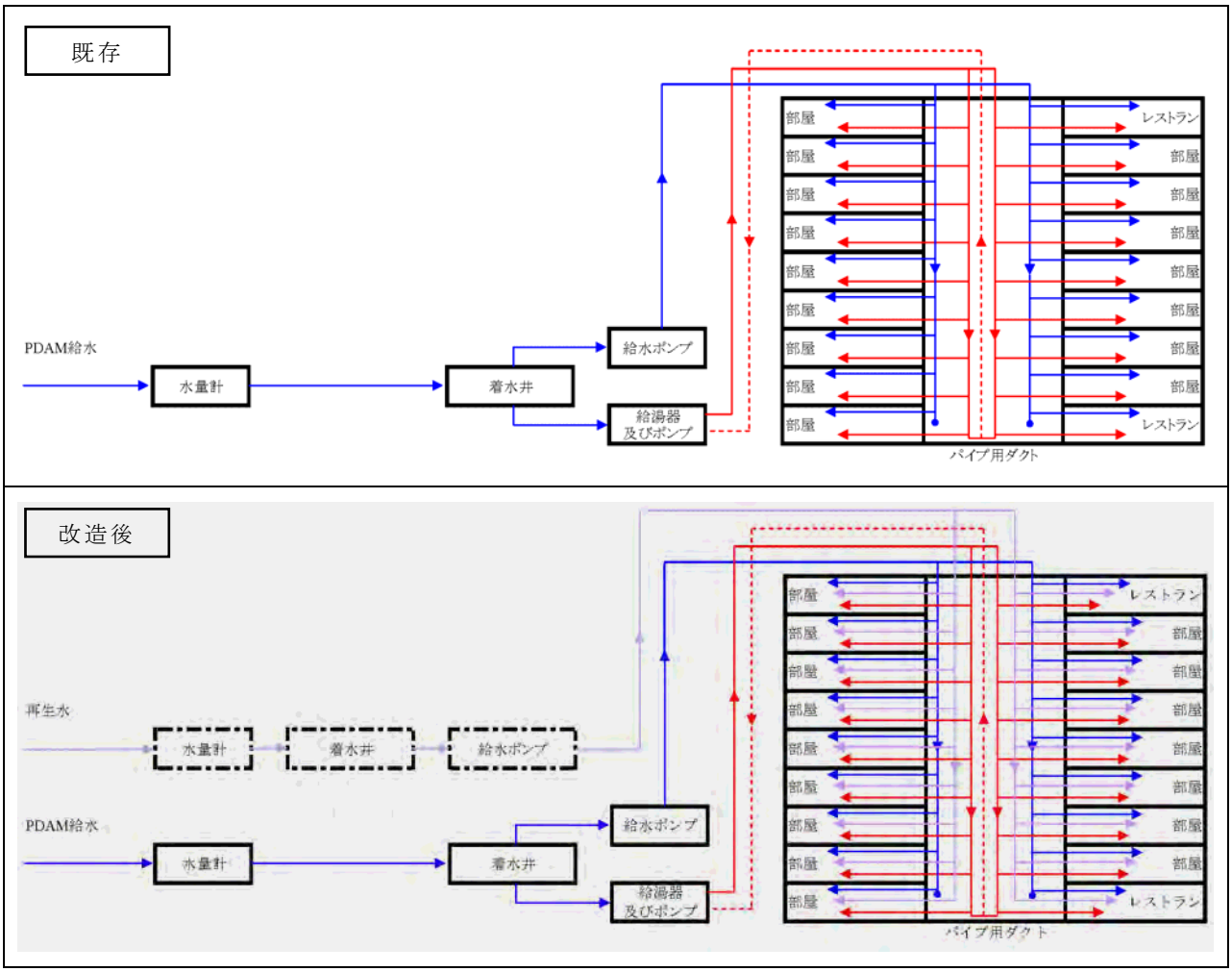


図 7.b.3　給水管改築モデル図（ケース 1）

したがって、改築工事としては以下の項目が発生する。

・再生水給水管設置工事（水量計～着水井～給水ポンプ～各個室）
・再生水受水槽設置工事
・水量計の設置工事
・給水ポンプ設置工事

新設給水配管ルートのイメージを図 7.b.4 に示す。

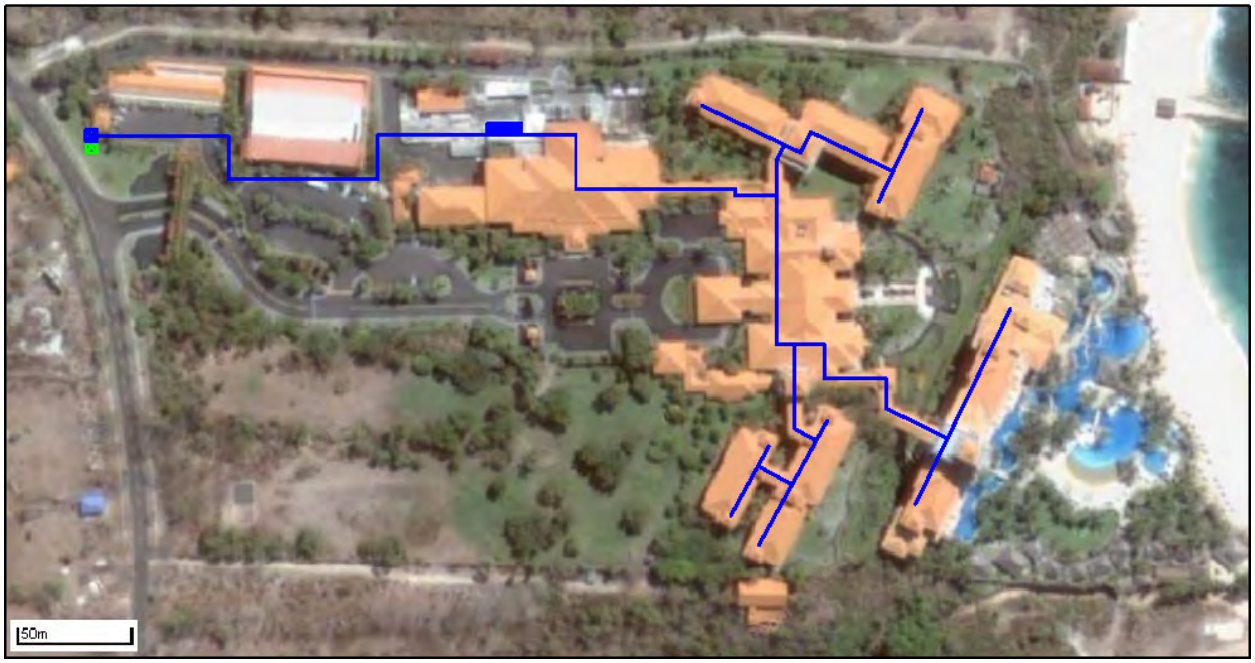


図 7.b.4　新設給水配管のルートイメージ図（ケース１）

図 7.b.4 の緑色は既設水量計の位置を示しており、青色が新設再生水給水ルートを示している。

上記ルートにて改造費を積算すると表 7.b.2 のようになる。

表 7.b.2　従来型の再生水利用のためのホテル内の給水管改築費（ケース 1）

項目	数量	単位	単価（IDR）	費用(IDR)
再生水給水管設置工事	2,420	m	370,000	895,400,000
再生水受水槽工事	1	式	488,870,000	488,870,000
水量計の設置工事	1	式	8,000,000	8,000,000
給水ポンプ設置工事	1	式	100,000,000	100,000,000
合計				1,492,270,000

(2) ケース 2 の改築案

ケース 2 の場合の改築案について、施設改築は図 7.b.5 に示すモデルのようになる。

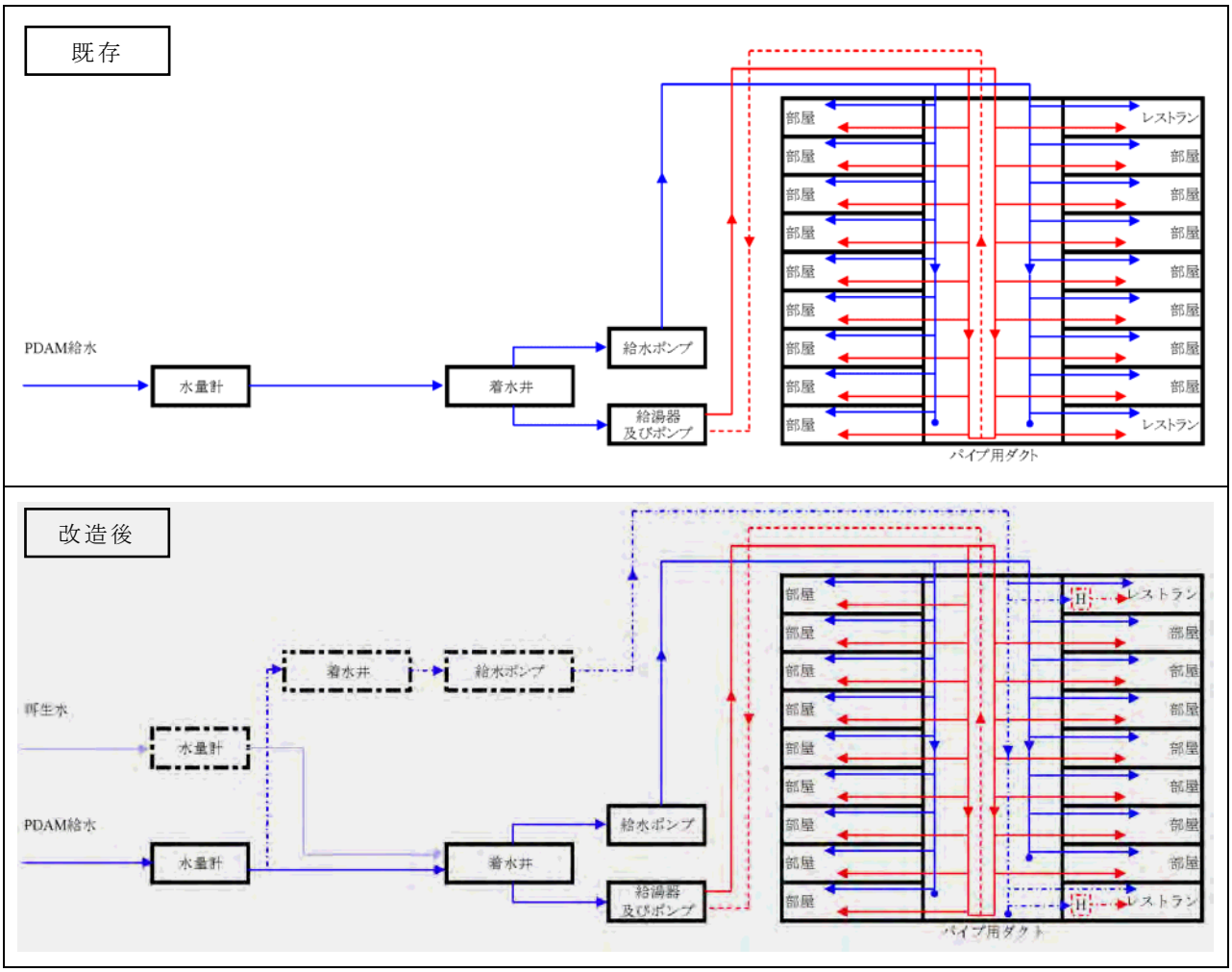


図 7.b.5　給水管改造モデル図（ケース 2）

したがって、改築工事としては以下の項目が発生する。

・再生水給水管設置工事
　（再生水：水量計～着水井、PDAM 給水：既設管～着水井～給水ポンプ～各レストラン）
・再生水受水槽設置工事
・水量計の設置工事
・給水ポンプ設置工事
・ヒータ設置工事（各レストラン用）

新設給水配管ルートのイメージを図 7.b.6 に示す。

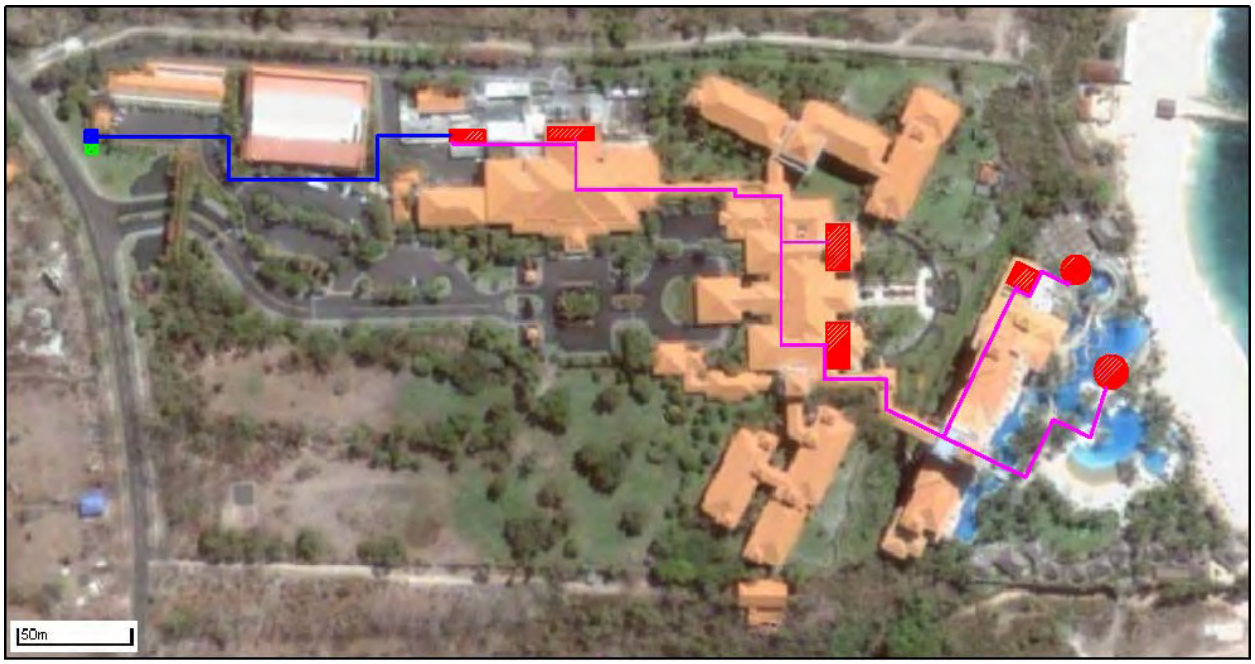


図 7.b.6　新設給水配管のルートイメージ図（ケース 2）

図 7.b.6 の緑色は既設水量計、赤色はレストランの位置を示しており、青色が新設再生水給水ルート、桃色は新設 PDAM 給水ルートを示している。

上記ルートにて改造費を積算すると表 7.b.3 のようになる。

表 7.b.3　従来型の再生水利用のためのホテル内の給水管改築費（ケース 2）

項目	数量	単位	単価（IDR）	費用(IDR)
再生水給水管設置工事	920	m	363,000	333,960,000
再生水受水槽工事	1	式	488,870,000	488,870,000
水量計の設置工事	1	式	20,000,000	20,000,000
給水ポンプ設置工事	1	式	100,000,000	100,000,000
ヒータ設置工事	6	式	8,000,000	48,000,000
合計				990,830,000

付属資料 8

事業費積算資料

付属資料 8　事業費積算資料

8.a　　事業費の構成要素

再生水利用事業費の構成要素は、大項目として、建設費、エンジニアリングサービス費、税金、維持管理費に分け、さらに小項目として以下の通りとする。

表 8.a.1　事業費の構成要素

大項目	小項目
【１】建設費	（A）敷地造成費
	（B）再生水施設建設費
	（C）送水管建設費
	（D）配水池修繕費
	（E）配水管修繕、建設費
	（F）ホテル内の給水管設備の改築費
【２】エンジニアリングサービス費	（A）詳細設計、工事監理、その他調査費
	（B）人材育成費
	（C）広報及び教育関連費
【３】税金	（A）付加価値税
	（B）輸入税
	（C）取水税
【４】維持管理費	（A）人件費
	（B）電力費
	（C）薬品費
	（D）燃料費
	（E）水質試験費
	（F）修繕及び交換費
	（G）事務所費
	（H）処理水使用料金

8.b　　建設費

建設費については、再生水処理施設からホテル内の給水管設備の改築に関わる全ての費用を算出する。なお、本論第 9 章で述べたように、事業目的会社（SPC）、水道公社（PDAM）、及び各ホテルにそれぞれの役割分担が明確化されている。建設費用でもそれぞれの関係機関別に算定した。まず、SPC が関わる建設費としては、敷地造成費、再生水施設建設費及び送水管建設費がある。つぎに PDAM が関わる建設費としては、配水池改造費及び配水管（既設管と新設管）整備費がある。各ホテルについては、給水管切替え工事に関わる改築

費が上げられる。各項目の詳細を以下に記述する。

表 8.b.1　事業費の構成要素

項目	SPC	PDAM	各ホテル
（A）敷地造成費	○		
（B）再生水施設建設費	○		
（C）送水管建設費	○		
（D）配水池修繕費		○	
（E）配水管修繕、建設費		○	
（F）ホテル内の給水管設備の改築費			○

(1) 敷地造成費

敷地造成費は、施設建設の前準備として以下の建設工事を実施するために必要な費用を積算した。なお、土地自体はバリ州政府側が、契約で貸与することが前提である。

・ 維持管理導線整備
・ 伐採及び浚渫（林、コンクリート殻、軟弱土）
・ 購入土による埋立て

(2) 再生水処理施設建設費

再生水処理施設建設費は､デンパサール下水処理場から二次処理水を揚水し､生物膜処理、オゾン処理、膜ろ過処理、送水の施設を建設する費用である。これらの建設費用の内訳を以下の通り整理して示す。

1) 構造物建設費（土木及び建築工事）

・原水ポンプ棟費
・生物処理棟費
・オゾン処理棟費
・膜ろ過棟費
・場内整備費
・車両購入費
・電力接続料

2) 機械及び電気設備建設費

・機械設備費（機器費及び設置据付費）
・電気設備費（機器費及び設置据付費）

(3) 送水管敷設費

デンパサール下水処理場からヌサドゥア地区にある PDAM の既設の UPA 配水池までの送水管の敷設費は、作業性や交通渋滞を考慮して 4 つの工区に分けた。総工事費はそれぞれ

の区間の合計とし、それぞれの工区延長は以下のようになる。
・開削工法（昼間工事：約 7.5km）
・開削工法（夜間工事：バドゥン側周辺～サマ川周辺の約 7km）
・水管橋（河川、排水路横断部）
・推進工法（空港周辺の約 400m）

(4) 配水池改築費
既存の配水池は、屋根が無く、壁面にもひびが入り漏水跡が見られるため、修繕及び改築が必要であり、以下の費用を積算する。
・内面補修費
・防水塗装費
・覆蓋設置費

(5) 配水管敷設費
配水池から各ホテルの給水施設まで再生水を配るための再生水専用の配水管の敷設費用を以下に分けて積算する。
・ヌサドゥア地区での既設の配水管の修繕整備費
・ブノア地区への新規の配水管敷設費
・サワンガン地区への新設の配水管敷設費

(6) ホテル内の給水管の改築費
これは再生水をホテルで使用するために必要な改築工事費であり、第 6 章で検討した費用を積算する。

＜ケース 1 の費用概要＞
再生水を各トイレまで供給する給水管システムを構築するための改築工事費である。

＜ケース 2 の費用概要＞
PDAM 水と再生水を混ぜて供給する給水管システムと、レストラン等への飲料水や炊事用水専用（PDAM 水のみ）の給水管システムを構築するための、改築工事費である。

(7) 建設費の総計
上記条件で算出した施設別および責任分担機関（組織）別の合計を表 8.b.2（ケース 1)、表 8.b.3（ケース 2）示す。また、ケース 1 とケース 2 の項目明細を表 8.b.4 と表 8.b.5 に、工事単価表を表 8.b.6 それぞれ示す。

表 8.b.2　ケース 1 の建設費

(1) 施設別建設費

項目	IDR (×1,000)			JPY (×1,000)
	内貨	外貨	合計	合計
【A　敷地造成費】				
敷地造成費	5,968,887	0	5,968,887	54,257
【B　再生水施設建設費】				
構造物建設費				
原水ポンプ棟	976,400	0	976,400	8,875
生物処理棟	5,455,191	0	5,455,191	49,588
オゾン処理棟	7,942,297	0	7,942,297	72,195
膜ろ過棟	12,454,956	0	12,454,956	113,216
現場作業	3,598,539	0	3,598,539	32,711
車輌	2,070,000	0	2,070,000	18,816
電力接続料	631,250	0	631,250	5,738
小計 (1)	33,128,632	0	33,128,632	301,139
機械及び電気設備				
機械設備	28,027,620	24,004,951	52,032,571	472,976
電気設備	35,613,810	0	35,613,810	323,730
小計 (2)	63,641,430	24,004,951	87,646,381	796,706
合計	96,770,062	24,004,951	120,775,013	1,097,845
【C　送水管建設費】				
送水管建設費	44,144,600	0	44,144,600	401,274
【D　配水池修繕費】				
配水池修繕費	3,449,933	0	3,449,933	31,360
【E 配水管建設費】				
Nusa Dua地区配水管建設費	3,342,380	0	3,342,380	30,382
Benoa地区配水管建設費	10,285,000	0	10,285,000	93,491
Sawangan地区配水管建設費	8,465,200	0	8,465,200	76,949
合計	22,092,580	0	22,092,580	200,822
【F ホテル内の給水管設備の改築費】				
ホテル内の給水管設備の改築費	29,230,000	0	29,230,000	265,701
合計	29,230,000	0	29,230,000	265,701

(2) 責任分担機関別建設費

項目	IDR (×1,000)			JPY (×1,000)
	内貨	外貨	合計	合計
SPC建設費	146,883,549	24,004,951	170,888,500	1,553,376
PDAM建設費	25,542,513	0	25,542,513	232,181
ホテル内の給水管設備の改築費	29,230,000	0	29,230,000	265,701
総計	201,656,062	24,004,951	225,661,013	2,051,259

表 8.b.3 ケース 2 の建設費

(1) 施設別建設費

項目	IDR (×1,000)			JPY (×1,000)
	内貨	外貨	合計	合計
【A 敷地造成費】				
敷地造成費	6,507,139	0	6,507,139	59,150
【B 再生水施設建設費】				
構造物建設費				
原水ポンプ棟	1,224,468	0	1,224,468	11,130
生物処理棟	9,387,773	0	9,387,773	85,335
オゾン処理棟	8,823,814	0	8,823,814	80,208
膜ろ過棟	14,261,371	0	14,261,371	129,636
現場作業	4,357,294	0	4,357,294	39,608
車輌	2,070,000	0	2,070,000	18,816
電力接続料	631,250	0	631,250	5,738
小計 (1)	40,755,971	0	40,755,971	370,472
機械及び電気設備				
機械設備	33,402,949	34,308,417	67,711,366	615,496
電気設備	35,613,810	0	35,613,810	323,730
小計 (2)	69,016,759	34,308,417	103,325,176	939,226
合計	109,772,730	34,308,417	144,081,147	1,309,698
【C 送水管建設費】				
送水管建設費	56,218,200	0	56,218,200	511,023
【D 配水池修繕費】				
配水池修繕費	3,449,933	0	3,449,933	31,360
【E 配水管建設費】				
Nusa Dua地区配水管建設費	3,342,380	0	3,342,380	30,382
Benoa地区配水管建設費	13,326,700	0	13,326,700	121,140
Sawangan地区配水管建設費	10,757,200	0	10,757,200	97,783
合計	27,426,280	0	27,426,280	249,305
【F ホテル内の給水管設備の改築費】				
ホテル内の給水管設備の改築費	19,750,000	0	19,750,000	179,528
合計	19,750,000	0	19,750,000	179,528

(2) 責任分担機関別建設費

項目	IDR (×1,000)			JPY (×1,000)
	内貨	外貨	合計	合計
SPC建設費	172,498,069	34,308,417	206,806,486	1,879,871
PDAM建設費	30,876,213	0	30,876,213	280,665
ホテル内の給水管設備の改築費	19,750,000	0	19,750,000	179,528
総計	223,124,281	34,308,417	257,432,698	2,340,063

A1 Site Preparation for Treatment Plant

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation (Root of Mangrove, Existing Structure		m^3	7,590	102,000	0	774,180	0	774,180	
Waste Disposal (Root of Mangrove, Existing Struc		m^3	7,590	56,600	0	429,594	0	429,594	
Landfill	(Compacted use buy soil)	m^3	19,800	144,800	0	2,867,040	0	2,867,040	
Existing Bridge Removal		m^2	30	1,980,000	0	59,400	0	59,400	
Administrative Road	Pavement Work	m^2	2,910	260,300	0	757,473	0	757,473	
Administrative Road	Sub-base (aggregate A)	m^3	600	330,000	0	198,000	0	198,000	
Administrative Road	Sub-base (aggregate B)	m^3	900	330,000	0	297,000	0	297,000	
New Bridge Construction	Width=5m, Length=3m	m^2	15	5,720,000	0	85,800	0	85,800	
New Bridge Construction	Width=5m, Length=14m	m^2	70	5,720,000	0	400,400	0	400,400	
Gate and Guard Post		set	1	100,000,000	0	100,000	0	100,000	
Total						5,968,887	0	5,968,887	

B1 Raw Water Pump Tank

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	756	46,000	0	34,776	0	34,776	
Back Filling	BH	m^3	580	43,300	0	25,114	0	25,114	
Surplus Soil Disposal		m^3	176	56,600	0	9,962	0	9,962	
Foundation Pile	L=20m	pcs	23	12,940,000	0	297,620	0	297,620	
Sand Layer		m^3	7	202,300	0	1,416	0	1,416	
Leveling Concrete		m^3	4	1,294,000	0	5,176	0	5,176	
Reinforced Concrete		m^3	136	2,534,000	0	344,624	0	344,624	
Reinforcement		t	13.6	16,120,000	0	219,232	0	219,232	
Roofing		m^2	37	1,040,000	0	38,480	0	38,480	
Total						976,400	0	976,400	

B2 Biological Treatment Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	185	46,000	0	8,510	0	8,510	
Back Filling	BH	m^3	7	43,300	0	303	0	303	
Surplus Soil Disposal		m^3	178	56,600	0	10,075	0	10,075	
Foundation Pile	L=20m	pcs	150	12,940,000	0	1,941,000	0	1,941,000	
Sand Layer		m^3	89	202,300	0	18,005	0	18,005	
Leveling Concrete		m^3	45	1,294,000	0	58,230	0	58,230	
Reinforced Concrete		m^3	749	2,534,000	0	1,897,966	0	1,897,966	
Reinforcement		t	74.9	16,120,000	0	1,207,388	0	1,207,388	
Roofing		m^2	224	1,040,000	0	232,960	0	232,960	
Waterproofing		m^2	1,252	64,500	0	80,754	0	80,754	
Total						5,455,191	0	5,455,191	

B3 Ozonation Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	373	46,000	0	17,158	0	17,158	
Back Filling	BH	m^3	10	43,300	0	433	0	433	
Surplus Soil Disposal		m^3	363	56,600	0	20,546	0	20,546	
Foundation Pile	L=20m	pcs	172	12,940,000	0	2,225,680	0	2,225,680	
Sand Layer		m^3	182	202,300	0	36,819	0	36,819	
Leveling Concrete		m^3	91	1,294,000	0	117,754	0	117,754	
Reinforced Concrete		m^3	1,106	2,534,000	0	2,802,604	0	2,802,604	
Reinforcement		t	110.6	16,120,000	0	1,782,872	0	1,782,872	
Roofing		m^2	765	1,040,000	0	795,600	0	795,600	
Waterproofing		m^2	447	64,500	0	28,832	0	28,832	
Corrosion Protection Coating		m^2	114	1,000,000	0	114,000	0	114,000	
Total						7,942,297	0	7,942,297	

B4 Membrane Filtration Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	1,924	46,000	0	88,504	0	88,504	
Back Filling	BH	m^3	649	43,300	0	28,102	0	28,102	
Surplus Soil Disposal		m^3	1,275	56,600	0	72,165	0	72,165	
Foundation Pile	L=20m	pcs	245	12,940,000	0	3,170,300	0	3,170,300	
Sand Layer		m^3	210	202,300	0	42,483	0	42,483	
Leveling Concrete		m^3	105	1,294,000	0	135,870	0	135,870	
Reinforced Concrete		m^3	1,580	2,534,000	0	4,003,720	0	4,003,720	
Reinforcement		t	158.0	16,120,000	0	2,546,960	0	2,546,960	
Roofing		m^2	1,278	1,040,000	0	1,329,120	0	1,329,120	
Waterproofing		m^2	585	64,500	0	37,733	0	37,733	
Laboratory Equipment		set	1	1,000,000,000	0	1,000,000	0	1,000,000	
Total						12,454,956	0	12,454,956	

B5 Site Work

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Fence		m	350	500,000	0	175,000	0	175,000	
Road	Pavement Work	m^2	2,900	260,300	0	754,870	0	754,870	
Road	Sub-base (aggregate A)	m^3	580	330,000	0	191,400	0	191,400	
Road	Sub-base (aggregate B)	m^3	870	330,000	0	287,100	0	287,100	
Lawn Grass		m^2	2,290	50,800	0	116,332	0	116,332	
Drainage		m	332	1,431,000	0	475,092	0	475,092	
Electric Lamp		set	10	3,000,000	0	30,000	0	30,000	
Gate and Guard Post		set	1	100,000,000	0	100,000	0	100,000	
Pipe Laying Work	For Transmission pipe (300mm	m	560	1,631,000	0	913,360	0	913,360	
Pipe Laying Work	For Raw water pipe (300mm)	m	100	1,631,000	0	163,100	0	163,100	
Pipe Laying Work	For Discharge pipe (200mm)	m	335	1,171,000	0	392,285	0	392,285	
Total						3,598,539	0	3,598,539	

B6 Maintenance Equipment

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Patrol Car	Sedan Type	units	1	270,000,000		270,000	0	270,000	
Tanker Truck	4t	units	2	900,000,000		1,800,000	0	1,800,000	
Total						2,070,000	0	2,070,000	

B7 Machinery Construction (1IDR = 0.00909)

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference (JPY)
				LC	FC	LC	FC	Total	
Machinery Equipment		units	1	6,077,331,000	17,569,307,000	6,077,331	17,569,307	23,646,638	159,705,000
Transmission Pump		units	2	225,000,000	0	450,000	0	450,000	
Crane		units	1	216,000,000	0	216,000	0	216,000	
Equipment and Pipe Instration		units	1	21,284,289,000	6,435,644,000	21,284,289	6,435,644	27,719,933	58,500,000
Total						28,027,620	24,004,951	52,032,571	

B8 Electricity Construction (1IDR = 0.00909)

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference (JPY)
				LC	FC	LC	FC	Total	
Electricity Equipment for Main Facilities		units	1	10,290,267,000	0	10,290,267	0	10,290,267	
Monitoring Device		units	1	2,457,000,000	0	2,457,000	0	2,457,000	
Receiving Electricity Equipment	20kV	units	1	1,602,000,000	0	1,602,000	0	1,602,000	
Electric Generator		units	1	7,605,000,000	0	7,605,000	0	7,605,000	
Electricity Equipment for Transmission Pump		units	1	522,000,000	0	522,000	0	522,000	
Instrumentation Equipment for UPA Reservoir		units	1	90,000,000	0	90,000	0	90,000	
Monitoring Device for UPA Reservoir		units	1	99,000,000	0	99,000	0	99,000	
Equipment and Cable Installation for Main		units	1	7,730,541,000	0	7,730,541	0	7,730,541	
Equipment and Cable Installation for Others		units	1	5,218,002,000	0	5,218,002	0	5,218,002	
Total						35,613,810	0	35,613,810	

C1 Water Transmission Pipe Line

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Open Cut Methods	ϕ 300 (Daytime work)	m	7,500	2,125,000	0	15,937,500	0	15,937,500	
Open Cut Methods	ϕ 300 (Nighttime work)	m	7,000	2,762,500	0	19,337,500	0	19,337,500	
Pipe Bridge Methods	ϕ 300, L=120m	set	1	1,440,000,000	0	1,440,000	0	1,440,000	
Pipe Bridge Methods	ϕ 300, L=50m	set	1	884,000,000	0	884,000	0	884,000	
Pipe Bridge Methods	ϕ 300, L=70m	set	1	645,600,000	0	645,600	0	645,600	
Pipe Bridge Methods	ϕ 300, L=10m	set	5	180,000,000	0	900,000	0	900,000	
Pipe Jacking Methods	ϕ 300	m	400	12,500,000	0	5,000,000	0	5,000,000	
Total						44,144,600	0	44,144,600	

D1 Distribution Reservoir

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Mortar Removal		m^2	500	26,000		13,000	0	13,000	
Chemical Anchor		pcs	2,000	1,000,000		2,000,000	0	2,000,000	
Reinforced Concrete		m^3	100	2,534,000		253,400	0	253,400	
Reinforcement		t	10	16,120,000		161,200	0	161,200	
Waterproofing		m^2	900	64,500		58,050	0	58,050	
Roof		m^2	400	2,000,000		800,000	0	800,000	
Fixtures and Fittings		set	1	164,282,500		164,283	0	164,283	Total cost 5%
Total						3,449,933	0	3,449,933	

E1 Distribution Pipe Line for Nusa Dua

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Water Leakage Investigation		set	1	250,000,000		250,000	0	250,000	
Pipe Replacement DCIP	ϕ 400	m	220	5,442,000		1,197,240	0	1,197,240	
Pipe Replacement DCIP	ϕ 300	m	80	3,652,000		292,160	0	292,160	
Pipe Replacement DCIP	ϕ 200	m	190	2,302,000		437,380	0	437,380	
Pipe Replacement DCIP	ϕ 150	m	160	1,905,000		304,800	0	304,800	
Water Stop Valve Replacement	ϕ 400	set	2	72,000,000		144,000	0	144,000	
Water Stop Valve Replacement	ϕ 200	set	16	36,800,000		588,800	0	588,800	
Water Stop Valve Replacement	ϕ 150	set	4	32,000,000		128,000	0	128,000	
Total						3,342,380	0	3,342,380	

E2 Distribution Pipe Line for Benoa

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Pipe Laying	ϕ 200	m	5,800	1,606,000		9,314,800	0	9,314,800	
Pipe Laying	ϕ 100	m	700	1,386,000		970,200	0	970,200	
Total						10,285,000	0	10,285,000	

E3 Distribution Pipe Line for Sawangan

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Pipe Laying	φ200	m	4,000	1,606,000		6,424,000	0	6,424,000	
Pipe Laying	φ100	m	1,200	1,386,000		1,663,200	0	1,663,200	
Booster Pump	0.8m3/min 18.5kW	set	2	77,000,000		154,000	0	154,000	
Electric Panel	Soft Starter	set	1	224,000,000		224,000	0	224,000	
Total						8,465,200	0	8,465,200	

F1 Hotel Conversion

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Hotel Converting Cost		Room	7,900	3,700,000		29,230,000	0	29,230,000	
Total						29,230,000	0	29,230,000	

A1 Site Preparation for Treatment Plant

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation (Root of Mangrove, Existing Structure		m^3	8,610	102,000	0	878,220	0	878,220	
Waste Disposal (Root of Mangrove, Existing Struc		m^3	8,610	56,600	0	487,326	0	487,326	
Landfill	(Compacted use buy soil)	m^3	22,400	144,800	0	3,243,520	0	3,243,520	
Existing Bridge Removal		m^2	30	1,980,000	0	59,400	0	59,400	
Administrative Road	Pavement Work	m^2	2,910	260,300	0	757,473	0	757,473	
Administrative Road	Sub-base (aggregate A)	m^3	600	330,000	0	198,000	0	198,000	
Administrative Road	Sub-base (aggregate B)	m^3	900	330,000	0	297,000	0	297,000	
New Bridge Construction	Width=5m, Length=3m	m^2	15	5,720,000	0	85,800	0	85,800	
New Bridge Construction	Width=5m, Length=14m	m^2	70	5,720,000	0	400,400	0	400,400	
Gate and Guard Post		set	1	100,000,000	0	100,000	0	100,000	
Total						6,507,139	0	6,507,139	

B1 Raw Water Pump Tank

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	837	46,000	0	38,502	0	38,502	
Back Filling	BH	m^3	616	43,300	0	26,673	0	26,673	
Surplus Soil Disposal		m^3	221	56,600	0	12,509	0	12,509	
Foundation Pile	L=20m	pcs	29	12,940,000	0	375,260	0	375,260	
Sand Layer		m^3	10	202,300	0	2,023	0	2,023	
Leveling Concrete		m^3	5	1,294,000	0	6,470	0	6,470	
Reinforced Concrete		m^3	172	2,534,000	0	435,848	0	435,848	
Reinforcement		t	17.2	16,120,000	0	277,264	0	277,264	
Roofing		m^2	48	1,040,000	0	49,920	0	49,920	
Total						1,224,468	0	1,224,468	

B2 Biological Treatment Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	303	46,000	0	13,938	0	13,938	
Back Filling	BH	m^3	8	43,300	0	346	0	346	
Surplus Soil Disposal		m^3	295	56,600	0	16,697	0	16,697	
Foundation Pile	L=20m	pcs	266	12,940,000	0	3,442,040	0	3,442,040	
Sand Layer		m^3	147	202,300	0	29,738	0	29,738	
Leveling Concrete		m^3	74	1,294,000	0	95,756	0	95,756	
Reinforced Concrete		m^3	1,277	2,534,000	0	3,235,918	0	3,235,918	
Reinforcement		t	127.7	16,120,000	0	2,058,524	0	2,058,524	
Roofing		m^2	327	1,040,000	0	340,080	0	340,080	
Waterproofing		m^2	2,399	64,500	0	154,736	0	154,736	
Total						9,387,773	0	9,387,773	

B3 Ozonation Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	373	46,000	0	17,158	0	17,158	
Back Filling	BH	m^3	10	43,300	0	433	0	433	
Surplus Soil Disposal		m^3	363	56,600	0	20,546	0	20,546	
Foundation Pile	L=20m	pcs	197	12,940,000	0	2,549,180	0	2,549,180	
Sand Layer		m^3	182	202,300	0	36,819	0	36,819	
Leveling Concrete		m^3	91	1,294,000	0	117,754	0	117,754	
Reinforced Concrete		m^3	1,234	2,534,000	0	3,126,956	0	3,126,956	
Reinforcement		t	123.4	16,120,000	0	1,989,208	0	1,989,208	
Roofing		m^2	683	1,040,000	0	710,320	0	710,320	
Waterproofing		m^2	658	64,500	0	42,441	0	42,441	
Corrosion Protection Coating		m^2	213	1,000,000	0	213,000	0	213,000	
Total						8,823,814	0	8,823,814	

B4 Membrane Filtration Building

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Excavation	Sand, Cray	m^3	2,422	46,000	0	111,412	0	111,412	
Back Filling	BH	m^3	706	43,300	0	30,570	0	30,570	
Surplus Soil Disposal		m^3	1,716	56,600	0	97,126	0	97,126	
Foundation Pile	L=20m	pcs	291	12,940,000	0	3,765,540	0	3,765,540	
Sand Layer		m^3	256	202,300	0	51,789	0	51,789	
Leveling Concrete		m^3	128	1,294,000	0	165,632	0	165,632	
Reinforced Concrete		m^3	1,848	2,534,000	0	4,682,832	0	4,682,832	
Reinforcement		t	184.8	16,120,000	0	2,978,976	0	2,978,976	
Roofing		m^2	1,278	1,040,000	0	1,329,120	0	1,329,120	
Waterproofing		m^2	750	64,500	0	48,375	0	48,375	
Laboratory Equipment		set	1	1,000,000,000	0	1,000,000	0	1,000,000	
Total						14,261,371	0	14,261,371	

B5 Site Work

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Fence		m	400	500,000	0	200,000	0	200,000	
Road	Pavement Work	m^2	3,200	260,300	0	832,960	0	832,960	
Road	Sub-base (aggregate A)	m^3	640	330,000	0	211,200	0	211,200	
Road	Sub-base (aggregate B)	m^3	960	330,000	0	316,800	0	316,800	
Lawn Grass		m^2	2,500	50,800	0	127,000	0	127,000	
Drainage		m	370	1,431,000	0	529,470	0	529,470	
Electric Lamp		set	10	3,000,000	0	30,000	0	30,000	
Gate and Guard Post		set	1	100,000,000	0	100,000	0	100,000	
Pipe Laying Work	For Transmission pipe (400mm	m	558	2,230,000	0	1,244,340	0	1,244,340	
Pipe Laying Work	For Raw water pipe (400mm)	m	99	2,230,000	0	220,770	0	220,770	
Pipe Laying Work	For Discharge pipe (300mm)	m	334	1,631,000	0	544,754	0	544,754	
Total						4,357,294	0	4,357,294	

B6 Maintenance Equipment

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Patrol Car	Sedan Type	units	1	270,000,000		270,000	0	270,000	
Tanker Truck	4t	units	2	900,000,000		1,800,000	0	1,800,000	
Total						2,070,000	0	2,070,000	

B7 Machinery Construction (1IDR = 0.00909)

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference (JPY)
				LC	FC	LC	FC	Total	
Machinery Equipment		units	1	7,780,617,000	25,504,456,000	7,780,617	25,504,456	33,285,073	231,835,500
Transmission Pump		units	3	168,750,000	0	506,250	0	506,250	
Crane		units	1	162,000,000	0	162,000	0	162,000	
Equipment and Pipe Instration		units	1	24,954,081,750	8,803,961,000	24,954,082	8,803,961	33,758,043	80,028,000
Total						33,402,949	34,308,417	67,711,366	

B8 Electricity Construction (1IDR = 0.00909)

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference (JPY)
				LC	FC	LC	FC	Total	
Electricity Equipment for Main Facilities		units	1	12,129,507,000	0	12,129,507	0	12,129,507	
Monitoring Device		units	1	2,457,000,000	0	2,457,000	0	2,457,000	
Receiving Electricity Equipment	20kV	units	1	1,201,500,000	0	1,201,500	0	1,201,500	
Electric Generator		units	1	5,703,750,000	0	5,703,750	0	5,703,750	
Electricity Equipment for Transmission Pump		units	1	445,500,000	0	445,500	0	445,500	
Instrumentation Equipment for UPA Reservoir		units	1	67,500,000	0	67,500	0	67,500	
Monitoring Device for UPA Reservoir		units	1	74,250,000	0	74,250	0	74,250	
Equipment and Cable Installation for Main		units	1	9,039,303,000	0	9,039,303	0	9,039,303	
Equipment and Cable Installation for Others		units	1	4,495,500,000	0	4,495,500	0	4,495,500	
Total						35,613,810	0	35,613,810	

C1 Water Transmission Pipe Line

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Open Cut Methods	ϕ 400 (Daytime work)	m	7,500	2,782,000	0	20,865,000	0	20,865,000	
Open Cut Methods	ϕ 400 (Nighttime work)	m	7,000	3,616,600	0	25,316,200	0	25,316,200	
Pipe Bridge Methods	ϕ 400, L=120m	set	1	1,800,000,000	0	1,800,000	0	1,800,000	
Pipe Bridge Methods	ϕ 400, L=50m	set	1	1,105,000,000	0	1,105,000	0	1,105,000	
Pipe Bridge Methods	ϕ 400, L=70m	set	1	807,000,000	0	807,000	0	807,000	
Pipe Bridge Methods	ϕ 400, L=10m	set	5	225,000,000	0	1,125,000	0	1,125,000	
Pipe Jacking Methods	ϕ 400	m	400	13,000,000	0	5,200,000	0	5,200,000	
Total						56,218,200	0	56,218,200	

D1 Distribution Reservoir

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Mortar Removal		m^2	500	26,000		13,000	0	13,000	
Chemical Anchor		pcs	2,000	1,000,000		2,000,000	0	2,000,000	
Reinforced Concrete		m^3	100	2,534,000		253,400	0	253,400	
Reinforcement		t	10	16,120,000		161,200	0	161,200	
Waterproofing		m^2	900	64,500		58,050	0	58,050	
Roof		m^2	400	2,000,000		800,000	0	800,000	
Fixtures and Fittings		set	1	164,282,500		164,283	0	164,283	Total cost 5%
Total						3,449,933	0	3,449,933	

E1 Distribution Pipe Line for Nusa Dua

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Water Leakage Investigation		set	1	250,000,000		250,000	0	250,000	
Pipe Replacement DCIP	ϕ 400	m	220	5,442,000		1,197,240	0	1,197,240	
Pipe Replacement DCIP	ϕ 300	m	80	3,652,000		292,160	0	292,160	
Pipe Replacement DCIP	ϕ 200	m	190	2,302,000		437,380	0	437,380	
Pipe Replacement DCIP	ϕ 150	m	160	1,905,000		304,800	0	304,800	
Water Stop Valve Replacement	ϕ 400	set	2	72,000,000		144,000	0	144,000	
Water Stop Valve Replacement	ϕ 200	set	16	36,800,000		588,800	0	588,800	
Water Stop Valve Replacement	ϕ 150	set	4	32,000,000		128,000	0	128,000	
Total						3,342,380	0	3,342,380	

E2 Distribution Pipe Line for Benoa

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Pipe Laying	ϕ 300	m	5,800	2,125,000		12,325,000	0	12,325,000	
Pipe Laying	ϕ 150	m	700	1,431,000		1,001,700	0	1,001,700	
Total						13,326,700	0	13,326,700	

E3 Distribution Pipe Line for Sawangan

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Pipe Laying	φ300	m	4,000	2,125,000		8,500,000	0	8,500,000	
Pipe Laying	φ150	m	1,200	1,431,000		1,717,200	0	1,717,200	
Booster Pump	1.5m3/min 18.5kW	set	2	110,000,000		220,000	0	220,000	
Electric Panel	Soft Starter	set	1	320,000,000		320,000	0	320,000	
Total						10,757,200	0	10,757,200	

F1 Hotel Conversion

Items	Specification	Unit	Quantity	Unit Cost (IDR)		Total Cost (1,000IDR)			Reference
				LC	FC	LC	FC	Total	
Hotel Converting Cost		Room	7,900	2,500,000		19,750,000	0	19,750,000	
Total						19,750,000	0	19,750,000	

表 8.b.6　工事単価表

Items	Specification	Unit	Unit Price		Remarks
			IDR	YEN	
Excavation	Root of Mangrove, Existing Structure	m^3	102,000		
Excavation	BH, Sand, Clay, Gravel	m^3	46,000		
Excavation	BH, Rock	m^3	102,000		
Backfilling by purchase Soil		m^3	145,000		
Backfilling	BH	m^3	43,300		
Backfilling	Bulldozer	m^3	20,000		
Backfilling	(Compacted use buy soil)	m^3	144,800		
Surplus Soil Disposal		m^3	56,600		
Waste Disposal		m^3	56,600		
Sand Layer		m^3	202,300		
Leveling Concrete		m^3	1,294,000		
Reinforced Concrete	Including formwork	m^3	2,534,000		
Reinforcement Bar	With rebar fabrication and assembly	t	16,120,000		
Roof	Without slab and beam	m^2	1,040,000		
Roof		m^2	2,000,000		
Pile	φ300	m	647,000		
Pile	φ300, L=20m	pcs	12,940,000		
Pavement work	block	m^2	260,300		
Cube Stone		m	148,300		
Sub-base (aggregate A)		m^3	330,000		
Sub-base (aggregate B)		m^3	330,000		
PVC Pipe	φ=150mm without Pavement	m	1,025,000		
PVC Pipe	φ=200mm without Pavement	m	1,171,000		
PVC Pipe	φ=300mm without Pavement	m	1,631,000		
HDPE Pipe	φ=400mm without Pavement	m	2,230,000		
PVC Pipe	φ=150mm with Pavement	m	1,431,000		
PVC Pipe	φ=200mm with Pavement	m	1,606,000		
PVC Pipe	φ=300mm with Pavement	m	2,125,000		
HDPE Pipe	φ=400mm with Pavement	m	2,782,000		
DCIP Pipe	φ=150mm with Pavement	m	1,905,000		
DCIP Pipe	φ=200mm with Pavement	m	2,302,000		
DCIP Pipe	φ=300mm with Pavement	m	3,652,000		
DCIP Pipe	φ=400mm with Pavement	m	5,442,000		
Water Stop Valve Replacement	φ=400mm	set	72,000,000		
Water Stop Valve Replacement	φ=200mm	set	36,800,000		
Water Stop Valve Replacement	φ=150mm	set	32,000,000		
Pipe Bridge	φ=400mm, L=120m	set	1,800,000,000		
Pipe Bridge	φ=400mm, L=70m	set	1,105,000,000		
Pipe Bridge	φ=400mm, L=50m	set	807,000,000		
Pipe Bridge	φ=400mm, L=10m	set	225,000,000		
Pipe Bridge	φ=300mm, L=120m	set	1,440,000,000		
Pipe Bridge	φ=300mm, L=70m	set	884,000,000		
Pipe Bridge	φ=300mm, L=50m	set	645,600,000		
Pipe Bridge	φ=300mm, L=10m	set	180,000,000		
Pipe Jacking	φ=400mm	m	13,000,000		
Pipe Jacking	φ=300mm	m	12,500,000		
Laboratory Equipment		set	1,000,000,000		
Mortar Removal		m^2	26,000		
Chemical Anchor		set	100,000		
Waterproofing		m^2	64,500		
Protecting Coating	for corrosion protection coating	m^2	1,000,000		
Electric Lamp		set	3,000,000		
Lawn Grass		m^2	50,800		
Fence	H=1.2m	m	500,000		
Gate and Guard Post		set	100,000,000		
Bridge Removal		m^2	1,980,000		
Bridge Construction		m^2	5,720,000		
Demolish		m^3	100,000		
Water Leakage Investigation		set	250,000,000		
Booster Pump	1.5m3/min 18.5kw	set	110,000,000		
Electric Panel	Soft Starter	set	320,000,000		
Converting Cost	for Case1 (for Room Toilet)	room	3,700,000		
Converting Cost	for Case2 (for Restaurant)	room	2,500,000		

8.c　エンジニアリング・サービス費用

8.c.1 詳細設計、工事管理、その他の調査費

以下の費用について算出する。
・詳細設計費
・工事管理費
・設計施工期間のプロジェクト管理費
・EIA 実施費
・追加測量土質調査費
・既存の配水池や配水管（元灌漑用）の調査費

この費用の算出は、詳細設計及び工事管理に必要なエンジニアの MM を積み上げ、それに必要な事務所経費や調査費を個別に上乗せして積算している。エンジニアの MM は以下のように想定した。

・外国人エンジニア： 86MM
・現地人エンジニア：275MM

8.c.2 人材育成費、広報及び教育関連費

人材育成費、広報及び教育関連費については、現在デンパサール下水処理場でのテストプラント運転実施を含めて実施中である。この広報及び教育関連費については本事業開始前に実施を予定しており、本事業費では見込まないこととする。

表 8.c.1　エンジニアリングサービス集計表

	Description	Unit	Unit Price	Total Quantity	Total Amount
1. Foreign Cost					
1. Remuneration for Professional A			yen		Japanese Yen
	Foreign Staff				
	1-1 Foreign Staff				
A- 1	Consulting Services - Team Leader	M/M	3,200,000	22	70,400,000
A- 2	Sub-Team Leader - Pipe Line Engineer	M/M	3,000,000	9	27,000,000
A- 3	Civil Engineer for Transmission Pipe	M/M	2,800,000	3	8,400,000
A- 4	Sub-Team Leader - Treatment Plant/Pump Station	M/M	3,000,000	9	27,000,000
A- 5	Civil / Structural Engineer	M/M	2,800,000	4	11,200,000
A- 6	Mechanical Engineer	M/M	2,800,000	12	33,600,000
A- 7	Electrical Engineer	M/M	2,800,000	12	33,600,000
A- 8	Architect	M/M	2,800,000	3	8,400,000
A- 9	Document Specialist	M/M	2,800,000	5	14,000,000
A- 10	Cost Estimator	M/M	2,800,000	3	8,400,000
A- 11	Environmental Specialist	M/M	2,800,000	4	11,200,000
				86	
2. Direct Cost					
1	International Air Fare	nos	200,000	45	9,000,000
	Total				**262,200,000**

	Description	Unit	Unit Price	Total Quantity	Total Amount
II. Local Cost					
1. Remuneration for Professional B			IDR		IDR
B- 1	Deputy Team Leader	M/M	33,003,000	45	1,485,135,000
B- 2	Geotechnical Engineer	M/M	27,503,000	4	110,012,000
B- 3	Topographic Surveyor	M/M	27,503,000	6	165,018,000
B- 4	Pipe Line Engineer	M/M	27,503,000	16	440,048,000
B- 5	Civil Engineer	M/M	27,503,000	16	440,048,000
B- 6	Structural Engineer	M/M	27,503,000	6	165,018,000
B- 7	Mechanical Engineer	M/M	27,503,000	17	467,551,000
B- 8	Electrical Engineer	M/M	27,503,000	17	467,551,000
B- 9	Architect	M/M	27,503,000	7	192,521,000
B- 10	Document Specialist	M/M	27,503,000	6	165,018,000
B- 11	Environmental Expert	M/M	27,503,000	7	192,521,000
B- 12	Quantity Surveyor	M/M	27,503,000	46	1,265,138,000
B- 13	Chief Inspector	M/M	16,502,000	41	676,582,000
B- 14	Inspector	M/M	11,001,000	41	451,041,000
				275	
2. Remuneration for Supporting Staffs					
	1-7 Project Office				
C- 1	Office Manager	M/M	10,000,000	45	450,000,000
C- 2	Accountant	M/M	10,000,000	45	450,000,000
C- 3	CAD Support for Pipe Line	M/M	10,000,000	20	200,000,000
C- 4	CAD Support for Civil Works and Structural	M/M	10,000,000	5	50,000,000
C- 5	CAD Support for M & E	M/M	10,000,000	20	200,000,000
C- 6	Translator / Interpreter	M/M	10,000,000	34	340,000,000
C- 7	Secretary	M/M	5,000,000	45	225,000,000
C- 8	Security Guard	M/M	1,000,000	135	135,000,000
C- 9	Office Boy	M/M	1,000,000	54	54,000,000
				403	
3. Direct Cost					
1	Accommodation for Professional A	Month	33,003,000	86	2,838,258,000
2	Accommodation for Professional B	Month	3,300,000	275	907,500,000
3	Vehicle Rental	Month/Car	11,001,000	120	1,320,120,000
4	Office Rental	Month	22,002,000	45	990,090,000
5	International Communications	Month	2,200,000	45	99,000,000
6	Domestic Communications	Month	2,200,000	45	99,000,000
7	Office Maintenance	Month	5,501,000	45	247,545,000
8	Office Furniture and Equipment	Ls	220,022,000	1	220,022,000
9	Report Preparation	nos	550,000	45	24,750,000
10	Software (CAD etc)	Ls	110,011,000	1	110,011,000
11	Topographic Survey	Ls	110,011,000	1	110,011,000
12	Geological Investigation	Ls	165,017,000	1	165,017,000
13	EIA	Ls	1,650,165,017	1	1,650,165,017
	Total				**17,568,691,017**

Grand Total for Detail Design and Supervision	**Yen**	**421,899,401**

8.d　税金

プロジェクトに関わる税金として、以下の費用を計上する。

(1) 付加価値税（VAT）

付加価値税として、費用の 10%を計上する。

(2) 輸入税

輸入税は輸入品目により異なるが、テストプラント建設時の実績では輸入機器の総額の約10%程度であった。「イ」国の現地税務事務所の支援を得て調査・検討結果、資本財の輸入税免除に係る規定より、通関法改正に伴う財務大臣規定（101/PMK.04/2007）の適用が本再生水事業に認められれば、輸入税が免除される可能性があることが確認された。確認内容を以下に記す。

1) 当該財務大臣規定では、環境汚染防止に使用される機器や原料の輸入にかかる輸入関税を免除。免除は工業会社あるいは廃棄物処理会社に供与されるもので、輸入申告の登録から 2 年間、目的通りに使用された機器は、関税総局の許可を得た上で、他者へ譲渡したり、他の目的に使用したりすることができるという内容になっている。

2) 「廃棄物」についての定義は当該規定には明記されていない。また、本再生水事業を運営する SPC が、当該規定でいう「廃棄物処理会社」に該当するかどうかは不明確だが、法の趣旨に沿った事業であると考えられるので、事業認可後、財務省・国税総局に、下記書類を添付して輸入税免除の認可を申請することを薦める。
   - 投資調整庁の事業投資認可
   - 歳入局発行の Tax ID カード
   - VAT 登録事業者（PKP）
   - 輸入資機材の明細（金額、型式・仕様等）
   - 環境省・環境委員会による推薦状（廃棄物処理中に環境に悪影響をおよぼさないこと、また、廃棄物処理に使用される資機材として推薦すること）

輸入税免除の認可申請は SPC 設立後となるが、本調査の事業費算出では、輸入税が免除されることを前提条件として計算を行うこととする。

(3) 取水税

「イ」国法律（28/2009）では水を水道の水源として利用する場合、取水税が賦課されることが規定されている。税の運用と税率は地方政府規則に委ねられているが、課税対象は表流水と地下水のみが対象となっており下水二次処理水については規定がない状況である。

表 8.d.1　水源に対する法規制と税率

	水源	法規則	税率
1	表流水	バリ州規則（16/2009、改訂 1/2011）	水の価格の 10%
2	地下水	（バドゥン県の場合） バドゥン県規則（1/2011）	 水の価格の 20%

また、表流水の定義は「イ」国法律（7/2004、GR42/2008）で、「地上にある全ての水」と規定されているが、バリ州規則（1/2011）では地上・海上にある海水を除くと定義されており、バリ州では海水の水源利用は課税対象とならないと解釈出来る。

法令上、下水二次処理水を表流水と看做すべきかどうかについて、「イ」国の現地弁護士事務所および税務事務所に調査・検討を依頼した結果、バリ州政府の関係機関に確認・合意を求める必要はあるが、次の２つの理由から表流水として課税することには無理があると考えるとの回答があった。

1) 下水処理水は実態として海に放棄されており使用されていない水である。　強いて分類するなら海水と看做すべきで表流水ではない。
2) 課税の観点からみて、評価額を有していない。

上記専門家見解に基づき、本調査では下水二次処理水は非課税として検討を進める。

8.e　　維持管理費

維持管理費については、SPC が関わる全ての費用を算出する。維持管理費としては、1 年間当りの人件費、電気使用料、薬品費、燃料費、水質試験費、修繕及び交換費、事務所費等を見込んでいる。各項目については以下に記述し、算定表は表 8.e.3～8.e.10 を参照する。

(1) 人件費
SPC に関わる人件費として、ケース 1 では経営部門、管理及び財務部門、技術部門で計 22 名の現地スタッフ、また、ケース 2 では計 25 名の雇用するための費用を算出している。なお、スタッフの詳細は 9.4 節を参照する。

(2) 電力費
電力費は SPC が管理する全工程の年間平均電力消費量に電力単価を掛けて算出している。電力単価は、インドネシア国有電力会社（PT PLN）が規定している価格表（2010）により設定している。

(3) 薬品費
再生水施設で使用する以下の薬品の年間費用を算出している。
・凝集剤
・pH 調整用（酸、アルカリ）
・次亜塩素酸
・チオ硫酸

(4) 燃料費
SPC が使用する以下の機器、車両に関わる燃料費を見込んでいる。
・自家発電機（月一度の試運転用）
・巡回用車
・ダンク車

(5) 水質試験費
再生水施設内の水質試験室で行う日常試験以外の水質試験（毎月、半年毎）の外部委託費を計上している。

(6) 修繕及び交換費
施設及び設備の修繕費用として、以下の費用を計上している。
・建築及び土木施設：年間当り建設費の 0.1%
・機械及び電気設備：年間当り建設費の 1.5%
・車両関係　　：年間当り建設費の 3.0%

ろ過膜については、交換費として年間当りの費用を別途計上している。

(8) 処理水使用料金

現在、下水処理水は直接海に投棄されているため無価値と判断し使用料金は見込まない。

(9) 間接費

維持管理にかかわる様々な諸雑費等を間接費として、上記(1)から(8)の合計の 10%を見込んでいる。

(10) 税金

付加価値税として、上記(1)から(9)にそれぞれに 10%を見込んでいる。

(11) 維持管理費の総計

維持管理費の総計を表 8.e.1（ケース 1）と表 8.e.2（ケース 2）に分けて示す。

表 8.e.1　ケース１の維持管理費

項目	費用 (IDR/年)	税金 (IDR/年)	合計 (IDR/年)
〔A〕直接費			
1. 人件費	**2,061,600,000**	**206,160,000**	**2,267,760,000**
2. 電力費	**1,746,794,076**	**174,679,408**	**1,921,473,483**
3. 薬品費	**618,379,040**	**61,837,904**	**680,216,944**
4. 燃料費	**187,401,600**	**18,740,160**	**206,141,760**
5. 水質試験費	**17,800,000**	**1,780,000**	**19,580,000**
6. 修繕及び交換費	**1,631,336,584**	**163,133,658**	**1,794,470,243**
7. 事務所費	**600,000,000**	**60,000,000**	**660,000,000**
8. 処理水使用料金	**0**	**0**	**0**
小計 A	**6,863,311,300**	**686,331,130**	**7,549,642,430**
〔B〕間接費（直接費の10%）			
小計 B	**686,331,130**	**68,633,113**	**754,964,243**
合計	**7,549,642,430**	**754,964,243**	**8,304,606,673**

表 8.e.2　ケース２の維持管理費

項目	費用 (IDR/年)	税金 (IDR/年)	合計 (IDR/年)
〔A〕直接費			
1. 人件費	**2,259,600,000**	**225,960,000**	**2,485,560,000**
2. 電力費	**3,471,874,301**	**347,187,430**	**3,819,061,732**
3. 薬品費	**1,236,758,080**	**123,675,808**	**1,360,433,887**
4. 燃料費	**187,401,600**	**18,740,160**	**206,141,760**
5. 水質試験費	**17,800,000**	**1,780,000**	**19,580,000**
6. 修繕及び交換費	**2,060,757,696**	**206,075,770**	**2,266,833,466**
7. 事務所費	**600,000,000**	**60,000,000**	**660,000,000**
8. 処理水使用料金	**0**	**0**	**0**
小計 A	**9,834,191,677**	**983,419,168**	**10,817,610,845**
〔B〕間接費 (直接費の10%)			
小計 B	**983,419,168**	**98,341,917**	**1,081,761,085**
合計	**10,817,610,845**	**1,081,761,085**	**11,899,371,930**

表 8.e.3　人件費

（１）ケース１

		Numbers Total	Unit Price (IDR/Staff/month)	Annual Total (IDR)
Management	Director	1	33,000,000	396,000,000
	Deputy Director	1	22,000,000	264,000,000
	Secretary	1	5,500,000	66,000,000
	Sub Total	3		726,000,000
Admini & Finance	Manager	1	15,000,000	180,000,000
	Administration Secretary	1	5,500,000	66,000,000
	Administration Staff	2	5,500,000	132,000,000
	Security Staff	3	1,500,000	54,000,000
	Office Boy	1	1,000,000	12,000,000
	Sub Total	8		444,000,000
Treatment Plant and Pipe Facility Technical Staff	Manager	1	16,300,000	195,600,000
	Engineer/Operator	9	5,500,000	594,000,000
	Chemist	1	8,500,000	102,000,000
	Sub Total	11		891,600,000
Total		22		2,061,600,000

（２）ケース２

		Numbers Total	Unit Price (IDR/Staff/month)	Annual Total (IDR)
Management	Director	1	33,000,000	396,000,000
	Deputy Director	1	22,000,000	264,000,000
	Secretary	1	5,500,000	66,000,000
	Sub Total	3		726,000,000
Admini & Finance	Manager	1	15,000,000	180,000,000
	Administration Secretary	1	5,500,000	66,000,000
	Administration Staff	2	5,500,000	132,000,000
	Security Staff	3	1,500,000	54,000,000
	Office Boy	1	1,000,000	12,000,000
	Sub Total	8		444,000,000
Treatment Plant and Pipe Facility Technical Staff	Manager	1	16,300,000	195,600,000
	Engineer/Operator	12	5,500,000	792,000,000
	Chemist	1	8,500,000	102,000,000
	Sub Total	14		1,089,600,000
Total		25		2,259,600,000

表 8.e.4　電力費（ケース１）

	power [kW]	unit [unit]	total power [kW]	running unit [unit]	total power [kW]	running hour [h/day]	load (%)	Daily Electricity use (kWh)	Annual Electricity use (kWh)	Annual Electricity cost (IDR.)
BAR SCREEN	0.1	1	0.1	1	0.1	24.0	80	1.92	701	525,600
RAW WATER PUMP	30	2	60	1	30	24.0	80	576	210,240	157,680,000
STRAINER	0.75	1	0.75	1	0.75	24.0	80	14.4	5,256	3,942,000
BIOLOGICAL FILTER PUMP	15	2	30	1	15	24.0	80	288	105,120	78,840,000
BLOWER	29.2	2	58.4	1	29.2	24.0	80	560.64	204,634	153,475,200
BACKWASH BLOWER	47.2	2	94.4	1	47.2	0.1	80	4.5312	1,654	1,240,416
BACKWASH PUMP	45	3	135	2	90	0.1	80	8.64	3,154	2,365,200
OZONE REACTOR PUMP	30	2	60	1	30	24.0	80	576	210,240	157,680,000
OZONE GENERATOR	38	1	38	1	38	24.0	68	620.16	226,358	169,768,800
O2 PSA	0.1	1	0.1	1	0.1	24.0	90	2.16	788	591,300
AIR COMPRESSOR	55	1	55	1	55	24.0	65	858	313,170	234,877,500
CHILLER UNIT	48	1	48	1	48	24.0	76	875.52	319,565	239,673,600
OZONE TREATMENT UNIT（FOR OZONE UNIT)	1.25	1	1.25	1	1.25	24.0	80	24	8,760	6,570,000
AGITATOR (PH ADJUST)	2.2	1	2.2	1	2.2	24.0	80	42.24	15,418	11,563,200
AGITATOR (RAPID)	2.2	1	2.2	1	2.2	24.0	80	42.24	15,418	11,563,200
AGITATOR (SLOW)	2.2	1	2.2	1	2.2	24.0	80	42.24	15,418	11,563,200
COAGULANT FEED PUMP	0.02	2	0.04	1	0.02	24.0	65	0.312	114	85,410
PH MODIFIER PUMP (ACID INJECTION)	0.03	2	0.06	1	0.03	24.0	65	0.468	171	128,115
MEMBRANE FILTER PUMP	30	2	60	1	30	24.0	80	576	210,240	157,680,000
OZONE TREATMENT UNIT	3	1	3	1	3	24.0	80	57.6	21,024	15,768,000
COAGULANT TANK BLOWER	2.2	1	2.2	1	2.2	24.0	80	42.24	15,418	11,563,200
AIR COMPRESSOR	15	2	30	1	15	0.9	80	11.28	4,117	3,087,900
WATER SUPPLY PUMP UNIT	3.7	1	3.7	1	3.7	16.0	80	47.36	17,286	12,964,800
HYPOCHLORITE FEED PUMP	0.03	2	0.06	1	0.03	0.2	65	0.002925	1	801
ACID FEED PUMP	0.2	2	0.4	1	0.2	0.5	80	0.08	29	21,900
CHEMICAL CLEANING PUMP	1.2	2	2.4	2	2.4	-	80	0	≒0	≒0
CHEMICAL PULLING PUMP	1.5	2	3	2	3	-	80	0	≒0	≒0
THIOSULFURIC ACID PUMP	0.02	2	1	1	0.02	2.3	80	0.0368	13	10,074
SODIUM HYDROXIDE PUMP	0.02	2	0.04	1	0.02	7.0	80	0.112	41	30,660
DRAINAGE PUMP	11	2	22	1	11	6.0	80	52.8	19,272	14,454,000
TRANSMISSION PUMP	55	2	110	1	55	24.0	80	1056	385,440	289,080,000
Total								6,381	2,329,059	1,746,794,076

※Connection fee to Electric Power Company (631,250,000 IDR) is added on fist year.

750 IDR/kWh = Unit rate of electricity

Total Electricity Cost = 1,746,794,076 (IDR/ year)

表 8.e.5　薬品費（ケース１）

	Used Amount (kg/day)	Chemical usage rate	Cost/Kg (IDR)	Annual cost (IDR)
Coagulant (PACL)	540.0	0.5	4,348	428,495,400
Acid (pH)	92.7	0.5	2,717	45,965,527
Acid (Backwash)	47.0	0.5	2,717	23,305,068
Sodium Hydroxide	115.0	0.5	3,261	68,440,238
Hypochlorite	12.0	0.5	7,609	16,663,710
Thiosulfuric Acid	2.6	0.5	16,304	7,736,248
Hypochlorite (for Disinfection)	20.0	0.5	7,609	27,772,850
Total				618,379,040

表 8.e.6　電力費（ケース２）

	power [kW]	unit [unit]	total power [kW]	running unit [unit]	total power [kW]	running hour [h/day]	load (%)	Daily Electricity use (kWh)	Annual Electricity use (kWh)	Annual Electricity cost (IDR.)
BAR SCREEN	0.1	2	0.2	1	0.1	24.0	80	1.92	701	525,600
RAW WATER PUMP	30	3	90	2	60	24.0	80	1152	420,480	315,360,000
STRAINER	0.75	2	1.5	2	1.5	24.0	80	28.8	10,512	7,884,000
BIOLOGICAL FILTER PUMP	15	3	45	2	30	24.0	80	576	210,240	157,680,000
BLOWER	29.2	3	87.6	2	58.4	24.0	80	1121.28	409,267	306,950,400
BACKWASH BLOWER	47.2	2	94.4	1	47.2	0.1	80	4.5312	1,654	1,240,416
BACKWASH PUMP	45	3	135	2	90	0.1	80	8.64	3,154	2,365,200
OZONE REACTOR PUMP	30	3	90	2	60	24.0	80	1152	420,480	315,360,000
OZONE GENERATOR	38	2	76	2	76	24.0	68	1240.32	452,717	339,537,600
O2 PSA	0.1	2	0.2	2	0.2	24.0	90	4.32	1,577	1,182,600
AIR COMPRESSOR	55	2	110	2	110	24.0	65	1716	626,340	469,755,000
CHILLER UNIT	48	2	96	2	96	24.0	76	1751.04	639,130	479,347,200
OZONE TREATMENT UNIT（FOR OZONE UNIT)	1.25	2	2.5	2	2.5	24.0	80	48	17,520	13,140,000
AGITATOR (PH ADJUST)	2.2	2	4.4	2	4.4	24.0	80	84.48	30,835	23,126,400
AGITATOR (RAPID)	2.2	2	4.4	2	4.4	24.0	80	84.48	30,835	23,126,400
AGITATOR (SLOW)	2.2	2	4.4	2	4.4	24.0	80	84.48	30,835	23,126,400
COAGULANT FEED PUMP	0.02	3	0.06	2	0.04	24.0	65	0.624	228	170,820
PH MODIFIER PUMP (ACID INJECTION)	0.03	3	0.09	2	0.06	24.0	65	0.936	342	256,230
MEMBRANE FILTER PUMP	30	3	90	2	60	24.0	80	1152	420,480	315,360,000
OZONE TREATMENT UNIT	3	3	9	2	6	24.0	80	115.2	42,048	31,536,000
COAGULANT TANK BLOWER	2.2	2	4.4	2	4.4	24.0	80	84.48	30,835	23,126,400
AIR COMPRESSOR	15	2	30	1	15	0.9	80	11.28	4,117	3,087,900
WATER SUPPLY PUMP UNIT	3.7	2	7.4	2	7.4	16.0	80	94.72	34,573	25,929,600
HYPOCHLORITE FEED PUMP	0.03	3	0.09	2	0.06	0.2	65	0.00585	2	1,601
ACID FEED PUMP	0.2	3	0.6	2	0.4	0.5	80	0.16	58	43,800
CHEMICAL CLEANING PUMP	1.2	2	2.4	2	2.4	-	80	0	≒0	≒0
CHEMICAL PULLING PUMP	1.5	2	3	2	3	-	80	0	≒0	≒0
THIOSULFURIC ACID PUMP	0.02	2	1	1	0.02	2.3	80	0.0368	13	10,074
SODIUM HYDROXIDE PUMP	0.02	2	0.04	1	0.02	7.0	80	0.112	41	30,660
DRAINAGE PUMP	11	2	22	1	11	6.0	80	52.8	19,272	14,454,000
TRANSMISSION PUMP	55	3	165	2	110	24.0	80	2112	770,880	578,160,000
Total								12,683	4,629,166	3,471,874,301

750 IDR/kWh = Unit rate of electricity

Total Electricity Cost = 3,471,874,301 (IDR/ year)

表 8.e.7　薬品費（ケース２）

	Used Amount (kg/day)	Chemical usage rate	Cost/Kg (IDR)	Annual cost (IDR)
Coagulant (PACL)	540.0	1	4,348	856,990,800
Acid (pH)	92.7	1	2,717	91,931,054
Acid (Backwash)	47.0	1	2,717	46,610,135
Sodium Hydroxide	115.0	1	3,261	136,880,475
Hypochlorite	12.0	1	7,609	33,327,420
Thiosulfuric Acid	2.6	1	16,304	15,472,496
Hypochlorite (for Disinfection)	20.0	1	7,609	55,545,700
Total				1,236,758,080

表 8.e.8　燃料費（ケース１及びケース２）

For Vehicles　　Diesel fuel Unit Price = 6,000 IDR/liter

	No of days/ year	Fuel Consumption (liter/hours)	Working Time (hours/day)	Unit cost/ (IDR/liter)	Unit cost/ day*	No of sets	Total cost (IDR/year)
Patrol Car	150	2.6	6	4,500	84,240	1	12,636,000
Tanker Truck	225	5.3	6	6,000	228,960	2	103,032,000
Others (20%)							23,133,600
Total							138,801,600

*Unit cost is including lubricant cost (20%)

For Standby Generator (for maintenance operation)

	Capacity (kVA)	Unit Consumption (liter/kVA/hour)	Working Time (hours/month)	Unit cost/ (IDR/liter)	Unit cost/ day*	No of sets	Total cost (IDR/year)
Treatment Plant	750	0.25	6	6,000	8,100,000	6	48,600,000

Total cost (IDR/year) = 187,401,600

表 8.e.9　水質試験費（ケース１及びケース２）

No.	Item	Unit	Cost	Measurement Item	
				(a) Monthly	(b)Semiannual
A.	Physical Parameter				
	1) Smell		3,500	3,500	3,500
	2) Floating Objects		5,000	5,000	5,000
	3) Clarity		5,000	5,000	5,000
	4) Color	TCU	20,000	20,000	20,000
	5) Oil	mg/l	5,000	5,000	5,000
	6) Turbidity	NTU	15,000	15,000	15,000
	7) TDS	mg/l	17,500		17,500
B.	Chemical Parameter				
	1) Al	mg/l	50,000		50,000
	2) Hardness	mg/l	15,000	15,000	15,000
	3) Oxygen absorbed (O2)	mg/l	15,000	15,000	15,000
	4) pH		5,000	5,000	5,000
	5) Residual Chlorine	mg/l	15,000	15,000	15,000
	6) Cu	mg/l	40,000		40,000
	7) Detergent (MBAS)	mg/l	50,000		50,000
	8) BOD	mg/l	30,000	30,000	30,000
	9) Dissolved Oxygen (O2)	mg/l	15,000	15,000	15,000
	10) As	mg/l	50,000		50,000
	11) F	mg/l	25,000		25,000
	12) Cr	mg/l	40,000		40,000
	13) Cd	mg/l	40,000		40,000
	14) Nitrite (NO2)	mg/l	25,000		25,000
	15) Nitrite (NO3)	mg/l	25,000		25,000
	16) CN	mg/l	25,000		25,000
	17) Se	mg/l	40,000		40,000
	18) Fe	mg/l	40,000		40,000
	19) Mn	mg/l	40,000		40,000
	20) Zn	mg/l	40,000		40,000
	21) SO4	mg/l	25,000		25,000
	22) Ammonia (NH3)	mg/l	25,000		25,000
C.	Microbiological Parameters				
	1) Total Coliform	CFU/100ml	42,000	42,000	42,000
	2) Number of Germs	Colonies/ml	42,000	42,000	42,000
Cost for 1 Set				232,500	830,000
Other Cost (100%)				232,500	830,000
Water Sample per year				24	4
Total Cost				11,160,000	6,640,000
				(a)+(b)	17,800,000

表 8.e.10　修繕費

（１）ケース１

A. Site Preparation

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	5,968,887	0.10%	5,968,887
Total	5,968,887		5,968,887

B. Reclaimed Water Treatment Facility

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	30,427,382	0.10%	30,427,382
Vehicles	2,070,000	3.00%	62,100,000
Equipment	87,646,381	1.50%	1,314,695,715
Membrane Replacement	174,000	100%	174,000,000
Total	120,143,763		1,581,223,097

C. Water Transmission Pipe

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	44,144,600	0.10%	44,144,600
Total	44,144,600		44,144,600

Case1 Cost　　1,631,336,584 IDR/year

（２）ケース２

A. Site Preparation

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	6,507,139	0.10%	6,507,139
Total	6,507,139		6,507,139

B. Reclaimed Water Treatment Facility

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	38,054,721	0.10%	38,054,721
Vehicles	2,070,000	3.00%	62,100,000
Equipment	103,325,176	1.50%	1,549,877,636
Membrane Replacement (1)	174,000	100%	174,000,000
Membrane Replacement (2)	174,000	100%	174,000,000
Total	143,449,897		1,998,032,357

C. Water Transmission Pipe

	Capital Cost	Annual repair and maintenance cost	
	(1,000IDR)	% of Capital Cost	(IDR/year)
Structure	56,218,200	0.10%	56,218,200
Total	56,218,200		56,218,200

Case2 Cost =　　2,060,757,696 IDR/year

付属資料 **9**

MM 記載の
“**Detailed Project Activity Plan**”

付属資料９　MM 記載の“Detailed Project Activity Plan”

この付属資料は、2010年12月1日に「イ」国政府とJICAとの間で交わされたMinutes of Meeting (MM)で要求されている“Detailed Project Activity Plan”として作成した。この付属資料の内容は、付属資料11（EIAのためのTORの草案）と同様、KA-ANDALのドラフトの準備において参考にすることができる。また、この付属資料では、主に「イ」国環境省のEIA報告書の準備等に関するガイドライン（No.8/2006）に基づき、提案した再生水供給事業の様々な活動について説明している。

9.a Background of the Project

Bali is one of the famous tourist spots in Asia. The regional economy in Bali relies on its tourism industry and agriculture of wet-rice cultivation. Denpasar City and Badung Regency located in Southern Bali are developing as a center of tourism and commerce and their population is increasing rapidly. The growth in economic and population is increasing water demand and causing water shortage. However, the development of water supply systems in Bali is left behind the growth in economic and population. Water shortage and river water pollution are disturbing the sustainable economic development in Bali.

Groundwater has been used for mitigating the water shortage. However, its overuse caused the salination and depletion of groundwater in the coastal areas of Southern Bali. These difficult situations in groundwater use have recently become obvious. On the other hand, Denpasar Sewerage Development Project is been implemented by Japanese ODA loan in Denpasar City and its surrounding areas having high population density. The collected wastewater is being treated at Suwung WWTP. The treated wastewater from the WWTP is an important water resource which can be recycled.

In order to reduce the water shortage in Southern Bali and mitigate the groundwater salination and depletion, effective uses of the treated wastewater from Suwung WWTP have been studied by Indonesian government agencies. However any reclaimed water project using the treated wastewater has not been realized due to financial difficulties. In these circumstances, a Japanese joint venture (consisting of Toyota Tsusho Corporation, Nihon Suido Consultants Co. Ltd, and METAWATER Co. Ltd) have proposed to JICA to study the possibility of formulating a reclaimed water supply project in Southern Bali as a Public-Private Partnership (referred as PPP) Project. In response, JICA commissioned this preparatory survey to the joint venture at the end of 2010 in order to formulate a feasible reclaimed water supply project in Southern Bali.

9.b Objectives and Benefits of the Project

The objectives of the reclaimed water supply project proposed in the preparatory survey are as follows:

1) To utilize the treated wastewater from Suwung WWTP for producing reclaimed water with suitable quality for showering, bathing and pool
2) To supply the reclaimed water to the hotels in Nusa Dua, Sawangan, Benoa where water shortage and overuse of groundwater are serious
3) To make the PDAM water more available to the domestic customers in the service areas of Estuary Water Purification Plant

The objects of this project are also explained in 7.1 of the main report. The main benefits of this project are as follows:

a) The reduction of the effluent from Suwung WWTP which have negative impacts on the environment around its discharge point.
b) The mitigation of the serious water shortage in the service areas of Estuary Water Purification Plant, which will contribute to:

i. the improvement of the targeted hotels and the development of new hotels in the target areas of the project;
ii. the reduction of the excessive extraction of groundwater in the targeted hotels and the new hotels; and
iii. the increase of drinking/clean water available for the domestic users.

c) The establishment of local experiences regarding wastewater reclamation, which will be important for the formulation of other reclaimed water supply projects in Indonesia in the future.

The results of the economic analysis on the project including the evaluation of these benefits are explained in Chapter 13 of the main report. These benefits are also explained as the positive impacts of the project in the environmental scooping (see 10.4.3 of the main report and 10.c of Appendix 10).

9.c Scope of the Project and Alternative Project Components

The proposed scope of the project is explained in 7.2 to 7.4 of the main report.

Although the route of the transmission pipeline along the existing main road (Ngurah Rai By-pass Road) was selected in this preparatory survey, the alternative analysis on the route of the transmission pipeline (see 10.b (3) of Appendix 10) should be reviewed in the EIA and the detailed design study in order to mitigate the traffic congestion to be caused by the pipe installation. Moreover, it is not yet confirmed that the proposed wastewater reclamation facilities can meet the existing Indonesian water quality standards for pool and public bath continuously. The size of the biological filter for the pretreatment may need to be larger than its proposed design if the existing water quality standards cannot be continuously met with the proposed design. In case that new Indonesian water quality standards for reclaimed water is established before the implementation of the detained design study and the EIA, the wastewater reclamation facilities should be re-designed based on the new water quality standards. The ratio of mixing the reclaimed water with the PDAM water at the target hotels may also be revised in the detailed design study based on the results of the reclaimed water demand confirmation to be conducted before the signing of the PPP contract.

9.d Maps and Social and Environmental Descriptions of the Project Sites

Figures 9.d.1 to 9.d.5 shows the overall layout of the facilities related to the project including the tentative route of the transmission pipeline, the site plan of the proposed water reclamation plant, and the routes of the existing trunk distribution pipes in Nusa Dua and new trunk distribution pipes to Benoa and Sawangan. Detail maps of the route for the transmission pipeline are shown in 6.c of Appendix 6.

The proposed site for the wastewater reclamation plant is located at the edge of Ngurah Rai Mangrove Forest Area which is owned by the Ministry of Environment as shown in Figure 9.d.2. The land use in this area is controlled by the ministry through a land use permission process. The Forestry Agency of Bali Provincial Government is in charge of the forestry management in this area.

Nusa Dua has many new large resort hotels. Benoa has some large resort hotels and many middle size hotels and small villas. New large resort hotels are currently under construction in Sawangan.

General natural conditions and socio-economic conditions of Bali Island are also described in 2.1 and 2.2 of the main report.

9.e Project Activities from Pre-Construction Stage to Post-Operation Stage

Section 9.7 of the main report shows the implementation schedule of the project.

The project activates in each stage of the project are explained in the following, which are in consistency with those listed in the comprehensive environmental scoping matrix (see Table 10.c.1 of Appendix 10).

(1) Pre-Construction Stage

In the pre-construction stage of the project, several types of permissions and agreements are required before starting the construction, which include the land use permit from the Ministry of Forestry, the PPP contract, the purchase agreement with PDAM Badung, the approvals on KA-ANDAL and the EIA documents, etc. The project also needs a further survey for confirming the targeted hotels' demand on the reclaimed water. The feasibility of the project has to be also examined by a PPP team from the Indonesian/Balinese side in the pre-construction stage.

1. Acquisition of Land Use Permit

   DINAS PU/Bali Provincial Government needs to acquire the land use permit from the Ministry of Forestry (in coordination with the Forestry Agency of Bali Provincial Government) for using the land of the proposed water reclamation plant site.

2. Acquisition of Other Approvals and Agreements

   The project needs a PPP contract with Bali Provincial Government and a purchase agreement with PDAM Badung. New reclaimed water standards (if necessary) and new tariffs for the reclaimed water supply may needs to be prepared before the signing of the PPP contract. The project also needs approval on the draft KA-ANDAL and the final EIA documents. The permissions to use the treated wastewater and to supply the reclaimed water should be included in these approvals and agreements.

3. Study and Field Survey

   More studies and filed surveys are required for the EIA, the detailed design, the confirmation of reclaimed water demand in the target hotels, the confirmation of achievable water quality and the establishment of new reclaimed water quality standards (if necessary).

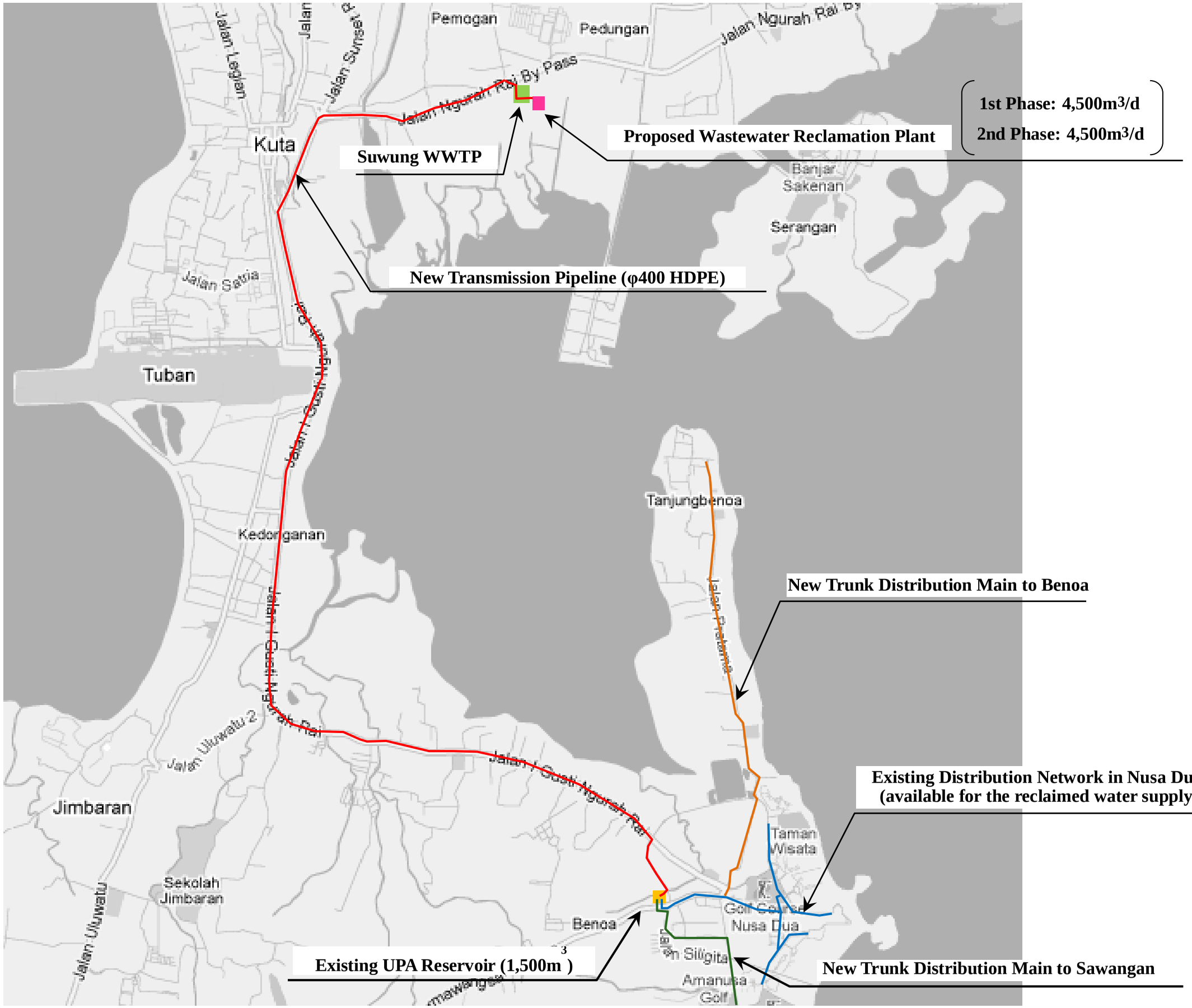


Figure 9.d.1 Overall Layout of the Facilities related to the Project

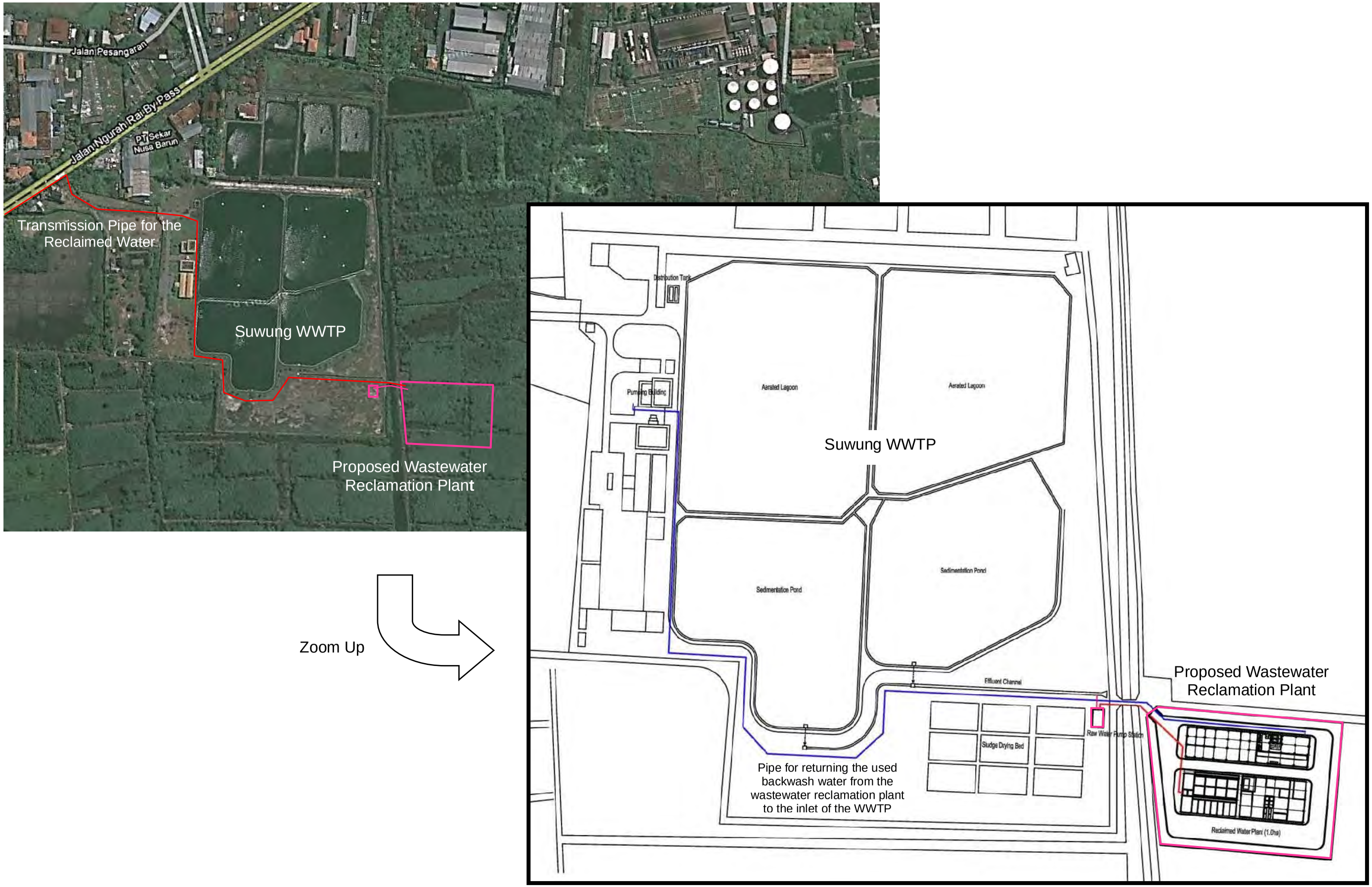


Figure 9.d.2 Site Plan for the Proposed Water Reclamation Plant

Route	Diameter	Point		Distance
		Start	End	m
400-1	400	1-1	1-2	1,369.2
400-2	400	1-2	1-3	174.1
400-3	400	1-3	1-4	72.6
400-4	400	1-4	1-5	21.5
400-5	400	1-5	End	4.7
400-6	400	1-2	1-6	460.9
400-7	400	1-6	1-7	51.7
400-8	400	1-7	1-8	5.9
400-9	400	1-8	End	7.5
Sub	400			2,168.1
300-1	300	1-6	2-1	276.8
300-2	300	1-6	2-2	373.5
300-3	300	2-2	2-3	96.7
300-4	300	2-3	2-4	9.7
300-5	300	2-4	End	45.1
Sub	300			801.8
150-1	150	2-1	4-1	277.6
150-2	150	4-1	4-2	653.1
150-3	150	4-1	C-11	54.3
150-4	150	3-1	4-3	473.5
150-5	150	4-3	4-4	168.4
150-6	150	4-4	End	3.4
Sub	150			1,630.3

Route	Diameter	Point		Distance
		Start	End	m
200-1	200	1-3	3-1	234.9
200-2	200	1-3	3-2	443.0
200-3	200	3-2	3-3	236.2
200-4	200	3-3	3-4	12.8
200-5	200	3-4	3-5	217.8
200-6	200	3-5	End	5.5
200-7	200	3-5	C-1	10.5
200-8	200	3-4	C-2	21.5
200-9	200	3-3	C-3	10.5
200-10	200	3-2	3-6	99.5
200-11	200	3-6	3-7	52.0
200-12	200	3-7	End	11.1
200-13	200	3-7	C-4	27.8
200-14	200	3-6	C-5	50.4
200-15	200	1-5	C-6	19.1
200-16	200	1-4	C-7	33.1
200-17	200	4-3	C-8	33.5
200-18	200	4-4	C-9	30.3
200-19	200	1-7	C-12	21.7
200-20	200	1-8	C-13	15.9
200-21	200	2-4	C-14	141.1
200-22	200	2-2	C-15	53.0
200-23	200	2-3	C-16	99.7
Sub	200			1,880.9
Total				6,481.1

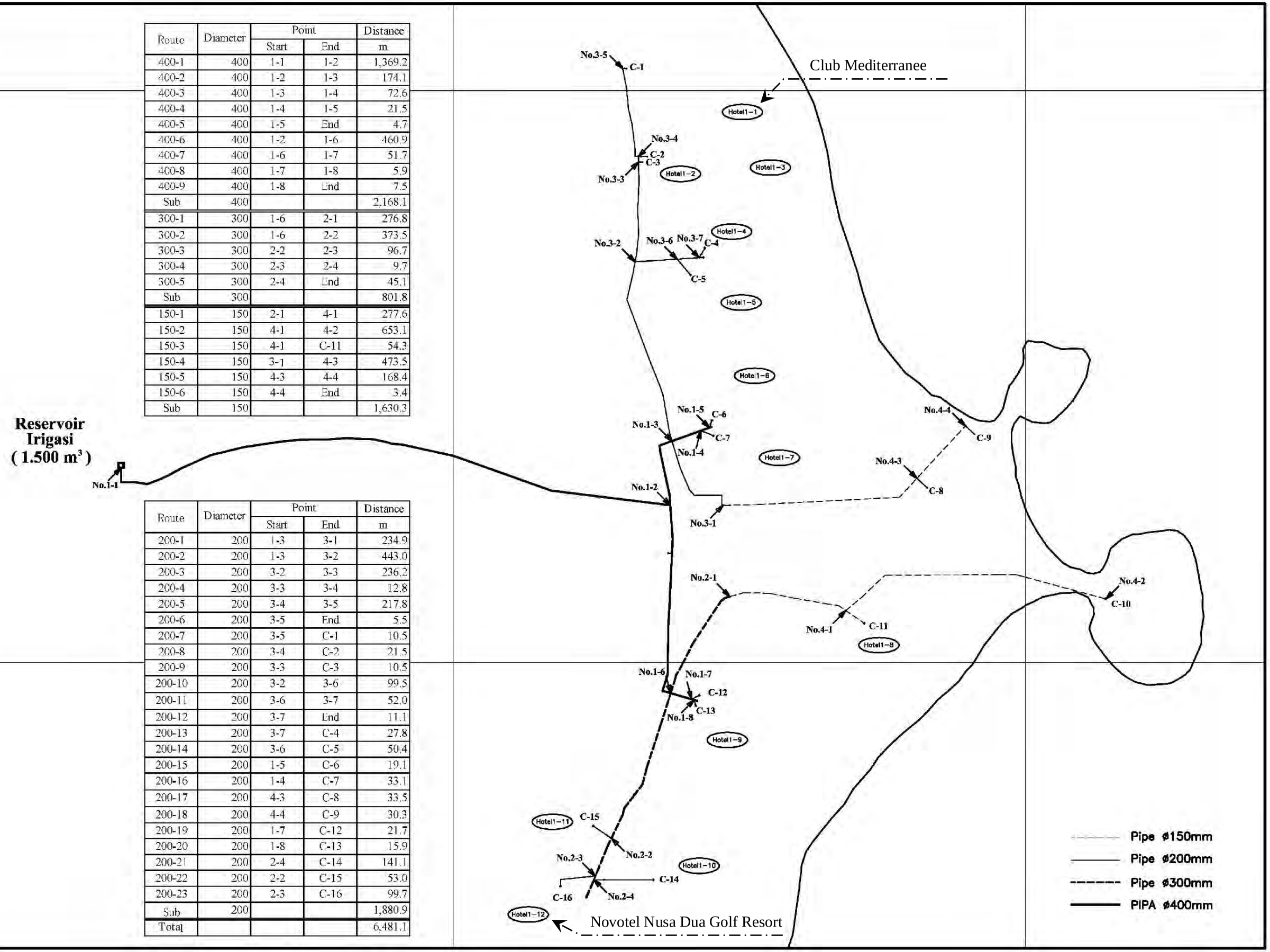


Figure 9.d.3 Existing Distribution Network in Nusa Dua available for the Reclaimed Water Supply

Route	Diameter	Point		Distance
		Start	End	m
300-1	300	5-1	5-2	1,428.1
300-2	300	5-2	5-3	132.3
300-3	300	5-3	5-4	232.2
300-4	300	5-4	5-5	470.7
300-5	300	5-5	5-6	142.4
300-6	300	5-6	5-7	258.9
300-7	300	5-7	5-8	393.3
300-8	300	5-8	5-9	153.3
300-9	300	5-9	5-10	89.1
300-10	300	5-10	5-11	80.0
300-11	300	5-11	5-12	86.5
300-12	300	5-12	5-13	154.3
300-13	300	5-13	5-14	125.8
300-14	300	5-14	5-15	139.6
300-15	300	5-15	5-16	86.8
300-16	300	5-16	5-17	100.9
300-17	300	5-17	5-18	74.3
300-18	300	5-18	5-19	120.7
300-19	300	5-19	5-20	436.8
300-20	300	5-20	5-21	377.3
300-21	300	5-21	5-22	681.4
Sub	300			5,764.7
200-1	200	5-2	H2-1	30.0
200-2	200	5-3	H2-2	30.0
200-3	200	5-4	H2-3	30.0
200-4	200	5-5	H2-4	120.0
200-5	200	5-6	H2-5	30.0
200-6	200	5-7	H2-6	30.0
200-7	200	5-8	H2-7	30.0
200-8	200	5-9	H2-8	30.0
200-9	200	5-10	H2-9	30.0
200-10	200	5-11	H2-10	30.0
200-11	200	5-12	H2-11	30.0
200-12	200	5-13	H2-12	30.0
200-13	200	5-14	H2-13	30.0
200-14	200	5-15	H2-14	30.0
200-15	200	5-16	H2-15	30.0
200-16	200	5-17	H2-16	30.0
200-17	200	5-18	H2-17	30.0
200-18	200	5-19	H2-18	30.0
200-19	200	5-20	H2-19	30.0
200-20	200	5-21	H2-20	30.0
200-21	200	5-22	H2-21	30.0
Sub	200			720.0
Total				6,484.7

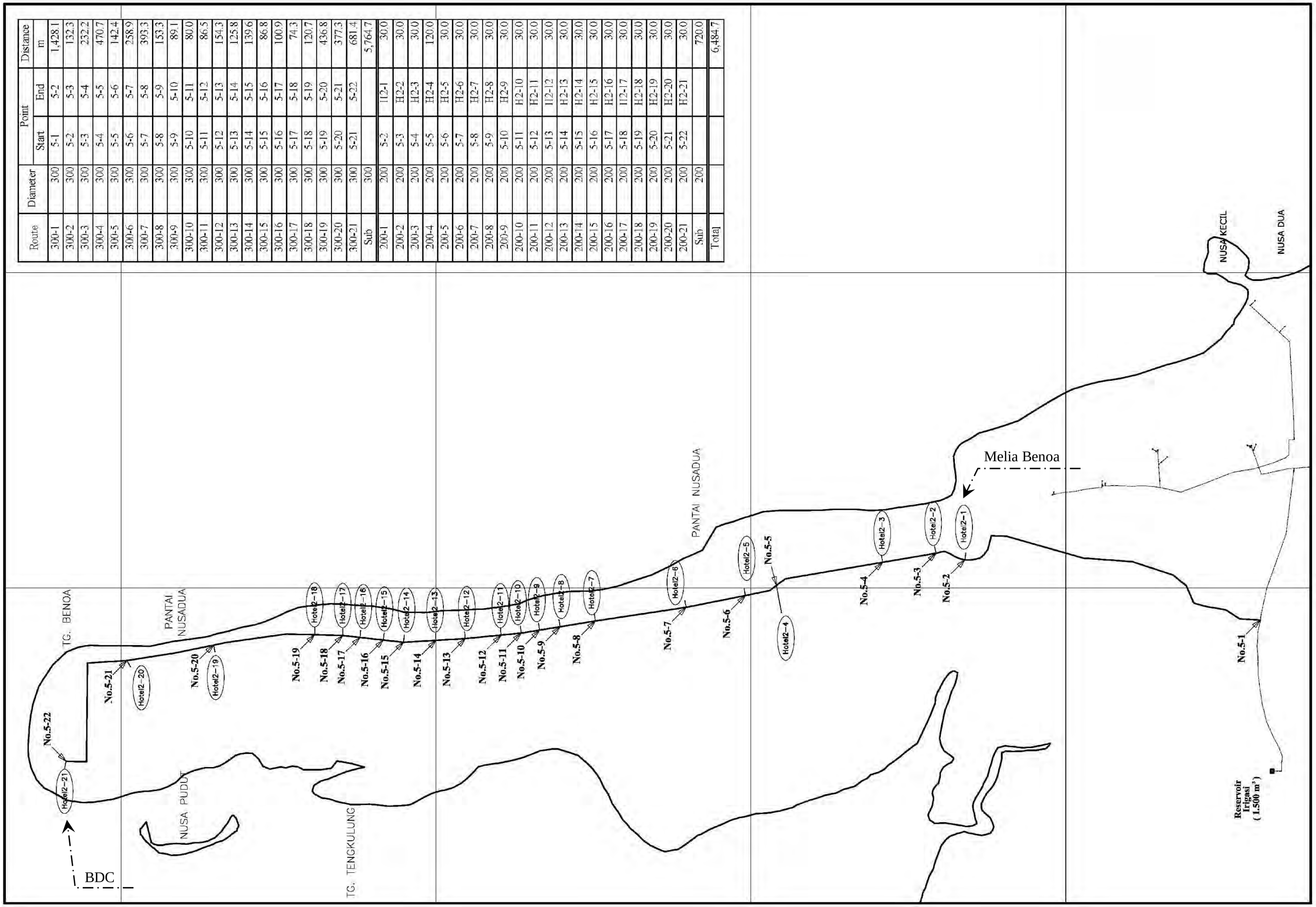
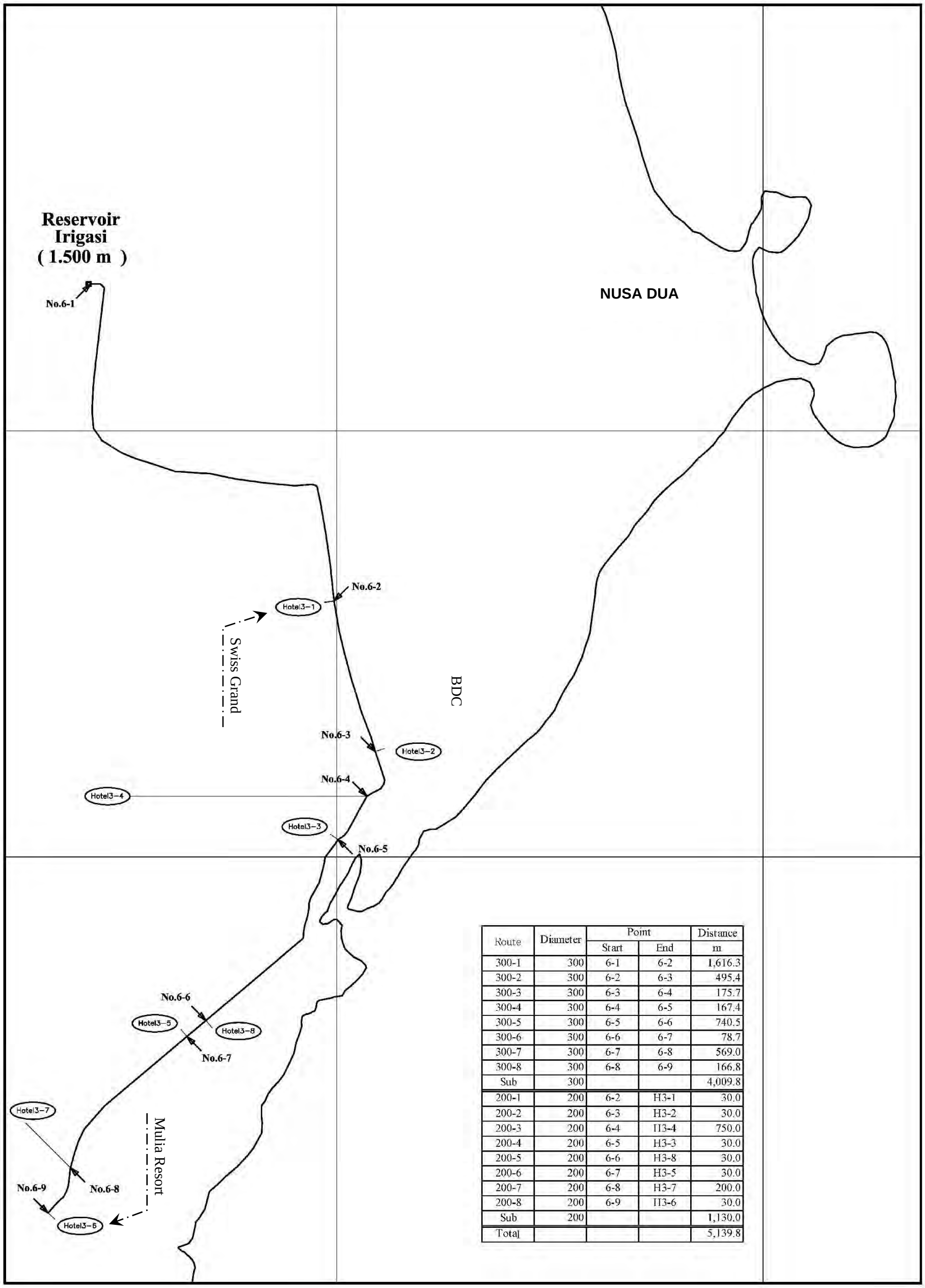


Figure 9.d.4 New Distribution Pipes to Benoa



Route	Diameter	Point		Distance
		Start	End	m
300-1	300	6-1	6-2	1,616.3
300-2	300	6-2	6-3	495.4
300-3	300	6-3	6-4	175.7
300-4	300	6-4	6-5	167.4
300-5	300	6-5	6-6	740.5
300-6	300	6-6	6-7	78.7
300-7	300	6-7	6-8	569.0
300-8	300	6-8	6-9	166.8
Sub	300			4,009.8
200-1	200	6-2	H3-1	30.0
200-2	200	6-3	H3-2	30.0
200-3	200	6-4	H3-4	750.0
200-4	200	6-5	H3-3	30.0
200-5	200	6-6	H3-8	30.0
200-6	200	6-7	H3-5	30.0
200-7	200	6-8	H3-7	200.0
200-8	200	6-9	H3-6	30.0
Sub	200			1,130.0
Total				5,139.8

Figure 9.d.5 New Distributing Pipes to Sawangan

4. Public Consultation and Socialization

   Public consultation and socialization are required for 1) the transaction of this PPP project (See 14.3.2 of the main report), 2) the establishment of new water quality standards for reclaimed water (if necessary), 3) the establishment of new tariffs for the reclaimed water supply, 5) the approval on the EIA documents, and 6) the start of construction at each project site (as planned in the environmental management plan).

(2) Construction Stage

The construction stage includes personal mobilization, base camp operation, material/equipment mobilization, construction works, equipment demobilization and personal demobilization. The construction works can be divided to those for the new wastewater reclamation plant and the existing distribution reservoir and those for the installation of transmission, distribution and service pipes. The construction works for the new wastewater reclamation plant can be further divided into land clearing, excavation/embankment, building the structures/installation of equipment and landscaping.

1. Personal Mobilization

   The SPC needs to establish a construction management team and need to make contracts with local sub-contractors.

2. Base Camp Operation

   A based camp needs to be established by lending office and accommodations or constructing prefabrication buildings. Utilities and office appliances needs to be ready to use in the base camp.

3. Material/Equipment Mobilization

   Materials and equipment required for the construction works need to be brought close to the construction sites.

4. Land Clearing

   The mangrove trees at the proposed site for the wastewater reclamation plant needs to be removed.

5. Land Excavation/Embankment

   The construction of the new wastewater reclamation plant requires the excavation of unstable surface soil after the removable of mangrove trees. Then, the site should be embanked up to the base ground level of the existing WWTP with stable soil for the construction. Soil excavation is also required to the construction of the new raw water pumping station for the wastewater reclamation within the existing WWTP.

6. Building of Structures/Installation of Equipment

   The proposed wastewater purification plant consists of several buildings for raw water transmission, biological treatment, ozone treatment, membrane treatment, chlorination, treated water transmission, etc.

7. Landscaping

The main gate and the buildings of the wastewater purification plant should follow building code regulations of Bali.

8. Installation of Pipe Facilities

   In order to supply the reclaimed water to the targeted areas, it is required to install 1) a transmission pipeline from the wastewater reclamation plant to the existing distributing reservoir in Nusa Dua, 2) two trunk distribution pipelines from the distribution reservoir to Benoa and Sawangan, and 3) service pipes from the existing distribution pipes in Nusa Dua and the new distribution pipes in Benoa and Sawangan to each hotel in the target areas. The rehabilitation of the existing distribution pipes in Nusa Dua and the installation of the new distribution pipes and service pipes are part of the responsibility of PDAM Badung according to the plan proposed in the preparatory survey.

9. Equipment Demobilization

   Equipment used in the construction is removed from the construction sites.

10. Personal Demobilization

    The construction workers need to move out of the base camp.

(3) Operation Stage

The operation stage of this project includes the personal mobilization of SPC and PDAM Badung, the operation and maintenance of reclaimed water treatment facilities (including the operation of pumps and valves for raw water intake, transmission and distribution and the maintenance of the pipes), meter reading, billing & revenue collection and customer services. The main components of the operation stage are explained as follows:

1. Personal Mobilization

   SPC needs to mobilize operational staff at the wastewater reclamation plant and PDAM Budung needs to assign O&M and administration tasks for the retail supply of the reclaimed water to their existing or new staff.

2. Water Treatment Operation

   The proposed treatment process for the wastewater reclamation includes the use of biological filter, pre-zonation, coagulation/flocculation, ceramic membrane and chlorination. The residual ozone after the pre-zonation is removed at the wastewater reclamation plant.

3. Backwash Water Management

   The biological filter and ceramic membrane needs to be backwashed regularly. It is planned to send back the used backwash water to the inlet of the WWTP. Therefore, no sludge will be generated from the used backwash water in the wastewater reclamation plant.

4. Rotating Machinery Operation

   In addition to the pumps for raw water intake, the pumps for water transmission and water distribution, the blowers for the diffuser of biological filters and the feed pump for ceramic membrane need to be operated continuously. The operation of power generator is also required during power failures.

5. Reclaimed Water Supply and Use

   The reclaimed water will be transmitted and sold by the SPC as bulk water to PDAM Badung at the existing reservoir in Nusa Dua that was used for irrigation water in the past. PDAM Badung will be in charge of the reclaimed water distribution to the hotels in the target areas and billing & collection. The hotels can deliver the reclaimed water with the existing pipes inside the hotels to each guest room after mixing it with PDAM's drinking/clean water.

6. Pipe Maintenance

   All the pipes used for the reclaimed water supply requires maintenance to reduce leakage of the reclaimed water. The maintenance work is also required to avoid water quality degradation in the pipes.

7. Office Management

   The office for management and administration staff and the workshop and resting place for technical staff need to be maintained.

8. Tariff Collection

   Reclaimed water charges will be collected from the hotels using the reclaimed water, based on their consumptions of the reclaimed water measured with water meters. PDAM Badung will be in charge of the tariff collection.

(4) Post-Operation Stage

Since this project is planned as a BOT of 25 years. The facilities to be constructed for the project will be handed over to Bali Provincial Government 25 years after the signing of PPP contract. The machinery and electrical equipment to be installed will reach its lifetime expectancy at the time of handing over. In order to continue the reclaimed water service, the replacement of the machineries and electrical equipment are required. After the cease of the operation, land rehabilitation and personal demobilization are required as explained in the following.

1. Land Rehabilitation

   After the cease of the operation, the land for the water reclamation plant needs to be rehabilitated before being returned to the Ministry of Forestry.

2. Personal Demobilization

   The staff working exclusively for the project may need support to find new jobs.