

3-4 諸外国・国際機関の援助状況

1985年9月現在、実施中の諸外国・国際機関の援助状況は、次のとおりである。

表-21 諸外国・国際機関の援助状況

Project	Sources
CHONBURI WATER SUPPLY EXPANSION PROJECT	GTZ & KFW
KHON KAEN WATER SUPPLY EXPANSION PROJECT	OECD
UDON THANI WATER SUPPLY EXPANSION PROJECT	KFW
HAD YAI-SONGKHLA & SADAQ, LAMPOON KARNCHANABURI, MUKDAHRN, BAN PHAI CHONNABOT AND AMNAT CHAROEN WATER SUPPLY EXPANSION PROJECT	ITALIAN
SURAT-THANI, PHETTCHBURI, PHATTA-LUNG WATER SUPPLY EXPANSION	ADB
CHIANGMAI, UBON-RATCHATHANI AND SUPHANBURI, PATTAYA WATER SUPPLY EXPANSION PROJECT	JICA
NAKORN PHANOM LOI, BURIRUM, PAK CHONG, NONG KHAI WATER SUPPLY EXPANSION PROJECT	CIDA & IBRD
PHUKET WATER SUPPLY EXPANSION PROJECT	IBRD
RANONG, CHAIYAPHUM, PRACHUAP KHIR CHAN WATER SUPPLY EXPANSION PROJECT	AUSTRALIAN
TAKUAPA, PATHUMTHANI, PRACHTHIPAT, SU-NGAIKOLOK, THUN-SONH, PHANG-NGA WATER SUPPLY EXPANSION PROJECTS	JICA & OECD

Technical Cooperation and Loan Projects

(in detail, except Japan)

1. The German Government Projects

- a. Management & Financial Service Management Project
- b. Strengthen Management and Operation Capability of PWA
- c. Master Plan, Feasibility Study and Detailed Design for Chonburi Water Supply System (Stage I)
- d. Decade Planning
- e. Master Plan, Feasibility Study and Detailed Design for Udonthani Water Supply System
- f. Master Plan and Feasibility Study for Phuket Water Supply System
- g. German Volunteers(2 persons)

2. UNDP Advisory Assistance

- a. -Corporate Planning Consultant
-Immediate Improvement Program
- b. Low-cost Planning & Design and Financial Planning

3. The World Bank Project (Loan Project)

- a. Immediate Improvement Program

4. USAID Program

- a. Institutional Development Program

(参考資料) Summary of related Activities(as of September 1984)

Sources of Donors	Project Activities	Status
(Japan) -JICA	Provision of B 50 million in grant for supplies and equipment under the urgent Programme for the improvement of Provincial Water Supply.	Training courses for uses of the provided equipment are being undertaken. All of the equipment are being delivered to Provincial sites.
-JICA	Master Plan and Feasibility Study for Chiangmai, Ubon and Suphanburi Water Supply.	Govt. of Japan agreed in principle. The project should be started around early 1985.
-JICA	Grant of approximately & 200 million for construction of PWA+MWA Training Center. Provision of Industrial experts.	The negotiation is underway. PWA and MWA are preparing a proposal to submit to the Govt. of Japan. Master Plan of Surin Water Supply has already been prepared by the past experts. The newcoming expert, Mr. Igarashi, has started his assignment in September 1984.
-OECF	Provision of B 14 million loan for Khon Kaen Water Supply Detailed Design	The contact agreement between PWA and the Contractor Group, Nihon Suido Consultants & Thai Engineering Consultants, is under negotiation. Mr. Yamada and Mr. Masuda are working at Regional No.8 and 6 respectively.
(GERMAN) -GTZ	Provision of B 22 million in grant for Management & Financial Services Management Project.	The project is run by C & I Consultant. The Following activities have already been finished: <ul style="list-style-type: none"> -New Organization set up. -New Financial management system, 4 regional offices have been implemented, the 6 remainders are underway. -Project extension requests has been submitted to DTEC and is expected to start in 1985.

Source of Donors	Project Activities	Status
-GTZ	Provision of B 22 million in grant for Water Quality Control supplies and equipment under the Strengthen Management and operation Capability of PWA Project	Contract Agreement was signed by both countries. Final procedure is being prepared.
-GTZ	Provision of B for Plan and Feasibility Study of Chonburi Water Supply System -Stage I: Master Plan, Feasibility study and detailed Design of Chonburi, Bang saen, Bang pha and Srirach water-works. -Stage II: Master Plan and Feasibility Study of remainder of water Supplies in Chonburi Province.	Kocks Consultants has finished the project partly in Aug. 1984. The whole Project expect to be finished 1985. Request for the Project has been already submitted to DTEC and Germany Embassy.
-GTZ	Provision of B 22 million for Master Plan, Feasibility	Consultant started working in Sept. 1984.
-KFW	-Provision of B 22 million for Master Plan, Feasibility Study and Detailed Design of Udonthani Water Supply System.	The Project is run by GITEC Consultants. The following activities have been completed: -Master Plan -Feasibility Study -Construction for Immediate Improvements.
-KFW	-B 200 million in loan Construction of Udonthani Water Supply Expansion Project.	The Detailed design will start in early 1985 and the construction will be completed in 1988.
-KFW	Provision of B 17 million in grant for Engineering Service of Phuket Water Supply system Phase I (Master Plan and Feasibility Study)	The Project is expected to be started in Fy 1985. Project duration is approximately 17 months. PWA will be responsible for the water supply scheme and Public Works Dept. for the sanitary scheme.

Source of Donors	Project Activities	Status
(UNDP) -THA 80/012	-PWA Advisor -Short Term Consultant for corporate Planning -Advisor for Immediate Improvement Program	The Project is expected to be Finished. The Project is underway. The Project is underway.
-RAS 80/001	Short Term Consultant including software for Low-cost Planning & design and Financial Planning Program.	PWA staff are now responsible for the HP project. O & M Training Program was finished by Parsons, Engineering Science Consultants.
(WORLD BANK)	Provision of US \$ 40 million in loan for immediate improvement Program and Operation & Maintenance Training.	PWA staff are now responsible for the HP project. O & M Training Program was finished by Parsons, Engineering Science Consultants.
(ITALY)	-Project preparation for Songkla-Hadyai, Sadao, Karnchanaburi, Lampon, Amnart Charoen, Ban Pha Chonnabot and Mukdahan; (Master Plan, Feasibility Study and Detailed Design)	Project agreed in principle by Italian Government.
(CANADA)	-Project preparation for Nakon Phanom, Loei, Burium, Pakcong and Nongkai (Master Plan and Feasibility Study)	Contracting Agreement is under negotiation with CEGIR-LGL Consult. Eng The project will be started by middle of 1985.
(FRANCE)	-Project preparation for 3~5 towns -Mobile Treatment Plants -15 water supply tour fellowships	Request has been submitted to DTEC, Ministry of Interior and the France Embassy.
(BRITISH)	1~2 Mobile Treatment Plants	Negotiation with the Embassy.
(ASDB)	Provincial Towns Water Supply Project 1 (Petchburi, Surat Thani and Pahattalung) The Project will be co-financed by the Swiss Government.	Under preparation with ASDB staff.
(AUSTRALIA)	Ranong Water Supply Project Preparation.	Project Identification is now under preparation.

第4章 事前調査団の提言及び勧告

タイ国においては、現在、第5次経済社会開発計画に基づいて、政策が運営されているが、この政策の重要課題の一つは、首都バンコクから周辺地域への人口、産業の分散を図ることである。

水道は、人々の生活、健康、産業にとって基本的なものであり、PWA政府の政策に沿って上水道整備5カ年計画を立案し、実施している。この政策は、PWAの給水区域において施設の改造、拡張及び新設を積極的に推進し、給水人口の増大、普及率の向上、完全な水の供給を目指すものであるが、政府からの補助金の不足などにより、計画の達成は困難な状況にある。

今回の調査都市は、いずれもPWAの計画の中でも緊急性の高いものであるが、地方の中核都市として、今後、人口・産業の地方分散によって水需要は増大し、施設の拡張が必要とされるとともに、現地の状況を見ると、施設は老朽化し、緊急に改造の必要がある。

日本政府としても、かかる状況を勘案して、今回の4都市の調査を推進し、タイ国の上水道を援助する必要がある。事前調査団は、現地調査及びPWAとの協議に基づいて、以下の点を提言及び勧告する。

1. 水需要推計上の問題点

本格調査のマスタープランでは20年後の、フィジビリティ調査では短期開発のための水需要予測を行ない、これに基づいて、施設の計画、設計が行なわれる。

この方法には、給水量のトレンドから求める方法、給水人口と1人1日給水量を乗じる方法、用途別給水量に分けて推計する方法等がある。

社会、経済の変動の激しい今日において、地方中核都市の長期の水需要を正確に予測するのは、各種の手法を用いて最も可能性の高いものを求めるのが妥当である。特に、用途別水量については、1カ月の使用水量100㎡以上の大口使用者には資料が整理されているが、それ以下の小口については整理されていないので、検針員等の協力のもとに現地調査を要する。水需要は、国、地方の政策によっても左右されるので、現在実施中の第5次、計画中の第6次経済社会開発計画、都市計画など上位計画との整合性をとって推計すべきである。

2. 水源の問題点

施設の拡張に当たっては、まず第1に水源を検討する必要がある。4都市は、それぞれ水源の状況が異なるが、将来水源としては、チェンマイでは表流水、ダム及び地下水、ウボンラチャタニでは表流水、スハンプリでは表流水、地下水、パタヤでは貯水池の利用が考えられる。

この中、地下水については、Department of Mineral Resourcesが実施した井戸に関する水量、水質等の調査資料があるが、古い資料であったり、水源地点から離れている場合も考えられるので、第1段階では検討を行ない、必要があれば第2段階のフィジビリティ調査時点でボーリング調査を行なうべきである。この場合、可能であれば、水源取得と水量の関係を調整する

ことが望ましい。

また、ダム、貯水池の開発はRID (Royal Irrigation Department) が権限を有している
ので、PWAを通じて資料の収集、計画実現についての交渉を図る必要がある。

今回の調査では、市域周辺への給水区域の拡大も考えられているので、これらについて既存施
設からの給水とともに、地下水の利用などによる地域給水を多面的に検討する必要がある。

3. 浄水施設の管理上の問題点

調査都市の浄水場では、凝集、薬品沈澱、急速ろ過、塩素消毒のプロセスで処理され、凝集剤
として固形硫酸バンド、凝集助剤として一部で石灰、消毒剤として液体塩素、次亜塩素酸カルシ
ウムが用いられている。

浄水施設管理上の問題点としては、

- ① 一部の浄水場では、容量が不足してオーバーロードとなっている。
- ② 水質試験は、個々の浄水場ではなく、一括してRegional Officeで行なわれている。ま
た、各浄水場にジャーテスターはあるが、これを使用していない場合は硫酸バンド、凝集助
剤の注入率が適正に管理されていないので、処理水質が悪い場合が見られる。
- ③ 急速ろ過池は逆洗のみで、殆ど表洗は行なわれていない。また、洗浄が不十分なためにろ
過池の表層には泥がたまって、ろ過機能が劣化している。チェンマイのPaton浄水場以外は
表洗装置を取り付けるべきである。
- ④ 浄水の残留塩素の管理、塩素ガスの安全対策が十分でない。小規模の浄水場では、次亜塩
素酸カルシウム（高度サラシ粉）又は次亜塩素酸ナトリウムを使用すべきである。
- ⑤ 浄水場内の計器、メータの故障が放置されており、水量管理が十分でない。

現在、PWAではワンパターンの浄水方法が採用されているが、本格調査においては、浄
水施設及び管理上の問題点を検討し、原水水質、維持管理のレベルを考慮し、省エネルギー、
低コストのもとで管理できる浄水施設を提案すべきである。

現在、PWAではワンパターンの浄水方法が採用されているが、本格調査においては、浄水施
設及び管理上の問題点を検討し、原水水質、維持管理のレベルを考慮し、省エネルギー、低コ
ストのもとで管理できる浄水施設を提案すべである。

4. 配水施設、管理上の問題点

配水管は主に石綿管が使用されており、漏水もかなりの量と推定（30～50％）され、配水区
域内には水圧が不足している地域が多い。また、配水量を計測するメータには故障しているもの
が多い。このため、配水管の更新、ポンプ、配水タンク等の充実、計量メータの補修・取り替え
を行なうとともに、漏水防止対策を進める必要がある。

本格調査では、①小区域（戸数100戸程度）をモデル的に選定し、1～2カ所をサンプリング、
②不良メータの取り替え、③調査地域の流入点への流量計の設置、④流量計と水道メータの計測、

⑤配水量，有収水量の計算，⑥漏水修理，⑦流量計と水道メータの計測を行ない，有収率，漏水率の推定及び漏水防止プログラムの基礎資料を収集する。また，パタヤ市には，漏水防止チームが作業中であるので，この指導も兼ねて行なえば効果は高いと思われる。

5. 給水装置の問題点

小口径の給水管では亜鉛メッキ鋼管，大口径管では石綿管が使用され，その老朽化は漏水の原因となっているので，その計画的な取り替えを検討する。また，水道メータの定期的な取り替えは行なわれておらず，かなりの水道メータが故障している模様である。

水道メータは，水道料金徴収上の基礎ともなるもので，メータの検査，修繕，取り替え体制を確立し，使用者とのトラブルを最小限に留めるべきである。

6. その他

本格調査では，既設のリハビリテーションとともに，施設の拡張も検討されるが，どんな立派な施設ができてそれを運転・維持管理する組織，人員，研修，経営管理等のソフトの面が十分でなければ，水道事業の目的を達成することはできない。従って，本格調査ではこれらの検討も行ない，具体的に提案すべきである。

またPWAとしては，今回の施設の拡張，リハビリテーションの実施に当たって，世界銀行，アジア開発銀行等の外国の融資を考えているので，これらの融資援助の審査に十分応えられるレベルのレポートを作成する必要がある。

同時に，本格調査で，M/P，F/Sを実施しながら，PWAスタッフを指導することによって，PWA職員の技術レベルを積極的に向上させるよう配慮する。

第5章 本格調査の実施方針

5-1 基本方針

タイ国政府の要請に基づく地方4都市水道整備計画調査を実施するに当たっては、同国水道の特殊な事情を十分に考慮し、また、4都市の実情を十分に把握して調査計画を作成しなくてはならない。以下に各都市ごとに、その留意点を述べる。

1. チェンマイ市

チェンマイ市は、タイ国の中で、バンコク、ハジャイに次ぐ人口第3位の都市であるとともに、北部タイ地方の商業、工業、教育、観光の中心地として非常に重要な位置を占めている。今回の本格調査では、チェンマイ市とその周辺4衛生区（San Sai, San Kamphaeng, Saraph, Hang Dong）を対象とし、給水区域の拡大、普及率の向上を図るものである。

チェンマイ水道の最重要な課題は、水源である。Pin川の表流水は、渇水期に水位が低下して、取水が困難になるとともに、かんがい用水路は補修のために、しばしば停水し使用できなくなる。このため、上流ダム、地下水（伏流水を含む）の利用、また、かんがい用水路の代わりに独自の導水路の建設、原水貯留池の建設など多角的に検討する必要がある。

また、施設をみると、Paton浄水場でも若干オーバーロードになっており、将来はさらに大幅に不足することが予想されるので、水需要に見合った施設の拡充を図る必要がある。

同時に、既施設についても、ろ過池の改造（表洗装置の取り付け、ろ過砂の入れ替え等）、計器類の取り替え、取り付けを行なって、良好な水質管理、水量管理ができるように検討する。

チェンマイ水道の無収率は33.8%（1984）とかなり高い。この原因は老朽化した石綿管、給水管、メータの故障にあると考えられるので、配水管、給水管の補修、取り替えを検討する。

2. ウボン・ラチャタニ市

ウボン・ラチャタニは農業都市であるとともに、北東タイ地域における2番目の都市として、商業、交通の中心である。

ウボン・ラチャタニの普及率は、48%と低いので、今後はこの向上を図るとともに、本格調査では、近接した未給水区域（Ban Heai Wang Nang, Ban Don Klang, Ban Tha Bong-Had Suangpha, Ban Mai Klangの4地区）への給水の拡大も検討する。

ウボン・ラチャタニ水道の水源は、メコン川の支流であるムーン（Moon）川である。この川は、乾期においても十分な流量があり、将来水源としても利用可能である。ただし、周辺地域の拡張に当たっては、既存の配水管網から遠距離のものについては、地下水の利用の検討が必要である。

将来、この市地域では、水需要の増加に対応して、各種施設の拡充を図る必要がある。

既存の浄水施設については、計器類の取り付け、取り替え、ろ過池の表洗装置の取り付け、ろ過砂の取り替え等が必要である。

1984年の無収率は、36.1%と高い。この原因は、老朽化した石綿管、給水管、メータの故

障と考えられるので、材質、継手を考慮のうえ、配水管、給水管の補修、取り替えを検討する。

3. スハンプリ市

スハンプリ県は、米、砂糖などの農業地帯であり、スハンプリ市は県庁所在地として、この地域の行政、教育、商業の中心地である。

スハンプリ水道の水源は、Tha-Chin川の表流水である。将来の水源としては、このTha-Chin川の表流水の使用と地下水の利用が考えられ、比較検討が必要である。

既存の浄水施設については、ろ過池の改造、計器類の整備などに大幅な改造を要する。

1984年の無収率は、44.1%と非常に高く、また、配水圧も非常に低いので、配水管、給水管の抜本的な対策が必要である。

4. パタヤ市

パタヤは、タイ湾東岸に位置し、国際的なリゾート地として有名である。タイ国では、国家的に、この地域の観光開発をさらに推進しようとしているので、将来の水需要はさらに増加し、大幅な水道施設の拡張を必要とする。

パタヤ水道の水源は、Map Prachan貯水池である。この貯水池の有効容量は、1,400万 m^3 であるが、将来的には不足することが予想されるので、RIDが実施しているこの地域の水源開発に参加して、水源の確保に努めなければならない。現在、考えられる対策は、このダムを50cm程度高上げることにより貯水量を300万 m^3 増加する案、50km北東にあるDok Krai貯水池から導水管を敷設して引水する案があるが、この地域にはこのほか貯水池群があるので、各種検討する必要がある。

既存の浄水施設は、比較的良好であるが、ろ過池の改造（表洗装置の設置等）などは必要と考えられる。

1984年の無収率は、10.3%と比較的良好であり、配水圧も全般的に良好であるが、一部高台で低いので、配水施設の改造を必要とする。また、一部の地域では古い配水管、給水管が存在しているので、この敷設替えが必要である。

以上、調査都市における留意点を述べたが、同時に施設を良好に運営していくためには、施設の増設、改造とともに、維持管理の問題を検討する必要がある。今回の調査では、浄水管理、漏水防止対策についてもプログラムを提示し、PWAの職員の手で適切な管理が行なえるようにしなければならない。

さらに、財政、組織の問題も非常に重要である。「料金体系をどうするか」、「建設に必要な財源をどう調達させるか」、「維持管理費を減少するにはどうすればよいか」などの財政上の問題の検討は、計画目標の達成の決め手ともなるので、調査の中で十分に検討する必要がある。

5-2 調査内容

この調査は、タイ国地方4都市（チェンマイ市、ウボンラチャタニ市、スハンプリ市、パタヤ市）の水道整備に関するマスタープラン、フィジビリティ調査を行なう。

計画目標年次は、マスタープラン（長期基本計画）については2006年とし、フィジビリティ調査については短期開発計画とする。

本格調査は次の2段階に分けて行なう。

1. 第1段階

短期計画策定のための前段階として4都市の概念的マスタープラン（長期基本計画）を策定する。主要な項目は次のとおりである。

1) データ収集と解析

2) 計画給水区域の設定

計画給水区域は、現在の給水区域、将来の人口見通し、土地利用計画、工業、観光などの開発計画、地形、地理、行政区域等を決定する。

3) 計画給水人口の設定及び水需要量の予測

水需要の予測は、全体水量のトレンドを求める。

4) 既存水道の調査

既設の水道施設、経営、組織、維持管理等について現況、問題点及び改善の必要を把握する。原水、浄水の既存の水質データを収集するとともに必要に応じて水質調査を行なう。

5) 水源調査

既存の水源の現況及び問題点を把握するとともに、既存資料から将来利用可能な水源ポテンシャルに概略把握する。

6) 水道の施設計画、維持管理計画

既存の水道施設の改造を含めた水道整備計画に係る組織・維持管理について概略検討する。

7) 建設費、維持費管理費の見積

以上の計画に基づいて概算金額を算出する。

8) 財政面からの検討

施設計画の実施見通しを財政面から検討する。

9) 実施計画

本段階では、2006年を目標とした、水需要の予測、水源、施設計画、規模につき検討を行ない、現状に見合ったフィジビリティ調査の枠組みを作成する。

2. 第2段階

第2段階は4都市のフィジビリティ調査（短期計画）を行なう。各項目の詳細な予測を行なう。

1) 計画給水区域の決定

2) 計画給水人口の決定

3) 水需要量の予測（住宅用、公共用、商業用、工業用、観光用等の用途別）

1) 2) 3)については、第1段階の調査に加え、各項目の詳細な予測を行なう。

4) 既存水道施設の改善調査

第1段階で行なった既存水道の調査に基づいて、また漏水防止については小地域を1～2カ所選定して、フィールド調査を行ない、改善方法を提示する。

5) 水源調査

第1段階の水源調査において地下水利用が最善で、地下水についての適当な資料が得られない場合はボーリング調査及び水質試験を行なう。

6) 施設の概略設計

複数の代替案について概略設計を行ない、長所、短所をあげながら検討し最終的に最適案を提示する。

7) 予備設計

設計指針、施工指針、維持管理指針等作業に必要な諸指針を定め、これに基づいて予備設計を行なう。

8) 建設資材・労働者の技能水準、建設業者の調査

9) 建設方法、資材、施工機械の調達方法の検討

10) 建設費及び維持管理費の見積

11) 水道料金体系の調査

適正な料金制度を検討する。

12) 便益の見積

直接的便益（料金収入、合理化に伴う費用の減少等）と間接的便益（水系伝染病の減少、医療費の減少、火災の減少、地価の上昇等）に分けて算定する。また間接的便益については定性的に行なう。

13) 経済、財務分析

水道事業の財政及び経済性に関して解析する。内容については、国際金融機関の審査基準を満足するものであること。

14) 組織、維持管理計画に関する調査

施設を円滑に運営していく組織、人員配置、研修、維持管理について調査し、提案する。特に、浄水管理については、運転、維持管理のプログラムを、漏水防止については、漏水防止対策のプログラムを提示し、これらに基づいてPWAが独自に実施できるようにする。

15) 実施計画

以上の計画を段階的に進める手順を提示する。

5-3 調査期間

本格調査は、16カ月間である。このうち、最初の3カ月間は第1段階としてデータ収集と長期計画方針の案案を、その後の13カ月間でフィジビリティ調査を行なう。

5-4 要員計画

調査団の構成は、概ね次のように考える。

担 当	内 容
1. 総 括	水道整備計画全般に関すること。
2. 上水道計画	統計資料の収集，需要予測に関すること。
3. 水源計画	各種水源の流量，水質等の調査に関すること。
4. 漏水調査	漏水調査作業及び推計解析に関すること。
5. 送配水施設計画	水道管及び配水池等の配置計画，維持管理に関すること。
6. 水質調査	水質統計，原水・浄水（各プロセスごと）・給水栓水等の水質試験
7. 浄水施設計画	浄水施設の改善，拡張計画，維持管理に関すること。
8. 組織計画	各種組織の改善計画に関すること。
9. 財務計画	財務，経営分析と計画に関すること。

5-5 携行資材関係

- ① 水質試験器具（携帯用）：1セット
- ② 漏水探知器具（ロケータ，金属用・非金属用）：2セット
- ③ 水圧計（消火栓用，給水栓用），流量計（超音波流量計φ200～500用）：各2セット

5-6 相手国の便宜供与

S/W，M/M記載のとおりである。

5-7 報告書の作成

S/W，M/M記載のとおりである。

5-8 資料・情報の入手について

事前調査で入手した資料・情報については，添付資料（付-2）に示すとおりである。

このほか，持ち帰れなかった資料，作成中の資料もあるので，本格調査時には，その他の資料・情報収集に努められたい。

資料の多くは，タイ語で書かれたものが多いので，調査団にタイ語を判読できる人がいれば申し分はない。

(添付資料)

付-1 面会者一覧表

1. タイ国水道公社 (Provincial Waterworks Authority)

TAWAT Wichaidit Ph. D	Governor
Mr. Sukhon Sithilertpisan	Actig for Corporate Planning Department Director of Community Waterworks Division
Mr. Prakit Chanurai	Acting Chief, Planning Division Corporate Planning Department
Miss Orapin Asaavanig	Chief, International Cooperation Section Corporate Planning Department
Mr. Sanit	Planning Technical Section
Mr. Prapon Chanakitjanukit	CPD
Mr. Suthee Asawapichaid	CPD
Mr. Jaroon Upanan	CPD
Mr. Virusa Mahak-Khaphongs	Director, Operation and Maintenance I.
Mr. Sitthichai Pissathanporn	Director, Operation and Maintenance II.
(Suphanburi)	
Mr. Annot Mooljanabart	Director, Regional Office No. 3
(Ubon-Rachatani)	
Mr. Arun Thaichareon	Director Regional Office No. 8
Mr. Rittirong Jaiyasin	Technical Assistant Director
Mr. Samanchai Prowlap	Manager of Ubon Water Supply
Miss. Wilai Rakissara	Accounting
(Chiangmai)	
Mr. Manit Padungtin	Director, Regional Office No. 9
Mr. Winai Teeraprasert Sophon	Assistant Director, Engineering
Mr. Sompop Petehget	Assistant Director, Administration
Mr. Rongviea Pholamuengdee	Assistant Director, Operation
Miss. Ladda Keovara	Water Quality Laboratory,
Mr. Chot Inearaksa	Manager of Samkamphaeng Waterworks
Mr. Chadong Kongcharoen	Production Chief,
Mr Somsak Sawatdirak	Manager of Paton Waterworks

Mr. Kamol Hason Assistant Manager of Paton Waterworks
(Pattaya)

Mr. Nakorn Jirasvetakul Director, Chonburi Regional Office No. 2

Mr. Prasert Othong Manager, Pattaya Waterworks

Mr. Paisan Klaiyongthong Engineer, RID, Reservoir Mab-Prachan

2. Department of Technical and Economic Corporation (DTEC)

Mr. Kasem Unahasuan Dupty Director-General

Mr. Suthin Susila Chief, Japan Sub-Division

Mr. Surayuth Kungsadan Member

3. 国際協力事業団 (JICA) バンコク事務所

後藤基教 所長

日野卓人

四釜嘉総

甲斐寿治

4. 在タイ日本大使館

高山康信 一等書記官

上東輝夫 チェンマイ駐在官事務所 参事官 兼 領事

5. JICA 専門家

田中 優 タイ国地方水道公社

五十嵐 勲 平 タイ国地方水道公社

田口 徳 男 タイ首都圏水道公社

小野 善 文 タイ首都圏水道公社

矢野 博 司 チェンマイ大学

山田 海外青年協力隊 (チェンマイ, 水質担当)

青山 海外青年協力隊 (PWA)

付-2 収集資料一覧表

(持ち帰り資料)

1. PWA と RID の関係
2. 管径と土被りの関係 ($\phi 100\text{mm} \sim \phi 600\text{mm}$)
3. 石綿管の敷設費 ($\phi 100\text{mm} \sim \phi 600\text{mm}$)
4. Corporate Plan for Second Half of the Water Decade (1985~1990) PWA
(Tentative Plan Draft)
5. Record of Wells (Oct. 1977~Sept. 1978)(Sample)
Hydrogeology Section, Ground Water Division, Department of Mineral Resource
6. Economic Feasibility Analysis
7. PWA 組織図 (Aug. 1985)
8. 質問回答書
9. チェンマイ関係
 - ① Paton Treatment-Plant Flow Chart
 - ② Monthly Statistic Data Number of Consumers classified by sized for Fiscal Year
 - ③ Statistical Data on Number of Consumers classification (Apr. 1985)
 - ④ Statistical Data on Number of Consumers classification (June 1985)
 - ⑤ Water Bill Collection based on sizes of meter for the month (Apr. 1985)
 - ⑥ Meter Reading Table Commercial Consumers
 - ⑦ Pipes in distribution system Table
 - ⑧ 配管図, 施設図 2 葉
10. バタヤ関係
 - ① Mab Prachan Reservoir
 - ② Mab Prachan Reservoir, Water Level-Volume 1981~1983
 - ③ Mab Prachan Reservoir, Water Level-Volume 1983~1985
 - ④ 月別生産量, 配水量, 貯水量
 - ⑤ 水道事務所別配水量 (1984~1985)
 - ⑥ 水質試験表 (Feb. 1985)
 - ⑦ 配管図, 施設図 9 葉
11. スハンブリ関係
 - ① 水質試験表 (Apr. 16. 1985)
 - ② 配管図, 施設図 4 葉

12. ウボンラチャタニ関係
 - ① 都市計画図…… 1 葉
 - ② 配管図, 施設図…… 2 葉
13. 4 都市共通
 - ① 配水圧状況
 - ② 年度別総配水量(1975~1984)
 - ③ 配水有効率(1984)
 - ④ 配水区域, 浄水場位置図
14. Hydrography Mean Monthly Discharge (Mean Annual Discharge)(1951~1970)
15. Major Land Uses
16. Mean Annual Rainfall(1951~1970)(Variation of Monthly Rainfall 1961~1971)
17. Mean Monthly Rainfall(1951~1970)
18. Land Capability(1972)
19. Daily Discharge of the Major Rivers(1965/66~1969/70)

(参考資料)

1. タイ国ラムチャバン臨海部開発計画調査報告書 昭和60年2月 JICA
2. タイ国東部工業港開発計画調査報告書 昭和58年11月 JICA
3. タイ国パタヤ地区基盤整備計画調査報告書 昭和52年12月 JICA
4. PATTAYA Tourism Development (Feasibility Study)(Final Report) Dec. 1978
JICA
5. Asian and Pacific Regional Division International Association for Hydraulic
Research Vol. I, II, (1984) Asian Institute of Technology (AIT)
sponsored by the Committee for Coordination and Water Resources Development
6. Ground Water Well Data of Thailand (1978), AIT
7. Hydrological Yearbook 1912~1980, RID
8. Report on Identification Survey of Three Provincial Water Supply Projects in
Thailand (1983), JICA

付-3 Term of Reference (TOR)

No. MI 5705/692



Provincial Waterworks Authority
72 Chaengwattana 1 Rd., Laksi
Bangkhen, Bangkok 10210.

March 13, 1985

Mr. Yasunobu Takayama
First Secretary
Embassy of Japan
1674 New Petchburi Road
Bangkok 10310, Thailand

Dear Mr. Takayama ;

Re : JICA FEASIBILITY STUDY FOR THREE CITIES WATER SUPPLY
AT CHIANGMAI, UBON RATCHATANI, AND SUPHANBURI

I am aware that a Japanese Government Contact Mission will be visiting Thailand around June of this year to appraise PWA's three cities water supply project for a JICA-supported Feasibility Study.

I would like to take this early opportunity to express PWA's position that improvements of water supply services for these three cities are considered having high priorities for PWA and I sincerely hope that the feasibility studies can be authorized as early as possible this year.

Your strong support to the appropriate Japanese Government Offices of our interest in the project would be sincerely appreciated.

Yours sincerely,

Mechai Viravaidya
Governor
Provincial Waterworks Authority

cc. Mr. Michimoto Goto

Corporate Planning Department
Tel. 521-2220-4 ext. 360-362

Request for new Technical Assistance Project

Project Title : Master Plans and Feasibility Studies for Chiangmai,
Ubun-Ratchathani and Suphanburi

Requesting Agency : Provincial Waterworks Authority (PWA)

Proposed Sources of Assistance : The Government of Japan

1. Background Information and Justification for the Project

The government of the Kingdom of Thailand has adopted the targets of the International Drinking Water Supply and Sanitation Decade and sets its long range goal to supply the entire population with clean and drinkable water by the end of the Decade. The Provincial Waterworks Authority (PWA), as one of the responsible agency for providing, operating and maintaining water supply systems in the country except Bangkok, will enable the government in pursuing such policy. At the present PWA owns and operates about 176 urban water supply systems serving a total of about 3 million people.

Many of these systems, facing with raw water shortages, excessive water wastage in distribution systems and approaching the capacity of the treatment plants need improvements and expansions to meet the increasing demands. Therefore, elaborate studies and long range plans should be efficiently carried out in order to receive the most fruitful results.

The three major towns which are regional growth centers and rapidly developing designated for the master plans and feasibility studies are Chiangmai, Ubun Ratchathani and Suphanburi.

Chiangmai

Chiangmai is located in the northern region of Thailand, approximately 700 km. north of Bangkok. Chiangmai is the administrative, educational and commercial center of northern Thailand. There are many world-famous buddhist temples and cultural centers which attract more than one million tourists from various parts of the world each year. This induces rapidly the industrial and commercial development indicated by a number of government offices, various kinds of shops, bazaars, restaurants and modernized hotels. The study areas of Chiangmai consist of Chiangmai Municipality and its surrounding communities :

/Sansai...

Sansai, San-kamphaeng, Saraphi and Hang Dong with the total population of about 180,000 in 1983. The projected year 2005 population is 270,000. Only 54,000 people are currently served by the existing systems.

Ubon Ratchathani

Ubon Ratchathani is one of the largest municipalities in the northeastern region of Thailand; approximately 647 km. from Bangkok. The study area includes Ubon Ratchathani and Warin Chamrap Municipalities. The Mun River flows across the study area from west to east. Ubon Ratchathani Municipality is located on the north side of the river and Warin Chamrap Municipality on the south side. The area has developed as a center for trade, local government and economy of the northeastern region. The present (1983) population of the twin municipalities is about 130,000 and the projected year 2005 population is 200,000. Ubon and Warin Municipalities share a water supply system with four treatment plants working almost at full capacity. Only 57,000 people are currently served by the existing system.

Suphanburi

Suphanburi Municipality is located in the central part of Thailand, approximately 150 km. northwest of Bangkok. This town is a marketing and commercial center for the surrounding agricultural area. The service area of Suphanburi Waterworks consists of Suphanburi Municipality and Phopraya Sanitary District. The present population in the water supply services area is about 28,000, expected to increase to about 41,000 by the year 2005. The existing water supply system serves only 19,200 people, apart from these still use unsafe water.

2. Details of the Project

2.1 Program Goal

To improve basic urban infrastructure facilities in the provincial areas in order to encourage the development of a regional economic base for the growth of industries and other economic activities in the regional urban centers. This is in direct support to one of the main objectives of the Fifth National Economic and Social Development Plan (1982-1986). Accordingly, it is the overall goal of PWA to provide clean water to provincial towns and large communities to

/ the....

the widest extent possible. The proposed study is aimed at providing a sound program for the development of water supply systems in designated towns and nearby communities.

2.2 Project Objective

The objective of the project is to develop master plans for the three provincial towns of Chiangmai, Ubon Ratchathani and Suphanburi and their nearby communities for expanded, cost-effective water supply and distribution systems to meet demand for the next 20 years. The available water resources will be identified for their development with their constraints in development and the policies adopted. Forecasts in the water demand will be established so that the amount of water supply can be planned accordingly. Furthermore, a leakage detection, including preparation of as-built drawings and systematic detection process of water leakage will be done with the most cost-effective solution for each system. Within the framework of the 20-year master plans, to carry out feasibility studies for the recommended first phases of implementation covering a 10-year period.

2.3 Conditions Expected at Completion of Project

A set of master plan reports for the water supplies of the ^hree provincial towns for the next 20 years (2005) is expected upon completion of the project. Furthermore, feasibility studies shall be done to determine the least cost solutions for the implementation of the first 10 year-period of the Project.

2.4 Recommended Sources of Information and Data Related to the project, Necessary for Project Verification

Data and information related to the project are to be provided by the Provincial Waterworks Authority. An Identification Report prepared by ECFA should also be referred to.

2.5 Duration of the Project

The tentative schedule set for the Project is from April 1984-March 1985.

2.6 Project Site

An office will be provided in Bangkok at PWA Headquarters. An adequate field office will also be provided at each waterworks.

/2.7...

2.7 Project Work Plan and Activities

Detailed Works Plan, Project Activities and Scope of Work for each System.

Phase I (Immediate Improvement, up to 3 months)

1. Evaluate all available data such as maps, geological, hydrological and climatological reports, census statistics, water production and demand etc. Analyse and develop such data and information as required to support the project analysis.
2. Define a general description of the proposed project, utilizing mentioned information and own investigation.
3. Conduct field surveys and make studies on population, socio-economics, locations of facilities, water production and consumption, power capacity and requirements, availability of local construction materials and equipment and effect of the project on the environment.
4. Determine the chemical, physical and bacteriological quality of the various surface and ground water alternative sources and treated water.
5. Determine the general capacities and efficiencies of the existing transmission, distribution, storage, pumping, treatment, etc.
6. Determine the water leakage in distribution system as well as propose as-built drawing, systematic detection process of water leakage and the most cost-effective solution for improvement of each system.
7. Propose restoration of existing components for immediate improvement, to be implemented on a priority basis after approved by PWA.
8. Assess the expected impact of immediate improvement on the capacity and reliability of the existing water supply schemes.

Phase II (Master Plan, up to 4 months)

1. Make hydrogeological and hydrological studies to determine the availability of various alternative water resources and prepare a development plan to meet present and future demands.
2. Estimate increase in population, water demand of various consumers and land use from the projections of industrial and commercial growth over the designed period.
3. Delineate the service areas for the two specified periods (10,20 years), carefully evaluating future development of the study areas.

4. Provide the proposed water supply system and develop alternative plans for water sources, treatment, transmission and distribution of water supply system for each period.
5. Select a plan, based on the least present cost, taking into consideration capital cost and annual operating and maintenance costs for at least 20 years.

Phase III(Feasibility Study, up to 5 months)

1. Make preliminary engineering plans which are sufficiently accurate and complete to indicate the location, arrangement, evaluation and principal features of the project, which serve as the basis for sound cost estimates, including drawings, design criteria and analysis, all sufficiently detailed to define the project.
2. Prepare cost estimates for the engineering, construction, operation and maintenance of the project recommended for the first period. Each of the cost items shall be defined in terms of local and foreign exchanges. Total cost estimated shall be summation of the unit costs of the works including a bill of quantities and unit prices which consist of materials equipment and labor costs or other bases used for the estimates.
3. Prepare economic analysis of the project and its implications to the population with regards to health, income and social benefits as well as determine the community's willingness and ability to pay in terms of water tariff.
4. Prepare a financial plan based on the required investment of the recommended project indicating source of funds and timing of the investments. Carry out a detailed analysis of the existing and projected financial operation including yearly estimate of revenue, operating expenditure, borrowing, capital investment, etc., and its effects of expected price escalation and water rate increase.
5. Prepare economic justification for the net benefits and costs. Costs shall be converted to economic cost to reflect alternative uses of resources by the nation. Benefits shall include effects of the Project on water users and national interest extended beyond local bounds.

6. Formulate proposals for further activities and respective Terms of Reference of detailed designs and tender documents, etc.

2.8 Time schedule for project activities.

Activities	Months												
	1	2	3	4	5	6	7	8	9	10	11	12	
Immediate Improvement													
Long Term Master Plan													
Feasibility Study													

3. Details of the Implementing/Operating Agency.

3.1 Institutional Framework.

Several government agencies are currently responsible for supply of clean and drinkable water to the communities in Thailand. Provincial Waterworks Authority has the responsibility of supplying piped water to all but in Bangkok Metropolitan area that has population greater than a few thousand. Other agencies such as the Accelerated Rural Development, and the Deep-Well Drilling Departments and Groundwater Division of Mineral Resources Department are primarily responsible for potable water supply in rural areas.

Provincial Waterworks Authority is a state enterprise operating under the supervision of the Board of Directors within the framework of Ministry of Interior. It is the merger of two former government agencies, namely the Provincial Water Supply Division of Public Works Department and the Rural Water Supply Division of Public Health Department.

3.2 Staff/Personnel Participating in Project Implementation

a) Project Manager/Coordinator

A highly qualified PWA staff will be assigned to oversee the execution of the Project. He will also be responsible for the progress and results of the investigation of the studies in each phase.

b) Project Engineers

A number of experts in various fields of study involved will be assigned to assist the Project Manager. These engineers will include :

- i) a survey engineer
- ii) a sanitary engineer
- iii) a water-resources engineer

They will not be required to work full time on the project but at various phases as needed.

c) Economist/Financial analyst/Public Relations

A qualified person to assist in data gathering and analyses for demand forecast purposes, and evaluating alternatives for the least cost solution.

d) Survey Party

A qualified survey party to work on topographic maps, pipeline locations as well as any other required information.

4. Assistance Requested

4.1 Experts

Item	No.	man-month
Project Manager	1	12
Water Supply Engineer	3	36
Water Resources Engineer	1	12
Hydrogeologist	1	6
Socio-economist	1	6
Other Experts	2	4
Total	9	78

4.1.1 ...

4.1.1 Justification for Requesting Experts :

A team of experts with multi-disciplinary fields of study will be required to solve such complicated yet delicate problem as a water supply system and come up with solid master plan and feasibility studies. It is anticipated that through the mission of these experts, PWA counterparts will have transferred their technical know-how's, thus reducing, if not eliminating, the use of private consulting services.

4.1.2 Job Description of Each Expert Requested
Project Manager/Coordinator

A highly qualified person who has a diverse experience in the field of water supply. To be responsible for the progress, results and recommendations of the investigation and preparation of the master plan and feasibility study.

Experts.

Highly qualified persons who have an extensive experience in the field of work indicated and have been involved in international works are to be responsible for all phases of studies.

4.2 Fellowships

Field of Training	Total		1985	
	No.	m/m	No.	m/m
1. General Planning	2	4	2	4
2. Water Engineering	2	4	2	4

4.2.1 Justification for Requesting Fellowships

In order to receive the most benefits possible from the Project, PWA personnels should be given a chance for study tours such that the analyses and other important studies can be followed.

Complete.....

Complete knowledge of master plan, planning can readily be transferred. As a side benefit, these Thai personnels can be arranged to visit some water supply systems in other more developed countries.

4.3 Equipment

Description of Equipment	Amount Requested
1. Flow Measurement Equipment Set	3 sets
2. Leakage Detector	3 sets

4.3.1 Justification for Requesting Equipment

Whenever a master plan study is performed, accurate quantity of water production and sale is always required. At the present, PWA still lacks of flow measurement equipment both in quantity and quality. Modern equipment could speed up the work many times and yet give very accurate results.

A good master plan should also include evaluations of the existing system. Attempts should be made to detect leakages in the system. At the moment PWA has inadequate device to do such a job. Leakage detectors provided by the Japanese Government can readily be used in this project and any subsequent projects that will follow.

5. Thai Government Counterpart Contributions to the Project.

1. Office space and facilities at PWA.
2. Laboratory facilities
3. Data provision
4. Data collection assistance and participation
5. Analysis assistance and participation
6. Policy guidance

6. ...

6. Future Work Plan

After the completion of the Project, the master plans for Chiangmai, Ubon Ratchathani and Suphanburi water supplies will be submitted to PWA governing body for final approval, after which it will be implemented immediately.

The well-trained Thai counterparts will be assigned to conduct similar studies of their own in other projects.

No. HI 57401/ 16 6 85

Provincial Waterworks Authority
72 Chaengwattana 1 Rd., Laksi
Bangkhen, Bangkok 10210.

June 11, 1985

Mr. Yasunobu Takayama
First Secretary
Embassy of Japan
1674 New Petchburi Road
Bangkok 10310.

Dear Mr. Takayama ;

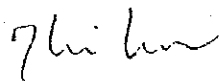
Re : JICA FEASIBILITY STUDY FOR THREE CITIES WATER SUPPLY
PROJECT

I am aware that a Japanese Government Contact Mission will be visiting Thailand around July of this year to define the scope of work for PWA's captioned project for a JICA supported Feasibility Study.

On this occasion I have to inform you that in addition to the three cities i.e., CHIANGMAI, UBBON RATCHAPANI, and SUPHANBURI, PWA has come to face an urgent need for immediate improvement of water supply in the City of PATTAYA and request your esteemed consideration for adding the City of PATTAYA to the JICA study areas if such a change could be arranged at this stage of process.

Your kind contact to Japanese Government Offices and support to make them understand our position in this respect would be sincerely appreciated.

Yours sincerely,



Mechai Viravaidya
Governor
Provincial Waterworks Authority

Corporate Planning Department
Tel. 521-2220-4 ext. 360-362

PROVINCIAL WATERWORKS AUTHORITY
PATTAYA-NAKLUA WATER SUPPLY EXPANSION PROJECT

1. BACKGROUND

Mr. Mechai Viravaidya, Governor, Provincial Waterworks Authority, by letter of 11 June, 1985 to the Embassy of Japan, Bangkok formally requested that JICA add the City of Pattaya to the planned Feasibility Study for Water Supply at Chiangmai, Ubon Ratchatani, and Suphanburi because of the urgent need for immediate improvement of water supply facilities for this city.

On June 14, 1985 Khun Sanit Kitchawan, Sanitary Engineer, Corporate Planning Department, PWA, accompanied Mr. Tamaki Nakadonari and Mr. Charles Kretch of Nihon Suido Consultants Co., Ltd. to conduct a field reconnaissance survey of the project study area. A meeting was held with Khun Narong Wongphayak, Chief of Services Section, Pattaya - Naklua Waterworks Office who assisted during the inspection tour of the water system facilities and in gathering technical data.

This brief provides the basic documentation describing the existing system and conditions which establish the project need, summarizes population and water demand forecasts, appraises the essential future water system requirements, outlines the scope of work anticipated, and includes preliminary cost estimates.

The information provided herein hopefully will familiarize members of the Japanese Government Contact Mission with the crucial water supply needs in Pattaya sufficiently to accept this project in the Feasibility Study planned by JICA in 1985.

2. EXISTING SYSTEM AND CONDITIONS

The City of Pattaya and surrounding Eastern Seaboard Development areas including available water resources are shown on Figure 1 attached.

Municipal water supply facilities were first installed in Pattaya in 1971 consisting of a water treatment plant of 80 m³/hr capacity located near Highway No.2 north of Pattaya with the Nong Pru as a source. Full treatment was provided with flocculation, sedimentation, and filtration at one plant plus a high lift pump station and clear water reservoir as shown in Photos 1 and 2.

Because of the limited water resources, the Map Prachan Reservoir and Dam were constructed on the Huai Nong Pru by 1979. The reservoir capacity used almost entirely for municipal water supply was 13.9 million m³ per year. Technical data on the reservoir and dam are summarized in Table 1.

By 1981, the first expansion of the Pattaya water supply facilities was completed including an Intake Tower and Pump Station at the reservoir, a 500 metre long 600 mm ϕ DI raw water transmission main to a water treatment plant on adjacent property having a capacity of 1,000 m³/hour. Also provided was a 250 m³ elevated tank, a 6,000 m³ clear water storage reservoir and a 600 mm D.I gravity trunk feedermain to Pattaya over 9 Km in length. At the time of the expansion, the original 80 m³/hour water treatment plant near Highway 2 was taken out of service.

In 1982, over 8 Km of 350 mm ϕ steel, mechanical joint trunk feedermain were installed by PWA from the old water treatment plant at Highway 2 to a central point on the distribution system. At the same time a 300 mm inter-connection was made from the Map Prachan trunk feedermain to the 1,000 m³ clear water reservoir at the old water plant as the high lift pumps were changed for an 80 metre hydraulic head. The purpose of this alteration was to pump water via the steel pipeline up the Ong Phra Mountain to a new 2,000 m³ capacity ground storage reservoir to serve commercial and residential development in this elevated area. A small booster pump station was also constructed at the reservoir as shown in Photo 3 to supply the nearby Wat (Temple) on the mountain peak. Leakage problems are now being experienced on the 1982 steel pipeline at some of the joints and because of the high commercial water demand repairs are not usually made on weekends. Apparently there are only two air release valves over the 8.4 Km length.

The water pressure in Pattaya is reported generally around 57 metres from the gravity system but low pressures are experienced on higher land to the north of Pattaya. Based on an assumed elevation of 100 metres at the old water plant, the elevation at the new Map Prachan plant is 152, at the Ong Phra Mountain Reservoir 170 m, along the Beach Road at Pattaya 94, and at Highway 2 about 106. The distribution system ranges in size from 100 mm to 600 mm extending over 100 Km in length as summarized in Table 2.

Table 3 which follows shows the growth in service connections and serviced population from 1978 to 1985 and Table 4 lists current statistics from Oct., 1984 to April, 1985 on water production, sales, chemical use, and service connection installations. Although the water sold is based on individual meters and the recently increased PWA water tariff, water production is estimated from the raw water pumping rates and times of operation as no flow meter was provided for the 1981 expansion facilities.

During the inspection of the Map Prachan water supply facilities it was observed that the reservoir water level was about 3 metres below the normal high water level as evident in Photo 4 and will recover to full reservoir capacity by October following the current rainy season. The Intake Pump Station has facilities for 3 pumps and future space for 3 more. One pump was not of service but an electrically driven vertical pump and diesel engine unit are operational with capacities of 1,000 and 500 m³/hour respectively. The diesel unit is shown in Photo 5 and the future space for 3 pumps is shown on Photo 6.

The intake tower bridge carries the 600 mm ϕ D.I raw water transmission pipeline on one side with provision on the opposite side for a parallel pipeline in the future as shown on Photos 7 and 8 respectively. Structural damage to the concrete support collar near the pump station due to water hammer surge pressure was observed during the inspection.

The Map Prachan treatment plant is shown on Photo 9 taken from the receiving well, viewing the flocculation and sedimentation basins, and filtration and administration building. Photo 10 shows the abundant land space between the existing water treatment plant and the Reservoir for future expansion. No problems are reported in controlling water quality but during peak demand tourist periods both raw water pumps are operated simultaneously resulting in 1,500 m³/hour of flow through the treatment plant units for up to 10 hours duration which is 50 percent higher than the design capacity of 1,000 m³/hour.

TABLE 1

SALIENT FEATURES OF MAP PRACHAN RESERVOIR AND DAM

DESCRIPTION	UNIT	TECHNICAL DATA
1. Year of Completion		1979
2. Hydrology		
Name of River		Huai Nong Pru
Catchment area	km ²	37.9
Average annual inflow	10 ⁶ m ³	13.9
3. Reservoir		
Surcharge capacity	10 ⁶ m ³	2.2
Active storage capacity	10 ⁶ m ³	14.0
Dead storage capacity	10 ⁶ m ³	0.8
Gross storage capacity	10 ⁶ m ³	17.0
Flood water level	El.m	45.7
High water level	El.m	45.0
Low water level	El.m	36.0
Reservoir surface area at HWL	km ²	2.8
4. Dam		
Type		Earthfill
Height	m	17.0
Crest	El.m	47.0
Crest length	m	2,000
Volume	10 ⁶ m ³	NA
5. Spillway		
Type		Morning glory
Discharge capacity	m ³ /s	NA
Crest elevation	EL.m	37.0
Crest length	m	6.0

Data Source : RID

TABLE 2

1982 WATER DISTRIBUTION SYSTEM SUMMARY

<u>PIPE SIZE</u>	<u>MATERIAL</u>	<u>LENGTH (m)</u>
600 mm	D.I	9,250
500	D.I	2,400
400	D.I	8,120
350	D.I	2,510
350	STEEL	8,420
300	A.C	11,260
200	A.C	13,020
150	A.C	28,090
100	A.C	<u>16,719</u>
	<u>TOTAL</u>	<u>99,789 m</u> (100 Km)

NOTE : Since 1982 the service mains have been extended by 20%.

TABLE 4

CURRENT WATERWORKS STATISTICS

DESCRIPTION	1984			1985			
	OCT	NOV	DEC	JAN	FEB	MAR	APR
WATER PRODUCTION (m ³) ^{5/}	590,375	581,500	626,000	649,875	601,305	709,250	680,500
WATER SOLD (m ³) ^{6/}	567,331	562,412	572,329	599,195	528,646	625,935	694,475 ^{1/}
CHEMICAL USE							
ALUM ^{2/}	13,700	9,550	8,600	9,650	8,840	14,875	16,250
CHLORINE ^{3/}	900	900	1,000	1,000	1,000	1,500	1,300
LIME	-	-	100	560	340	680	320
SERVICE CONNECTIONS							
REQUESTED	82	118	78	123	145	89	97
INSTALLED ^{4/}	139	112	86	107	111	121	132
ACCUMULATED TOTAL	4,392	4,504	4,590	4,678	4,786	4,905	5,050

- NOTES :
- 1/ In April, 1985 Operating Costs = ₦ 700,880 compared to Revenue of ₦ 4,245,947.
 - 2/ No water quality problems reported. Alum and treatment process reduces raw water turbidity of 35-55 ppm to 4-5 ppm.
 - 3/ Chlorine residual leaving water treatment plant 0.5 to 1.0 ppm.
 - 4/ More than 50% of new service connections are residential.
 - 5/ Water Production estimated from raw water pump operation since no flow measurement provided.
 - 6/ Apparent Non Revenue Water = $\frac{4,438,805 - 4,150,343}{4,150,343} \times 100$
= 6.95%

TABLE 3
CONNECTIONS AND SERVICED POPULATION

<u>YEAR</u>	<u>TOTAL</u> ^{1/} <u>POPULATION</u>	<u>NO. OF</u> <u>CONNECTIONS</u>	<u>% SERVED</u>	<u>ESTIMATED</u> <u>SERVICED</u> <u>POPULATION</u>
1978	29,776	819	16.5	4,913
1979	31,573	911	17.3	5,462
1980	34,706	1,014	17.5	6,074
1981	36,295	1,386	22.9	8,312
1982	37,500	2,571	34.3	12,863
1983	39,700	3,683	46.4	18,421
1984	42,800	4,239	49.5 ^{2/}	21,186
1985 (APR.)	N/A	5,050	N/A	25,250

NOTES : 1/ Population in Pattaya & Naklua.

2/ Assumed average of 5 persons per connection. Therefore Serviced population = 5 x 4,239 = 21,195 or 49.5% of total

3. POPULATION, LAND USE AND WATER DEMAND

The Master Land Use Plan for Pattaya shows the land use categorized into the following areas :-

- Low Density Residential
- Medium Density Residential
- Commercial and High Density Residential
- Industrial Enterprise
- Agricultural
- Preserved Environmental
- Educational
- Religious
- Government and Public Enterprise

Although industry is very limited in Pattaya City the residential and commercial sectors are growing at a substantial rate mostly attributed to the continuously increasing tourism industry. Table 5 projects the tourism growth in Pattaya from 1982 to 2001 showing an increase in this period from 9,200 to 30,900 tourists/day. More than 20 percent of all tourists to Thailand visit the internationally famous Pattaya. The Eastern Seaboard Development Program (ESDP) covers the three provinces of Chachoengsao, Rayong, and Chonburi which includes the Pattaya-Naklua water area. The development period of the ESDP covers the Fifth and Sixth National Plans, 1982 to 2001. One of ESDP's targets is to focus on the commercial and tourism industry in Pattaya. This is further evidenced by the 28 billion baht "city within a city" commercial complex planned for immediate construction in Pattaya as described in the attached article from the June 18, 1985 edition of the Bangkok Post newspaper.

The detailed population and water demand projections in 5 year increments for the 20 year period from 1986 to 2006 covering industrial domestic commercial and tourism water demand is shown in Table 6. Also included in the table are the per capita water usages, non-revenue water allowances of 15 percent and the service factors. During this period the permanent population is expected to more than double from 51,000 to 118,000 in development areas and the tourists will triple from 12,600 to 36,400 per day.

The 1985 annual water demand has been estimated at 8.2 million m³/day which will increase to 17.1 million in 1996 and 24.6 million m³/day by 2006.

The summary of water demand forecasts is more consisely presented in Table 7 for easy reference.

TABLE 5
PROJECTED TOURISM GROWTH IN PATTAYA

ITEM	Year				
	1982 ^{1/}	1986	1991	1996	2001
Number of Arrivals to Eastern Seaboard					
Foreign	450,000 ^{2/}	644,500	903,900	1,209,600	1,543,800
Thai	149,500	244,100	319,000	395,600	465,100
Total	599,500	888,600	1,222,900	1,605,200	2,008,900
Average Length of stay					
Foreign	-	6.75	7.25	7.75	8.25
Thai	-	3.30	3.85	4.40	5.00
Total	5.58 ^{3/}	5.80	6.36	6.92	7.49
Average Number of tourist(tourist/day)					
Foreign	-	11,900	18,000	25,700	34,900
Thai	-	2,200	3,400	4,800	6,300
Total	9,200	14,100	21,400	30,500	41,200
Portion to Pattaya					
(%)	100.0	89.4	84.7	81.3	75.0
Average Number of Tourist to Pattaya					
(tourist/day)	9,200	12,600	18,100	24,800	30,900

NOTES : 1/ Actual figure

2/ Does not include approximately 25,000 military personnel

3/ Data is available only for total

Data Source : ESS, Sector Studies "Tourism"

Tourism Authority of Thailand

TABLE 6

PROJECTED POPULATION AND WATER DEMAND

Description	Unit	1986	1991	1996	2001	2006
I. INDUSTRY, EXISTING	$m^3/yr \times 10^6$	<u>900</u>	<u>900</u>	<u>900</u>	<u>900</u>	<u>900</u>
II. DOMESTIC & COMMERCIAL						
1. Development area						
Population	10^3	51.4	67.9	85.8	103.0	117.7
Consumption rate	lpcd	265	280	290	300	310
Service factor	%	100	100	100	100	100
Non-Revenue water	%	15	15	15	15	15
Water demand	$m^3/yr \times 10^6$	5,849	8,164	10,685	13,269	15,668
2. Non-development area						
Population	10^3	18.1	20.0	20.1	18.0	17.0
Consumption rate	lpcd	148	155	163	170	177
Service factor	%	10	15	20	30	40
Non-Revenue water	%	15	15	15	15	15
Water demand	$m^3/yr \times 10^6$	115	200	281	394	517
3. Bang Lamung S/D						
Population	10^3	8.4	9.1	10.4	11.4	12.3
Consumption rate	lpcd	190	200	210	220	230
Service factor	%	100	100	100	100	100
Non-Revenue water	%	15	15	15	15	15
Water demand	$m^3/yr \times 10^6$	685	781	938	1,077	1,215
SUB-TOTAL	$m^3/yr \times 10^6$	<u>6,649</u>	<u>9,145</u>	<u>11,904</u>	<u>14,740</u>	<u>17,400</u>
III. TOURISM						
Average Number of Tourist to Pattaya	tourist/day	12,600	18,100	24,800	30,900	36,400
Consumption rate	lpcd	400	400	400	400	400
Non-Revenue Water	%	15	15	15	15	15
Tourism Water Demand	$m^3/yr \times 10^6$	<u>2,164</u>	<u>3,109</u>	<u>4,260</u>	<u>5,308</u>	<u>6,252</u>
IV. TOTAL WATER DEMAND	$m^3/yr \times 10^6$	<u>9,713</u>	<u>13,154</u>	<u>17,064</u>	<u>20,948</u>	<u>24,552</u>

TABLE 7
 SUMMARY OF
WATER DEMAND FORECAST

DESCRIPTION	PROJECTED WATER DEMAND - m ³ /yr x 10 ⁶				
	1986	1991	1996	2001	2006
Industry, existing	0.9	0.9	0.9	0.9	0.9
Domestic & Commercial					
Development Area	5.8	8.2	10.7	13.3	15.7
Non-Development Area	0.1	0.2	0.3	0.4	0.5
Bang Lamung S/D	0.7	0.8	0.9	1.1	1.2
Tourism	2.2	3.1	4.3	5.3	6.3
TOTALS	9.7 ^{1/}	13.2 ^{2/}	17.1	21.0	24.6

NOTES : 1/ Estimated 1985 water demand is 8.2×10^6 m³/yr.

2/ Existing Map Prachan Reservoir has capacity of 13.9×10^6 m³/yr.
 and therefore will reach limit by 1992

4. FUTURE WATER SYSTEM REQUIREMENTS

The existing Pattaya-Naklua water supply system serves approximately 50 percent of existing development within its water area from Jomtien Beach south of Pattaya to the built up areas north of Pattaya. It is also immediately planned to extend the system with a 10 Km pipeline northerly along Highway 2 to the Petroleum Authority of Thailand's complex in Bang Lamung.

The present average water production is estimated at 22,000 m³/day and the supply capability of the intake, raw water transmission pipeline, water treatment plant and clear water reservoir facilities at Map Prachan is only 24,000 m³/day based on maximum daily demand. The Map Prachan reservoir has a maximum annual capacity of 13.9 million m³ which is equivalent to 38,100 m³/day average demand or approximately twice the capability of the existing facilities.

Furthermore it was forecast in Table 7 that the average annual demand will match the available water resource capability of the Map Prachan Reservoir by 1992 only 7 years from now.

The "city within a city" commercial complex planned to be constructed within 5 years is another major concern which will dramatically affect future water demand and the use of Pattaya's water resources.

The existing gravity trunk feedermain system requires expansion as well as reviewing the condition of the bolted connections on the steel pipeline and investigation of the soil corrosion characteristics.

In the water service area on higher land, low pressure problems are being experienced which may be attributed to deficiencies in the secondary distribution network.

The overall water distribution system is in need of an intensive review including an accurate water demand study and definition of existing and future water service areas.

Based on the preliminary data and observations made during the June 14th reconnaissance survey as described herein, an outline of the scope of work and preliminary cost estimates have been prepared in Section 5 which follows.

5. SCOPE OF WORK AND ESTIMATE OF COSTS

Due to the present water demand in Pattaya approaching the capacity of the existing facilities combined with the rapid commercial and tourism development, it is clear that an immediate improvement and expansion program is urgently needed to avoid a water shortage crisis in this prominent resort city which attracts more than half a million foreign tourists and business people annually.

The immediate improvement program to be included in a Feasibility Study should essentially include doubling of the supply, raw water transmission, treatment, storage and trunk feedermain facilities which will be adequate to cover the development needs for about 7 years to 1992. This program will fully utilize the existing Map Prachan water resource capability of the Reservoir and therefore it is considered vital that this study also include a preliminary water resources appraisal for the Pattaya-Naklua system for a 20 year period to 2006, five years more than present planning schemes for the Eastern Seaboard Development area.

Because the water demand in Pattaya will soon reach the limit of the Production Facilities the scheduling of project implementation becomes critical. Considering that the construction period will span about 2 years, engineering of the project should proceed as quickly as possible. Desirably, the Feasibility Study should be completed by late 1985 or early 1986 to enable the Detailed Design Services to be approved for inclusion in the 1986 - 13th Yen Loan.

With these recommended terms of reference the scope of work and preliminary cost estimates are described as follows.

This questionnaire is an important investigation to make the basic plan for the project of three cities water supply at Chiangmai, Ubon Ratchatani, Suphanburi, or Pattaya Beach.

Therefore, detailed and concrete answers accompanied by sufficient references are required in order to understand the basic idea and present waterworks conditions of the Thai Side.

1. Important of the Project

- (1) Relationship between the Project and the Relevant Development Plan(e.g. National Development Plan, Regional Development Plan etc.)

The fifth and sixth five year plans, and the tourism development plan in Pattaya by ESDP

- (2) Utilization Plan of Technical Transfer

How to utilize and reflect the results of the technical transfer to future plans

- (3) Priority

Priority of the projects in Thailand

- (4) Urgency

Urgency of the projects in Thailand

- (5) Advantageous effect

Expected effects of the project on waterworks development and sanitary improvement

- (6) Solved problems

What kinds problems are solved by this project?

2. Outline of three cities

- (1) Data on geography topography, meteorology etc.

- (2) Type of city e.g. industrial etc.

- (3) The movement of population, economics (monthly income and expenditure per capita).... for the past five years

(4) Order of importance of the cities in Thailand

(5) Arrangement of Electricity supply, Water supply and drainage situation

(6) Characteristics (e.g. water supply....river water, ground water, tourism etc.)

3. References for Management and Organization of Waterworks

1) PWA

(1) Laws and regulations

- a. Laws and regulations referring to waterworks
- b. Water supply regulations and rules
- c. Laws and regulations referring to construction

(2) Purpose of activity

(3) Organization

- a. Organization and working staff members of the major waterworks
- b. National and regional administrative organization (concerning the project)

(4) Management situation

- a. Statement of budgets and accounts
- b. Annual and monthly management reports
- c. Water rate lists
- d. Maintenance cost

(5) Budget plan (general for waterworks and others)

(6) Future Plan (target)

(7) Outline of PWA s undertaking

(8) Process of decision making of budget and policy

2) Three cities

As above but excluding (7). Also (5) to include whole budget of the city.

4. Outline of three cities waterworks

- (1) Statistics of facilities
- (2) Statistics of population, water served population, supplied water, estimation of water demands
- (3) Served areas, efficiency of supply, population served ratio, etc.
- (4) Present situation of the waterworks facilities
 - a. Intake facilities....Numbers, capacities, water sources, intake amount, river discharge, durable years, quality of raw water, type of pump etc.
 - b. Conveyance, water transmission, distribution and service instalation.... Materials of pipes, diameter, pipe length, period of pipe laying, capacity of clear water reservoir, analysis of water leakage (method of detection and inspection systems and repair), construction method, situation and frequency of valves and hydrants
 - c. Purification facilities....Numbers, capacities, process of purification, chemicals, used chemical injection facilities, standard of water quality, inspection, purified water examination results, ability level of personnel
 - d. Maintenance of facilities....System of operation, inspection, repair, etc.
- (5) Prospects of future waterworks facilities
- (6) Technical Standard (Design Criteria Manual), Satandrd of Materials
- (7) Water rates system....metering, collection, water rate, installation condition and functional condition of water meters
- (8) Budget plan....local funds for this project
- (9) Techniques of construction, period according to budget, labour, wet season)

5. Present evaluation of waterworks ding analysis of causes)

5. Present evaluation of waterworks (including analysis of cause)

- (1) Techniques (man power)....situation or plan of training for operation and maintenance
- (2) Management system of water works (e.g. water quality control, distribution control)

(3) Stock of equipment (facilities and materials), existence of repair works factory

(4) Situation of finance (movement to improvement of management)

(5) Management plans for improvement

6. Relation to other administrative organizations (e.g. RID)

(1) Administrative organizations related to waterworks

(2) References (e.g. hydrological statistics, water quality statistics)

7. Adjustment of map or drawing in projected area

(1) Map of topography, roads

(2) Drawing of facilities

(3) Drawing of piping

(4) Process chart for facilities

8. Existing problems in PWA

Itemize each problem

(1) Problems about waterworks management

(2) Problems about planning

(3) Problems about design of water supply and distribution facilities

(4) Problems about design of purification facilities

(5) Problems about management of purification facilities

(6) Problems about management of water supply and distribution facilities

(7) Problems about construction and execution of various facilities

(8) Problems about control or water quality

(9) Problems about water supply meters

(10) Problems about maintenance techniques

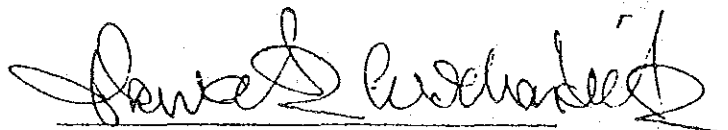
付-5 Scope of Work, Minutes of Meeting

SCOPE OF WORK
FOR
MASTER PLAN
AND
FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECTS
IN
THE KINGDOM OF THAILAND
AGREED UPON BETWEEN
PROVINCIAL WATERWORKS AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, 1985

細田三朗

Saburo HOSODA
Leader
JICA Preliminary Study Team



Dr. Tawat Wichaidit
The Governor
Provincial Waterworks
Authority

I. INTRODUCTION

In response to the request of the Government of Thailand, the Government of Japan decided to implement a Master Plan and a Feasibility Study on Provincial Water Supply Projects (Chiangmai, Ubon-Ratchathani, Suphanburi and Pattaya) in Thailand (hereinafter referred to as "the Study") within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of Thailand, signed on November, 1981.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, will undertake the study, in accordance with the relevant laws and regulations in force in Japan and in close cooperation with the authorities of Thailand. The Provincial Waterworks Authority (hereinafter referred to as "PWA") shall act as counter agency to the Japanese Study Team and also as a coordinating body in relation with other relevant organizations for the smooth implementation of the study. The present document sets forth the Scope of Work for the study.

II. OBJECTIVE OF THE STUDY

The objective of the study is to prepare a Master Plan (long term basic plan) for the Provincial water supply projects in Chiangmai Municipality and its Surrounding Communities Sansai, San-Kamphaeng, Saraphi and Hang Dong, Ubon-Ratchathani Municipality, Warin Chamrap Municipality Suphanburi, and Pattaya up to the next 20 years, (2006) and to carry out a feasibility study (short term development plan) for a project selected from the result of the Master Plan study.

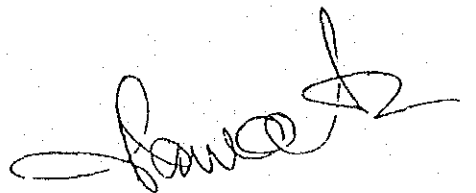
III. OUTLINE OF THE STUDY

The Study will be composed of field surveys and data collection in Thailand and of analysis works in both Thailand and Japan.

The items to be covered by the Study are as follows:

- (i) Phase I; Master Plan Study (Long term basic plan)
 - a. Data collection and analysis
 - b. Delineation of served areas for planning
 - c. Projection (estimation of population and Water demand etc.)
 - d. Study of existing water supply system (facilities, Management, and Organization etc)
 - e. Study of water sources (based on the available data)
 - f. Planning of appropriate water supply system (Organization, Operation and Management Plan)
 - g. Rough estimation of cost for construction, operation and maintenance
 - h. Preparation of implementation program
 - i. Identification of the project including immediate improvement and rehabilitation for the Feasibility Study.

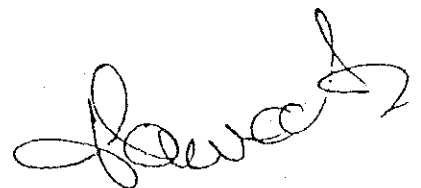
- (ii) Phase II; Feasibility Study (Short term development plan)
 - a. Delineation of project area
 - b. Estimation of population to be served
 - c. Estimation of water demand
 - d. Study of improvement of existing facilities
 - e. Study of water sources
 - f. Layout of facilities
 - g. Study for alternative plans



- h. Preliminary design (including design criteria)
- i. Study of construction materials and labour force
- j. Estimation of costs of construction, operation and maintenance
- k. Preparation of Construction method and procurement method of materials and equipments
- l. Study of Tariff System
- m. Estimation of benefits
- n. Economic Studies and Financial analysis
- o. Study of organization, operation and management plan
- p. Preparation of implementation schedule.

IV WORK SCHEDULE

The study will be conducted in accordance with the tentative schedule as shown in the Annex I herewith attached.



V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Thailand.

- 1) Inception Report
 - Copies 30
 - . at the beginning of the Field Survey (Master Plan Study)

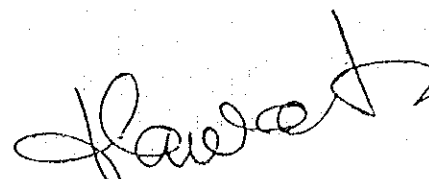
- 2) Progress Report
 - Copies 30
 - . at the end of Field Survey (feasibility study)

- 3) Interim Report
 - Copies 30 each
 - . within 3 months from the beginning of the Master Plan Study
 - . within 7 months from the beginning of the Feasibility study

- 4) Draft Final Report
 - Copies 30
 - . within 10 months from the beginning of the feasibility study

- 5) Final Report with summaries
 - Copies 50 each
 - . within 16 months from the beginning of the Master Plan study
 - . within 13 months from the beginning of the Feasibility study

The PWA shall submit her comments to JICA within one month after the receipt of Draft Final Report.



VI. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand dated November 5, 1981, the Government of the Kingdom of Thailand shall accord benefits to the Japanese study team as follows:-

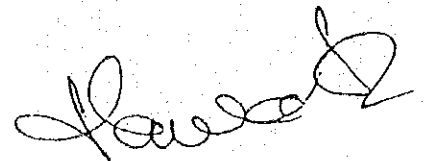
- (1) to permit the members of the Japanese study team to enter, leave and sojourn in Thailand for the duration of their assignment therein and exempt them from alien registration requirements and consular fees,
- (2) to exempt the members of the Japanese study team from taxes, duties and any other charges on equipment, machinery and other materials brought into Thailand for the conduct of the Study,
- (3) to exempt the members of the Japanese study team from income taxes and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese study team for their services in connection with the implementation of the Study,
- (4) to bear claims, if any arises against the members of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Japanese study team.

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2. To facilitate smooth conduct of the Study, PWA shall take necessary measures in cooperation with other relevant organization;
 - (1) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
 - (2) to secure permission for the study team to take all data and documents (including photographs) related to the Study out of Thailand to Japan.
 - (3) to provide the medical services as needed (Its expenses will be chargeable on members of the Japanese study team),
 - (4) to ensure the safety of the members of the Japanese study team when and as it is required in the course of the Study.

3. PWA shall, at its own expense, provide the Japanese study team with the followings:
 - (1) available data and information related to the Study,
 - (2) counterpart personnel,
 - (3) suitable office space with necessary equipment,
 - (4) credentials or identification cards.

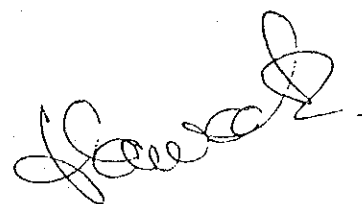


VII. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures,

- (1) to dispatch, at its own expense, study teams to Thailand,
- (2) to pursue technology transfer to the Thai counterpart personnel in the course of the Study.

VIII. JICA and PWA shall consult with each other in respect of any matter that may arise from or in connection with the Study.



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ANNEX I

Tentative Schedule for Master Plan, Feasibility Study

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Master Plan	△ IC/R		△ IT/R													△ E/R
Feasibility Study					△ P/R					△ IT/R			△ D/R			△ E/R

* Remarks

■ In Thailand

□ In Japan

IC/R Inception Report
P/R Progress Report
IT/R Interim Report
D/R Draft Final Report
E/R Final Report

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MINUTES OF MEETING
ON
THE SCOPE OF WORK FOR THE MASTER PLAN
AND
FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECTS

AUG. 13, 1985
BANGKOK, THAILAND

細田 三朗

Saburo HOSODA
Leader
JICA Preliminary Study Team

DR. TAWAT WICHADIT

DR. TAWAT Wichaidit
The Governor
Provincial Waterworks Authority

MINUTES OF MEETING

The Japanese Preliminary Study Team and the Thai counterpart of PWA held a series of discussions during July 30 - August 13, 1985 concerning the Scope of Work.

The present minutes were prepared to confirm the main issues discussed and matters agreed upon both parties.

A. Both parties confirmed the followings :-

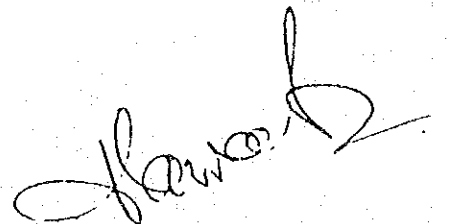
1. Scope of Work

The Japanese Study Team (hereinafter referred to as "the Study Team") shall implement a Master Plan and a Feasibility Study of Provincial Water Supply Projects in Thailand based on available data which the Study Team will study in cooperation with PWA, whose items are shown in Annex I.

- (1) The Master Plan will be selected by optimal solution by technical and economical evaluation.
- (2) Delineation of served areas for planning will be implemented in consideration of such as economic, geographical and related aspects.
- (3) Estimation of water demand will be implemented not only in terms of total demand but also divided in categories such as domestic, institutional, commercial and industrial demand.
- (4) The Study Team will implement the water sources studying on hydrological, hydrogeological, geophysical survey etc., based on such available data.

The Study Team will evaluate to determine the availability of alternative water sources.

- (5) In Feasibility Study, "Study for alternative plans" will include the selection of optimal plan.
- (6) Estimation of benefits of optimal plan will be implemented not only in direct but also indirect aspects such as improvement of human health etc., in general terms.



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(7) Water leakage detection concerning preparation of drawings and systematic detection of pipe bursts, etc., will be surveyed, studied and prepared in "Study of organization, operation and management plan" so that the Water Leakage Detection Program will be implemented by PWA.

2. Undertaking of PWA

PWA shall, at its own expense, provide the Study Team with the followings :-

- Counterpart personnel : 3 Engineers, during the study period
- Non-technical personnel : 1 Clerk (Full Time), 1 Clerk (Part Time)
- Main Office : Space (10 personnels occupied) with necessary equipment

(Desk, Chair, Locker, Telephone (1) (local use),
Air Conditioning, in PWA H.Q.)

Field Office : Suitable office space with Desk, Chair, etc. at
Chiangmai, Ubon-Ratchathani, Suphanburi, Pattaya in
PWA Regional Offices

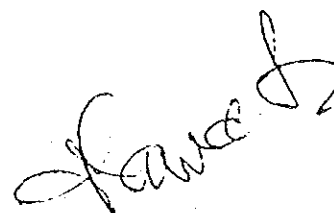
3. Technical Training

PWA requested that her counterparts will be invited to Japan for technical training, Japanese side promised to take the request for favorable consideration.

B : Attendants of the discussions :

1. PWA Side (Corporate Planning Department)

- Mr. PRAKIT Chanurai
Acting Chief, Planning Division
- Miss. ORAPIN Assavanig
Chief, International Cooperation Section
- Mr. PRAPON Chanakitjanukit, Engineer
- Mr. JAROON Upanan, Engineer
- Mr. SUTHEE Asawapichaid, Engineer



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2. Japanese Side

- Mr. Saburo HOSODA

Director of Riverhead Forestry Office, Bureau of Waterworks, TOKYO
METROPOLITAN GOVERNMENT

- Mr. Yoichi SEKI

Special Advisor to the Director, Social Department, JAPAN INTERNATIONAL
COOPERATION AGENCY

- Mr. Tsutomu NAGASAKA

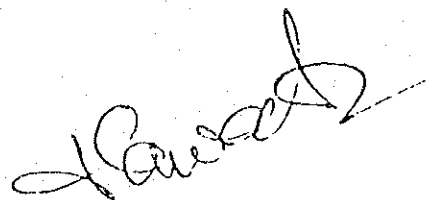
Engineer, Atsuta Office, NAGOYA WATERWORKS BUREAU

- Mr. Masuji IDE

Engineer, Northern Water Control Center, YOKOHAMA WATERWORKS BUREAU

- Mr. Hajime NISHIKAWA

Engineer, Water Supply Division, MINISTRY OF HEALTH AND WELFARE

A handwritten signature in cursive script, likely reading 'Hajime Nishikawa', is written in the lower right quadrant of the page.

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I. Importance of the Project

- (1) Relationship between the budget and the Relevant Development Plan.
- (2) Utilization Plan of technical transfer
- (3) Priority, urgency of the Project
- (4) Advantageous effect
- (5) Solved problem

II. Outline of four cities

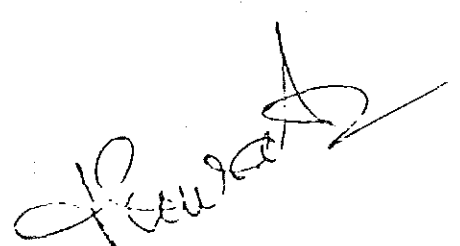
- (1) Data
 - Hydrology
 - Climate
 - Geography
- (2) Type of cities
- (3) The movement of population and economics
- (4) Order of importance of the cities
- (5) Arrangement of electricity supply, water supply and drainage situation
- (6) Characteristics
- (7) Public health

III. References

PWA

- (1) Laws and regulations
- (2) Purpose of activity
- (3) Organization
- (4) Management situation
- (5) Budget plan

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- (6) Future plan
- (7) Outline of PWA's undertaking
- (8) Process of decision making of budget and policy

Four cities

IV. Outline of four cities' waterworks

- (1) Statistics of facilities
- (2) Statistics of population and water demand
- (3) Served area
- (4) Present situation of the waterworks facilities
 - a. Intake facilities
 - b. Conveyance, water transmission, distribution and service installation
 - c. Purification facilities
 - d. Maintenance of facilities
 - e. Water sources
- (5) Prospects of future water works facilities (in details)
- (6) Technical Standard
- (7) Water rate system
- (8) Budget plan
- (9) Technique period, cost of construction

V. Present evaluation of waterworks (including analyses of causes)

- (1) Technique (man-power)
- (2) Management system waterworks
- (3) Stock of equipment, existance of repair works factory
- (4) Situation of finance
- (5) Management plans for improvement

VI. Relation with other administrative organizations

VII. Adjustment of map drawing in projected area

- (1) Map of topography, etc.
- (2) Drawing of facilities
- (3) Drawing of piping
- (4) Process chart for facilities

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5. 14

VIII. Existing problem in PWA

IX. Technical and economical cooperation by foreign countries or international organizations in recent years in relation with waterworks

X. Others

Forward

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PROVINCIAL WATER WORKS AUTHORITY ACT

1979

BHUMIBOL ADULYADEJ REX.

Given this 24th day of February 1979

Being the 24th Year of the Present Reign

His Majesty King Bhumibol Adulyadej has been graciously pleased to proclaim that:

Whereas it is expedient to establishing the Provincial Water Works Authority; Be it, therefore, enacted by His Majesty the King, by and with the advice and consent of the National Legislative Assembly, as follows:

SECTION 1. This Act shall be called the "Provincial Water Works Authority Act 1979"

SECTION 2. This Act shall come into force on and from the day following the date of its publication in the Government Gazette.

SECTION 3. In this Act:

"Board of Directors" means the board of directors of the Provincial Water Works Authority.

"Member of Board", means the member of the Board for Provincial Water Works Authority.

"Governor" means the governor of the Provincial Water Works Authority.

"Personnel" means the personnel of the Provincial Water Works Authority.

"Employee" means the employee of the Provincial Water Works Authority.

"Employee" means the employee of the Provincial Water Works Authority.

"Minister" means the Minister appointed for execution of this Act.

SECTION 4. The Minister of Interior is appointed for execution of this Act and empowered to issue the regulations for the purpose of this Act.

Chapter 1

Establishment, Capital Fund and Reserve Capital Fund

SECTION 5. There shall be established the authority cited as "the Provincial Water Works Authority" in short title as "PWWA". This newly established Provincial Water Works Authority shall be a juristic person having the objectives to engage in and promote the business of water works by conducting surveys, providing sources of water and procuring raw water for production, delivery and distribution of water including undertaking other business related to or in continuous from the water-

works; for the purpose of providing utilities services to the public giving primary consideration to the interest of the country and public health of the population.

SECTION 6. The Provincial Water Works Authority shall have its head office in Bangkok Metropolis and its branch office or agency may be established at any given location inside or outside the Kingdom but establishment of branch office outside the Kingdom is subject to the prior approval of the Minister.

SECTION 7. The Provincial Water Works Authority shall have the power to conduct any or various business within the context of its objectives pursuant to Section 5 and such powers shall include:

(1) to hold rights of ownership or rights to possession of various assets and the rights to construct, purchase, procure, sell rent, lease, hire-purchase, lend, borrow, take pawns, mortgage, exchange, assign, transfer, take a transfer or to conduct any act or acts in respect of such assets both inside and outside the Kingdom including such donated properties.

(2) to conduct surveys, planning and development of sources of raw water including procurement of raw water.

(3) to conduct surveys, planning and construct production system, delivery and distribution of piped water.

(4) to determine the selling prices of piped water, service charges, equipment cost and other facilities cost including methods and conditions in paying for such prices and considerations.

(5) to determine criteriards, methods and conditions in the use of piped water in the interest of providing utility service to the public.

(6) to prescribe regulations on use and maintenance of properties of the PWWA.

(7) to seek loans or borrowing both within and outside the Kingdom.

(8) to advance loans or borrowing with collateral security of property in the interest of engaging in and promoting the business of PWWA.

(9) to issue bonds or other instrument for a purpose of investment.

(10) to hold shares or enter into shareholding or joint venture with other person in the interest of engaging in and promoting the business of the PWWA.

SECTION 8. The PWWA shall have the power for the purpose of distribution of piped water in the areas outside the territory of the Metropolitan Water Works Authority. However, the PWWA may distribute piped water in the areas under the jurisdiction of the Metropolitan water Works Authority subject to the consent of the Metropolitan Water Works Authority.

SECTION 9. The Capital Fund of the PWWA consists of:

(1) Money and assets transferred pursuant to the provisions of Section 49 and Section 50 after reduction of liabilities.

(2) Money allocated pursuant to the National Expenditure Budget Act for a purpose of operating or expanding the business.

(3) Money or properties donated by outside persons.

SECTION 10. The Reserve Capital Fund of the PWWA consists of ordinary reserve fund established against shortage, reserve fund for expansion of business, reserve fund for redemption of mortgages or debts and other reserve funds as necessary for each individual purpose subject to the consent of the Board.

The Reserve Capital Funds may be spent with the consent of the Board only.

SECTION 11. The assets of the PWWA which is being used or to be used for the purpose of effective operations of the waterworks system shall not be subject to legal proceedings.

Chapter 2

Board of Directors and the Governor

SECTION 12. There shall be one board cited as "the Board of Directors of the Provincial Water Works Authority" consisting of the Chairman, the Director General of Public Works Department, Director General of Public Health Department, the Governor and not less than other seven persons as members of the Board.

The cabinet shall appoint the Chairman of the Board and other members of the Board. The Governor shall be the secretary to the Board.

SECTION 13. In the interest of the business of PWWA, the Board has the power to appoint the sub-committee to conduct any business of PWWA and the sub-committee is to report to the Board.

SECTION 14. The Chairman of the Board or members of the Board appointed by the Cabinet must,

(1) not be personnel or employee,

(2) not have mutual interests in the business engaged with PWWA or in other business competing with the business of PWWA whether directly or indirectly,

(3) have the required qualifications and have no other prohibitive characteristics pursuant to the law on Qualifications Criteria for members of the Board and personnel of the State Enterprises.

SECTION 15. The chairman of the Board or members of the Board appointed by the Cabinet shall be in office for a three-year term.

In case of a member of the Board appointed by the Cabinet vacates office before the expiry date of term of office or in case of new appointments to the office during the term of office the Cabinet-appointed committee the person appointed is resume or replace the vacant office and shall remain on office for the unexpired term of office of the appointed member of the Board.

Upon completion of term of office pursuant to paragraph one, if new appointment of the chairman or members of the Board has not been made, the chairman or members of Board who had completed his term of office is required to remain in office pending the appointment of a new chairman or members of the Board.

Chairman of the Board or members of the Board who vacated office at expiry date of term of office may be re-appointed but not more than two terms of office consecutively.

SECTION 16. Unless vacation office pursuant to the provision of Section 15, the Chairman of the Board or members of the Board appointed by the Cabinet shall also vacate office upon:

- (1) death
- (2) resignation
- (3) becoming a disabled or quasi-disabled person by the Court's Decree
- (4) absence from the Committee meeting more than three times consecutively without reasonable justifications.
- (5) being removed from office by the resolution of the Cabinet
- (6) lack of qualifications or having disqualifications pursuant to Section 14.

SECTION 17. The Board shall have the power and duties to lay out policy and to have general control of the business of PWWA. Such power shall include:

- (1) to prescribe regulations for the purpose of compliance with the provisions of Section 5 and Section 7,
- (2) to prescribe rules of meeting and functions of the Board and sub-committee,
- (3) to prescribe regulations on organization and administration of PWWA.
- (4) to prescribe regulations on functions of the governor and delegation of functions of the governor to other persons,
- (5) to prescribe regulations on job position, rate of salary, wage and other moneys of personnel and employees,
- (6) to prescribe regulation on position placement, appointment and raises in salary or wages, termination, dismissal of, disciplines, penalty and appeal against penalty of personnel and employee,
- (7) to prescribe regulations on filling grievances of personnel and employees,
- (8) to prescribe regulations on Welfare Fund or other welfare services of personnel and employees as well as their families with the consent of the Cabinet,
- (9) to prescribe regulations on transportation fees, travel expense, accommodations expense, overtime payment, meeting remunerations and other expenses,

- (10) to prescribe regulations on the uniform of personnel and employee,
- (11) to determine the selling price of price of piped water and rate of service charges including methods and conditions in payment of price and service charges,
- (12) to prescribe regulations on safety of use and maintenance of properties of PWWA.

SECTION 18. In the regulations pursuant to Section 17, if limitations of power of the Governor in entering into legal obligations is specified, the Minister is to announce such power in the Gazette.

SECTION 19. The Board shall appoint and determine the salary of the Governor subject to consent of the Cabinet.

SECTION 20. The Governor must:

- (1) have no interest in the business unengaged with the PWWA or in the business competing with the business of the PWWA whether directly or indirectly.
- (2) have the required qualifications or have no other prohibitive characteristics pursuant to the law on Qualifications Criteria for members of the Board and personnel of State Enterprises.

SECTION 21. The Governor shall vacate office upon,

- (1) death
- (2) resignation
- (3) being dismissed from the governorship by the resolution of the Board
- (4) Becoming disabled person or quasi-disabled person,
- (5) absence from the Board meetings more than two times consecutively without reasonable justifications,
- (6) lack of qualifications or have disqualifications pursuant to Section 20.

The resolution of the Board for dismissal of the Governor from office pursuant to (3) must have the votes of not less than three fourth of the total number of members of the Board in office except the Governor and such resolution must have the consent of the Cabinet.

SECTION 22. The Governor has the functions and power to handles the administration of PWWA in keeping with law and objectives, power and duties of PWWA and in keeping with the policies and regulations prescribed by the Board together with the power to have the command of personnel and employees of all levels.

The Governor shall be responsible to the Board in respect of administration of the business of PWWA.

SECTION 23. The Governor shall have the power:

- (1) to place on position, appoint, dismiss, promote, reduce, cut salary or

wages, prescribe disciplinary penalty on the personnel and employees including power to remove personnel or employee from position according to the regulations prescribed by the Board. If such personnel or employee is of advisory level, technical expert, director of department or equivalent position upward such removal shall be subject to the prior consent of the Board.

- (2) to prescribe working conditions for personnel and employee and to issue the regulations on operations PWWA not contravening or in conflict with the regulations prescribed by the Board.

SECTION 24. In the affairs dealing with outside person, the Governor shall represent the PWWA and for this purpose, shall delegate power to any person to act on his behalf in a particular type of function but such delegation of power must conform with the regulations prescribed by the Board.

Legal obligations entered into by the Governor in contravention of Section 18 shall not have any legal binding on the PWWA unless it is ratified by the Board.

SECTION 25. In case the Governor is unable to perform his duty or in case of vacancy which remains to be filled, the Board shall appoint any one personnel to be acting Governor.

The acting Governor shall have the some power of the Governor.

SECTION 26. The chairman of the Board and members of the Board shall receive remunerations according to the regulations prescribed by the Cabinet.

SECTION 27. The chairman of the Board, members of the Board and personnel may receive bonus according to the regulations prescribed by the Cabinet.

SECTION 28. In performing duty in accordance with this Act, the Chairman of the Board, members of Board and personnel shall be content officer according to the Penal Code.

Chapter 3

Installation and Maintenance of Production System, Delivery and Distribution of Piped Water

SECTION 29. In the interest of installing and maintaining the production system, delivery and distribution of pipd water such as raw water sources, pipes, water pumping facilites, water gauging device, storage tank, filtering plant, sedimentation basin and various equipment, the personnel and employee are authorized to use or take possession of immovable proparties, not residential quarters of any person, temporarily upon conditions as follows:

- (1) if such use or possession is necessary for the purpose of conducting surveys for installation or maintenance of production system, delivery and distribution of piped water or for prevention of danger or damage which may occur to production system, delivery and distribution of piped water.
- (2) when the PWWA has served an advance notice in writing to the owner or possessor of immovable properties within appropriate time, but not less than 7 days, if personnel contact can not be made of not less than 30 days will be posted at the site of such immovable properties and at the area or district office, subdistrict office and properties and at the area or district office, subdistrict office and village chief's office in whose jurisdiction such immovable properties are located, by giving time and date of such notice to be posted.

For the purpose of this Section, personnel or employee must produce the Identification Card to person involved.

In case the personnel or his co-workers performing duty according to this Section has caused damages to owner or possessor or title holder of such immovable properties, such indemnity could not be reached, the dispute shall be settled by arbitration and in this case the law on expropriation of immovable properties shall be applied *mutatis mutandis*.

SECTION 30. For the purpose of producing, delivering and distributing piped water, the PWWA has the power to lay the water pipe system and install equipment under, above, on, or across any properties if such properties are not being used as residential quarters.

The PWWA shall have the power to determine the dimension of land for the purpose of laying the water pipes and installing equipment with the width of not more than 2.50 meters from each side for the pipe of more than 80 centimeters in diameter upward and the PWWA is required to put up boundary marks within the said area in keeping with the regulations prescribed by the Minister.

Within the areas prescribed pursuant to paragraph two, the PWWA shall have the power to remove, dismantle any construction or any structure, cut or trundle the branches or roots of trees or other vegetations on the land by paying compensations for use of such land, removal or dismantlement of any construction thereon as the case may be, to its owner, possessor in the equitable amount unless the owner or possessor has been receiving worthwhile benefits from such use. In case settlement of the amount of compensation can not be reached, the provisions of Section 29, paragraph three, shall be applied *mutatis mutandis*.

When such compensation has been made to the owner or possessor of such land,

but the owner or possessor shall refuse to accept or not be entitled to receiving the compensation, no subsequent demand for such compensation shall be permitted.

Before carrying out the above action, the PWWA shall give a written notice to the owner or possessor of immovable properties concerned and the provisions of Section 29, paragraph one (2) shall be applied mutatis mutandis. Nevertheless, the owner or possessor of such property may file complaints expressing disagreements to such action to the Board for consideration within 30 days from the date of receipt of such notice. The decision of the Board regarding such complaints shall be final.

SECTION 31. Within the areas prescribed pursuant to Section 30, paragraph two, no person shall be permitted to construct any house or other structures, plant trees or carry out any acts which may cause danger or obstacles to the production system, delivery and distribution of piped water, unless a written permission has been obtained from the PWWA. In granting such permission, the PWWA may prescribe any required conditions. An array of houses, constructions, trees or anything erected or built thereon without permission from the PWWA, the PWWA shall have the power to remove, dismantle, cut down or doing any act or acts as it see fit without having to pay compensation for damage and at the entire expense of the violator.

SECTION 32. Under necessary and urgent circumstances for the purpose of preventing dangers or damages, the personnel and employees may enter the land or premises of any person in order to inspect, repair or rectify the production system, delivery and distribution of piped water. If the owner or possessor is present in the premises, an advance notification shall be given to such owner or possessor by the personnel or employee.

In carrying out actions according to paragraph one, during hours of sunset to sunrise, the prior consent of the owner or possessor of the premises must be obtained. If the owner or possessor is not present at such premises, a prior consent of other persons present at the premises must be obtained.

SECTION 33. When PWWA finds it necessary to acquire immovable properties for use in laying water pipes or installing the production system, if the agreement on transfer of title can not be reached, the immovable properties shall be expropriated according to the law on expropriation of immovable properties.

SECTION 34. Any person who obstructs the work of PWWA or its personnel or employee performing duties according to Section 29, Section 30, Section 31

or Section 32, shall be liable to imprisonment of not more than six months or fine of not more 5,000 Baht or to both.

Chapter 4

Filing of Grievances and Welfare Services

SECTION 35. The personnel or employees are entitled to file grievances or appeals in accordance with the regulations prescribed by the Board.

SECTION 36. There shall be established by the Welfare Fund or other welfare services for the welfares of its personnel and employees and their families when they are discharged from the job, met with accidents, sick, dead or subject to other conditions eligible for welfare services.

There shall be established a welfare fund or other welfare subvention pursuant to paragraph one. Contributions to the Welfare Funds, determination of category of eligibility for the Welfare Fund, payment of welfare fund and management of the Welfare Fund shall be in accordance with the regulations prescribed by the Board.

Chapter 5

Finanaces, Accounting and Audits

SECTION 37. The PWWA must make its annual budget by itemizing into Investment Budget and Operational Budget. For investment budget, it must be submitted to the Cabinet for information.

SECTION 38. For incomes received by the PWWA each year shall become the revenue of the PWWA for use as operational budget and after reduction of operational expenditures, and other consideration costs such as maintenance, depreciation, reserve capital fund according to Section 10 and contribution to the Welfare Funds or other subvention according to Section 36 and investment capital approved by the Cabinet, the balance thereform shall be delivered as State revenues.

If incomes are not sufficient to meet the expenditures according to paragraph one, except the Reserve Fund pursuant to Section 10 and the PWWA is unable to secure money from other sources, the Government shall subsidize the PWWA equivalent to the amount needed.

SECTION 39. The PWWA is required to open Deposit Account with the Bank of Thailand or other bank in keeping with the regulations prescribed by the Cabinet.

SECTION 40. The PWWA is required to lay and hold suitable accounting system business categorizing-according to other of importance and to keep its ledger accounts making entry of receipts and expenditures, assets and liabilities presenting a fair and true view of its business according to the type of work; together with the statements on which such items are based and to arrange for periodic audits of its accounts.

SECTION 41. The PWWA must make its Balance Sheet, Statement of Business Accounts and Profit/Loss Account to be presented to the auditor within 120 days from the end of the accounting years.

SECTION 42. The Office of the Auditor General of Thailand shall be appointed auditor to examine the finances of the PWWA.

SECTION 43. The auditor has the power to examine various books and accounts, and relevant documents of the PWWA. For this purpose, the auditor shall further have the power to question the chairman of the Board, members of the Board, the Governor, personnel and employees of the PWWA.

SECTION 44. The auditor must make the report of the audits and finances to be submitted to the Board within 150 days from the end of the accounting year for further submission to the Minister.

SECTION 45. The Board is required to submit the annual report of the operation of the PWWA to the Minister in which the activities of the PWWA during the past year and the policies of the Board, programs and projects to be implemented during the coming year are included.

The PWWA is required to publicize its annual report, balance sheet, statement business accounts, profit/loss account correctly certified by the auditor together with the conclusive report of the operations during the past year within 180 days from the end of the accounting year of the PWWA.

Chapter 6

Supervision and Control

SECTION 46. The Minister shall have the power of general supervision of the operations of the PWWA. For this purpose, the Minister shall order the PWWA to present facts, express opinions, make up reports or delay the action of the PWWA deemed to be in conflict with the Government policies or the resolutions of the Cabinet including the power to order the PWWA to comply with the Government policy or the resolutions of the Cabinet and to order the investigation of the operations of the PWWA.

SECTION 47. In case the PWWA has something to be submitted to the Cabinet, such submission shall be made through the Minister.

SECTION 48. Unless approved by the Cabinet, the PWWA shall not be permitted to carry out the following activities:-

- (1) Investment for expansion of old project or initiation of new project with the starting capital of more than five million Baht.
- (2) Borrowing or advancing loans of more than 5 million Baht.
- (3) Issuing or advancing loans of more than 5 million Baht.
- (3) Issuing bonds or other instruments for the purpose of investment.
- (4) Disposing immovable properties valued at more than 500,000 Baht.
- (5) Writing off assets valued at more than 100,000 Baht from its accounts as bad debts.

- (6) determining the selling price of piped water,
- (7) Holding shares or entering into partnership or joint venture with other in the interest of engaging in or promoting the business of the PWWA.

Interim

SECTION 49. An array of business, assets, rights, liabilities including budget and circulation capital for distribution of piped water in the provincial of the Public Works Department, the Ministry of Interior, for the parts related to the waterworks according to the joint decision of the Minister of Interior and the PWWA shall be transferred to be of the PWWA, within 90 days of the date this Act goes into force.

SECTION 50. An array of business, assets, rights, liabilities including the budget of the Department of Health, the Ministry of Public Health, for the parts related to the waterworks according to the joint decision to be made by the Minister of Public Health and the PWWA shall be transferred to be of the PWWA within 90 days from date this Act goes into force.

SECTION 51. The rights pursuant to Section 49 and Section 50 shall include the rights to utilize the royal properties belonged to the Public Work Department, the Ministry of Interior or the Department of Health, the Ministry of Public Health, for the parts related to the business and assets so transferred.

SECTION 52. Government officials or any employee of the Public Works Department, the Ministry of Interior and the Department of Health, the Ministry of Public Health, performing duty related to the business so transferred pursuant to Section 49 or Section 50 as the case may be, if voluntarily wishing to be transferred to be under the PWWA the intention of such transfer shall be submitted in writing to the Director of the Department to which one is attached within 30 days from the date this Act goes into force. Such government officials or employee may be transferred to be the personnel or employee of the PWWA as the case may be.

Employee pursuant to paragraph one shall include the employee on revolving fund for selling the piped water in the provincial area of the Public Works Department.

The Government officials or employee transferred to be the personnel or employees of the PWWA pursuant to paragraph one shall receive salary or wages including rights and other fringe benefits in the same amount as had previously been received for the time being pending formal job placement and appointment. However, the salary and wages of such appointments shall not be less than the salary or wages previously received.

SECTION 53. The transfer of the Government officials pursuant to Section 52

shall be regarded as being retired from the service due to dissolution of position in accordance with the law on Retirement Pension of Civil Servants.

The transfer of the employee pursuant to Section 52 shall be regarded as being retired from position due to dissolution of position of termination of employment without committing offense and shall be eligible to receiving bonus according to the Regulations of the Ministry of Finance on Employee Bonus.

In the interest of counting the tenurs of service for calculation of bonus or pension according to the Regulations of the PWWA (if any), any Government official or employee so transferred pursuant to Section 52 wishing to count one's tenurs of service with the Government before a transfer to be the personnel or employee of the PWWA as being uninterrupted may be permitted to do so upon notice of cancellation of receiving the bonus or pension.

A notice of cancellation of receiving bonus or pension pursuant to paragraph three must be served within 30 days from the date of such transfer. In case of the Government officials, such notice of cancellation shall be made in compliance with the law on Retirement Pension of Civil Servants. In case of employee, such cancellation shall be submitted in writing and duly signed to the Employer for further submission to the Ministry of Finance for information.

SECTION 54. Within 100 days from the date this Act goes into force pending the appointment of the Governor, the Board may appoint any member of the Governor and for this purpose, the provision of Section 14 shall be applied.

SECTION 55. Within two years from the date this Act goes into force, the Minister of Interior may appoint any civil official to any position in the PWWA such official is approved by the Ministry to which he is attached. Such official is entitled to receiving either one's previous salary or the salary of the new appointment in the PWWA and this purpose the provisions of Section 17(5), Section 20 on the law regarding the Civil Service and law on Qualification Criteria of members of the Committee and personnel of the State Enterprise shall not be applied the appointment of such official.

付-7 設計基準（水質基準を含む）

Design Criterion of PWA

And

Water Quality Standard of PWA

DESIGN CRITERION

1. Population estimation formula

Case A. If the population is less than 10,000 use Arithmetic Progression (A.P.) Find "K" from:

$$K = \frac{P_n - P_o}{n - o}$$

where:

P_n = Total population in the final year.

P_o = Total population in the first year.

$n - o$ = Number of year (the final year - the first year)

Case B. If the population is more than 10,000 use Geometric Progression

$$P_n = P_o(1+R)^{n-o}$$

where:

P_n = Total population in the final year.

P_o = Total population in the first year.

R = Rate of increasing

$n - o$ = Number of year (the final year - the first year)

Case C. In a big city/town, which has low increasing rate use the "Least Square Method". Compare the result with the Geometric Progression (G.P.) which has a very high increasing rate.

$$Y = a + bx$$

where:

Y = Total population

x = Number of year counting from origin.

$a = \frac{Y}{X}$

$b = \frac{XY}{X^2}$

2. Rate of Consumption

Use	Average Consumption l/c/d.
Resident	100 - 300
Department	100 - 200
Restaurant	50 - 150
Hotel	80 - 120
Department Store	10 - 15
Theater	8 - 15
Office	50 - 80
Bank	50 - 100
Hospital	200 - 400
School	30 - 60

2.1 One consumer estimated 6 person/family.

2.2 New distribution area, counting number of houses which the pipe line goes through.

3. Water Requirement

3.1 Design Period 10 years.

3.2 Max. daily demand = 1.5 x Average daily demand.

3.3 Max. hourly demand = 2.25 x Average daily demand.

3.4 Plant capacity = Max. daily demand.

4. Water Resource

4.1 Surface water, consider

- Rate of flow (normal, max., min.)
- Min. water level.
- Duration of lack of water.
- Duration of over flown water.
- Water right
- Water Quality.
- Availability of land.

4.2 Reservoir, Consider

- Storage area & Catchment area.
- Rain fall & Evapolation.
- Storage, water level (Max., Min.)
- Quantity of water flow in the reservoir.
- Calculation.
- Water Quantity.
- Owner of reservoir.

4.3 Ground water well:

- Yield point.
- Draw down.
- Well log.
- Distance between well.
- Water Quantity.
- Water right
- Pumping equipment capacity 70% of pumping test.

5. Different types of pump

- 1) Centrifugal pump.
- 2) Turbine pump.
- 3) Submersible pump.

6. Transmission pipe.

- Calculate flow in the pipe x 10% of plant capacity.
- Velocity is not less than 0.3 m/s.
- Max. Velocity flow.
 - For A/C pipe = 3 m/s.
 - G/S pipe = 6 m/s.
- Size of blow-off about $\frac{1}{4}$ - $\frac{1}{2}$ time of pipe.
- Install Gate and blow-off every 3 km.

Size of air blow:

Ø 1"	For Main pipe, not exceed.	Ø 4"
Ø 2"	"	Ø 5" - Ø 8"
Ø 3"	"	Ø 9" - Ø 15"
Ø 4"	"	Ø 16" - Ø 30"
Ø 6"	"	Ø 31" - Ø 36"

- Pipes laid through highway and railway must have prevention iron pipe of a size which is more than 100 mm. of the laid pipes.
- Use the Iron pipe lines through the municipality roads and Rural roads.
- Use any other pipes on side-walks.
- Use Iron pipe (Ductile iron pipe or G/S pipe) for the ground lining.
- Use G/S pipe \emptyset 12" and Class medium.
- Use A/C pipe class 20.
- Pipe lined on pipe support must use flange fitting.
- Pipes and facilities is according to PWA's standard.
- Iron pipe laid on the pipe support or on ground must install "Expansion Joint" every 20-30 meters distances.

7. Intake receiving

- Retention Period = 1.5 min

8. Mixing Tank

- Mixing period 1-5 min
- Velocity more than 1.5 m/s

9. Flocculation Basins

- Velocity 15-30 cm/s

10. Sedimentation Basin

- Retention period = 2-4 h
- Velocity less than 45 cm/min

11. Rapid Sand Filter

- Rate 120-150 m³/day/m²
- Back wash using pump or Elevated tank

Water at pressure = 1.5 kg/cm² and water quantity = 0.6 - 0.9 m³/m²/min and time about 10-15 min.

Sand Layer

- Sand thickness = 60 - 70 cm
- Sand, effective size 0.35 - 0.50 mm or Max. size 2 mm
Min. size 0.3 mm

Gravel layer

1. \emptyset 2.0 - \emptyset 2.8 mm 15 cm thick.
2. \emptyset 5.6 - \emptyset 8 mm 10 cm thick.
3. \emptyset 16 - \emptyset 23 mm 15 cm thick.
4. \emptyset 38 - \emptyset 54 mm 20 cm thick.

Upper Sand, gravel conform to PWA. Standard.

12. Clear Well

Approximate = $\frac{1}{3}$ - $\frac{1}{2}$ time of max. daily demand.
Min. = $\frac{1}{4}$ time of max. daily demand.

13. Elevated tank

Approximate = 1 - 3 h of max. daily demand.

14. Distribution pipe

1. Pressure not less than 1 kg/cm²
2. Install gate valve every 1 km distance.
3. Install air valve and scour valve.

15. Chemical Feeding

CaO, Alum. - If alkalinity more than 20 ppm use alum.
- If alkalinity less than 20 ppm use alum & CaO

16. Chemical feeding depend on water quality testing from Laboratory.

- Alum solution about 5-10 mg/liter (ppm.)
- Use CaO before alum.

17. Pumping Equipment

17.1 Pumping equipment

- Number of pumping equipment.
- 110% of plant capacity.

Flow Rate. m ³ /day	Working pumping equi. & Stand by pumping equ.	Total
Up to 2,800	1 (1)	2
2,500 - 10,000	2 (2)	3
More than 9,000	More than 3 (1)	More than 4

17.2 High pumping equipment

- Max. h = 2.25 time of average daily demand.
- Number & Size of pumping equipment.

m ³ /hr.	Working pumping equipment Stand by pumping equipment	Total
125	2 (1)	3
120 - 450	Big 1 (1) Small 1	2 1
More than 400	Big 3 (1) Small 1	More than 4

Remark () = Stand by
 Big one = 50% of max. h demand.
 Small one = 25% of max. h demand.

17.3 To Calculate size of pumping equipment from the Formula .

$$\text{Size of pump} = \frac{Q \times H}{270 \times \text{eff}} \text{ hp.} \times \text{Safety factor.}$$

$$Q = \text{m}^3/\text{h}$$

$$H = \text{m}$$

Efficiency of pump

- Small one = 0.60
- Big one = 0.75 - 0.80

Safety factor

- Electric Motor pump 1.25
- Diesel pump 1.33

Max. revolution 1,500 rpm

18. Suction pipe

- Max. flow 1.3 m/s
- End of Suction pipes more than 1.5 time of ϕ suction pipe lower than Min. level water.
- End of Suction pipe is higher than 0.8 time of ϕ suction pipe.
- Distance of suction pipe between the wall, more than 1.5 time of ϕ suction pipe.
- Distance between suction pipe of each pumping equipment must be 3 time of ϕ of highest suction pipe.

19. To install pumping equipment, must have

1. Foot valve in the suction pipe to protect the returning flow, except such as positive suction head.
2. Gate in suction pipe in Positive Suction Head.
3. Gate in the transmission pipe to adjust Rate of Flow from pumps.
4. Check Valve to protect Returning flow.
5. Vacuum gauge & Pressure gauge.
6. Sampling cock & drain cock.
7. Water level gauge (In case of Deep well)

20. Disinfection

Rate of closing must have free residual chlorine at the end of the pipe ≥ 0.2 ppm

PWA's Water quality standard is held according to drinkable water standard UDC. 257/1-2521

1. Scope

1.1 This standard is said about properties, branding, sampling, acceptable concentration and drinkable water testing and water used for food and soft drink.

2. Definition of Terms.

2.1 Platinum-cobalt scale = Color measuring unit.

2.2 Silica scale unit = Turbidity measuring unit.

2.3 Standard plate count = Colony of Bateria/cm³. (when feeding in the limited food, Temperature and time)

2.4 MPN (Most probable Number of Coliform Organism found out from feeding the organism in the proportional water sample solution.

3. Properties

3.1 The standard drinkable water must conform Part 2 of the figure 1, Part 2 of the figure 2 and the figure 3 and 4

3.2 If the properties difference from cause 3.1, it will not conform this standard document. (No. 1-2521)

Figure 1 Phisical Property

Part 1 Item	Part 2 Maximum acceptable - concentration	Part 3 Maximum allowable concentration
Color (Platinum-cobalt scale)	5	15
Test	Unobjectionable	Unobjectionable
Odour	Unobjectionable	Unobjectionable
Turbidity (Silica scale unit)	5	20
PH range	6.5 - 8.5	< 9.2

Figure 2 Chemical Property

Part 1 Item	Part 2 Maximum acceptable concentration (mg/Dm ³)	Part 3 Maximum allowable concentration (mg/Dm ³)
Total solids	500	1,500
Iron (Fe)	0.5	1.0
Manganese (Mn)	0.3	0.5
Iron (Fe) & Manganese (Mn)	0.5	1.0
Copper (Cu)	1.0	1.5
Zinc (Zn)	5	15
Calcium (Ca)	75	200
Magnesium (Mg)	50	150
Sulphate (So ₄)	200	250***
Chloride (Cl)	250	600
Fluoride (F)	0.7	1.0
Nitrate (No ₃)	45	45
Alkye benxyl sulfonates (ABS)	0.5	1.0
Phenolic substances as phenol	0.001	0.002

Remark

* The maximum allowable in part 3 is accepted to use for water supply or ground water which are necessary to temporarily drink and the water which is conformed in part 2 and 3 not allowed to brand.

** If there is Ca⁺⁺ higher the max acceptable concentration and Mg⁺⁺ lower than the max acceptable concentration, should consider Mg⁺⁺ and Ca⁺⁺ in the term of total hardness. In the case, total hardness is calculated in term of CaCO₃ is less than 200 mg/Dm³, that water is according to the standard classification of water hardness in the followings:

- 0-75 mg/Dm³ = Soft water.
- 75-150 mg/Dm³ = Mean hard water
- 150-300 mg/Dm³ = Hard water
- up 300 mg/Dm³ = Very hard water

*** If there is So₄ = more than 250mg/Dm³, Mg⁺⁺ must not exceed 30mg/Dm³

Figure 3 Poisonous Substance

Item	Maximum acceptable concentration
Hg	0.001
Pb	0.005
As	0.05
Se	0.01
Cr. hexavalent	0.05
CN	0.2
Cd	0.01
Ba	1.0

Figure 4 Biological Property

Item	Maximum acceptable concentration
Standard plate count (colony / Dm ³)	500
MPN (Coliform Organism/100Dm ³)	2.2
E., coli	None.

JICA