Rerating Training Program Report

Water Efficiency Team Technology for the Establishment of Rerating (WETTER)

March 2000

Contract No: PCE-I-00-97-00039-00

This publication was produced for review by the United States Agency for International Development. It was prepared by Chemonics International Inc in association with The Institute for Public-Private Partnerships (IP3). The author's views expressed in this publication do not necessarily reflect the views of USAID or the United States Government.

PURSE / WET PROJECT

Private Participation in Urban Services - Water Efficiency Team

WATER EFFICIENCY TEAM
TECHNOLOGY for the ESTABLISHMENT of RERATING (WETTER)

RERATING TRAINING PROGRAM REPORT

WETTER Report No.: LIR-TP/00/22

Submitted by :

Chemonics International, Inc.,
Jakarta, Indonesia

In association with :

The Institute for Public-Private Partnerships (IP3)

March 2000

Under Contract Number : PCE-I-00-97-00039-00
United States Agency for International Development
Office of Urban Environmental Management
Jakarta, Indonesia

Chemonics International Indonesia
Wisma Kodel, 8th Floor, Jl. H.R. Rasuna Said Kav. B4 - Jakarta 12920 - Indonesia
Telp : (62 21) 5221461 - 5221462 Fax : (62 21) 5221460
e-mail : chemonic@rad.net.id

WATER EFFICIENCY TEAM
TECHNOLOGY for the ESTABLISHMENT of RERATING
(WETTER)

RERATING TRAINING PROGRAM REPORT

WETTER Report No.: LIR-TP/00/22

March 2000

The Water Efficiency Team Technology for the Establishment of Rerating (WETTER)

RERATING TRAINING PROGRAM REPORT

Table of Contents

Page

Appendices

List of Figures

List Of Tables

RINGKASAN EKSEKUTIF

Tim Effesiensi Air Bersih untuk Tehnologi Rerating (WETTER) memberikan program pelatihan rerating instalasi pengolahan air bersih kepada 19 PDAM di seluruh Indonesia.

Tujuan dari analisa rerating ini adalah untuk menentukan apakah kapasitas bisa lebih banyak diolah pada fasilitas yang ada sekarang ini sehingga menghasilkan tambahan pendapatan serta menurunkan ukuran dan biaya dari fasilitas yang sekarang dengan sedikit atau tanpa biaya tambahan sama sekali. Pendekatan ini dapat membantu meningkatkan keuangan PDAM dengan segera, menurunkan tarif yang berlaku terhadap pelanggang sekarang dan yang akan datang, dan dapat menjadikan proyek-proyek dimasa yang akan datang lebih menarik minat investor.

Analisa rerating ini merupakan suatu proses yang berurutan yang terdiri dari 3 langkah dasar yaitu :

1. **Analisa Operasional** dari kinerja Instalasi yang sekarang
2. **Proses evaluasi** dari masing-masing unit proses pada debit design dan pada tingkat debit yang lebih tinggi.
3. **Evaluasi Hydrolic** dari struktur instalasi pada debit yang lebih tinggi yang dipilih pada tahap ke dua

Pelatihan reratining ini terbagi dalam satu minggu seminar di Jakarta, yang dilanjutkan dengan 3 hari di Bandung, dimana para peserta melakukan analisa rerating pada instalasi pengolahan air bersih yang sebenarnya, yaitu IPA Cimahi. Para peserta menentukan apakah IPA Cimahi tersebut dapat direrating kapasitasnya **menjadi 73% lebih besar dari proyeksi design saat ini**, dengan peningkatan dalam kapasitas air hasil olahan menjadi 70 liter per detik.

Peningkatan kapasitas air hasil olahan dengan tanpa adanya tambahan biaya modal, akan menghasilkan **tambahan pendapatan sebesar Rp. 479 juta ($117,000) per tahun bagi PDAM**. Dengan begitu, konstruksi instalasi baru yang dibutuhkan di masa mendatang dapat ditunda atau berkurang.

Metodologi secara rinci perlu ditetapkan untuk melaksanakan prosedur rerating di kota-kota lain di Indonesia. Dengan metode pengajaran di kelas, pelatihan interaktif antar group, dan praktek langsung di instalasi pengolahan air, para peserta dapat belajar untuk melakukan prosedur rerating ke dalam situasi yang sebenarnya dan melaksanakan tehnik tersebut kepada instalasi mereka sendiri.

Sesi pelatihan untuk pelatih diberikan kepada para peserta guna menentukan pelatihan rerating selanjutnya di PDAM-PDAM lainnya. Semua materi diterjemahkan ke dalam Bahasa Indonesia untuk memfasilitasikan usaha tersebut. Para peserta menyatakan dalam questionnaire yang dibagikan pada akhir pelatihan bahwa mereka sangat menyatakan dalam questionnaire yang dibagikan pada akhir pelatihan bahwa mereka sangat terbantu oleh program ini dan semua peserta yang mempunyai instalasi pengolahan menyatakan akan melakukan rerating pada instalasi mereka.

Diusulkan untuk memberikan pelatihan di masa-masa yang akan datang kepada PDAM, bersamaan dengan pemilihan tempat yang sesuai untuk kunjungan lapangan dan beberapa pengembangan pada tema tehnis pelatihan.

EXECUTIVE SUMMARY

The Water Efficiency Team Technology for the Establishment of Rerating (WETTER) developed and administered a training program to members of 19 PDAMs throughout Indonesia on implementing rerating of water treatment plants.

The purpose of the rerating analysis is to determine if more water can be treated by existing facilities, at little or no additional cost, in order to generate additional revenues and to reduce the size and cost of any new facilities. This approach helps to immediately improve the finances of PDAMs, reduces the tariff impacts on existing and future customers, and makes future projects more attractive for private investors.

The rerating analysis is an iterative process consisting of three basic steps:

1. An **Existing Operations Analysis** of plant performance;
2. A **Process Evaluation** of each unit process at design flows and at higher flows;
3. A **Hydraulic Evaluation** of the plant structures at the higher flow selected in the second step.

The training course consisted of a one-week seminar in Jakarta, followed by three days in Bandung, where participants performed a rerating analysis on an actual water treatment plant: IPA Cimahi. The participants determined that IPA Cimahi could be rerated to a capacity of **73% more than current projected design**, an increase in finished water capacity of 70 liters-per-second.

This increase in finished water capacity, which required no additional capital, will generate additional **revenue of Rp 478 million ($117,000) per year for the PDAM.** In addition, construction of new treatment facilities required in the future can be delayed or be significantly smaller.

A detailed methodology is put forth for performing the rerating protocol in other cities in Indonesia. Using classroom lectures, interactive group exercises, and fieldwork in the water plant, the trainees learned to apply the rerating protocol to an actual situation and to apply this technique to their own plants.

A training-of the trainer session was given to the participants to encourage further training in rerating within the PDAMs. All materials were translated into Bahasa Indonesia to facilitate this effort. The trainees responded to questionnaires distributed at the end of the program that they found the program very helpful and that all of those with water treatment plants would seek to rerate their plants.

Future training sessions are proposed for other PDAMs, along with criteria for selecting future sites for field training, and some expansion of technical topics.

CHAPTER 1
BACKGROUND

1.1 Benefits of Rerating

A major area where many PDAMs can make dramatic improvements in efficiency is in optimizing its water treatment facilities. In this case, optimizing treatment facilities means obtaining more treated water from existing facilities, with little or no loss in the quality of water produced, and at little or no additional capital.

The major benefit, which results, is increased revenue for the additional water that is generated after the rerating process. The potential revenues are reduced by the amount of unaccounted-for-water lost in the distribution system and any marginal cost of treatment.

For example, if the rerated flow for a plant were 50% greater than the design flow, the theoretical revenues would increase by 50%. However, most distribution systems in Indonesia experience distribution system losses of 50%, meaning that half of the additional water produced generates no revenue.

In this case, a 50% rerating increase would still generate a 25% increase in PDAM revenues, at little or no cost to a PDAM. Additional marginal operating expenses of electricity and chemicals would be incurred to produce and distribute the additional water.

1.2 Rationale for Rerating

Water treatment plants are designed or "rated" at a given flow by the plant's designer. Once given this flow "rating," a water treatment plant is generally considered to be limited to treating this flow, and no more. The design flow or rating is determined by applying a design factor or value to each element in the plant: process equipment, piping, etc.

Good design practice dictates that the designer be "conservative" in the selection and application of these design factors. In practice, each designer applies design factors that have worked well in the past. These values often differ from one designer to another. Therefore, water treatment processes are often designed over a "range" of values.

Indeed, water treatment design books often specify a range, depending upon specific variables such as raw water turbidity, water temperature, and other factors. A design factor from the low end of the design range is sometimes too conservative: yielding a process or piece of equipment that is too large, with no increase in treatment or performance efficiency.

The design and ultimate rated capacity of a water treatment plant is actually the sum of many design factors. These factors size hundreds of components in the plant: pumps, piping, process tanks, and chemical feed systems. They also are used to calculate the vertical spacing of the process tankage known as the "hydraulic profile." All of these calculations are critical to determining plant capacity.

Yet, if one component is sized very conservatively, it may become the single determinant of plant capacity. Adjusting that one unit process may produce significant increases in capacity at little or no cost. Locating and adjusting that component, if it exists, is a key objective of the rerating process.

The typical values used to test the original plant design capacity must be carefully selected, using local conditions and practices. For example, many international design references often recommend design values for sedimentation basins that assume a "worst-case" settling condition in winter using northern climate assumptions. Since cold weather is not a factor in Indonesia, "less conservative" settling values can often be used.

1.3 Training Program Development

The training program was developed as an extension of work performed in Manado and Pontianak under the USAID-financed PURSE (Private Participation in Urban Services) Project in 1997 and 1998. The PURSE staff performed rerating analyses on water plants in those cities as a way of reducing needed private-sector investment and keeping resulting tariff increases to a minimum.

For example, PDAM Pontianak's water treatment plant was rerated from 288 liters-per-second to 425 liters-per-second, saving PDAM Pontianak over $1 million in avoided capital costs.

The training program was designed with the assistance of PERPAMSI who identified appropriate PDAMs, identified suitable individual candidates from the PDAMs, and selected an appropriate site to perform a full-scale rerating exercise.

The training program was developed to be a practical, results-oriented exercise for degreed engineers working within the PDAMs. A training-of-trainers element is included to ensure that other staff within the PDAM receive similar training as appropriate.

The program consisted of a one-week training seminar, followed by three to four days of fieldwork at a selected PDAM facility. The training seminar was designed to be informal, with questions and discussion from participants encouraged and welcomed.

The training seminar begins with the basic principles of water treatment, typical factors used in plant design, and troubleshooting of water treatment problems. These topics are introduced over the first two days for review and to serve as a basis for the actual rerating process.

The goals and specific steps to take in rerating were covered next. Also, the basics of plant hydraulics and the mechanics of hydraulic calculations were covered. These topics require two days. Several case studies are included to ensure that all training participants would be actively involved in the training and to ensure that all participants would be familiar with the rerating calculations. Participants would be broken into groups to perform the analysis and to present their findings to the other participants and instructors.

The fifth and last day of the training seminar is a full-scale case study which requires the participants in their groups to perform a rerating exercise on a hypothetical though realistic example. The full-day case study was developed to ensure that all participants had performed the necessary calculations and analysis for rerating prior to the actual field exercise in the following week.

The field exercise is intended to provide the participants with a "real-life" application of rerating to an appropriate water treatment facility. The best applications for rerating are plants that are relatively new (typically less than 15 years old) and for which there is demand for the additional water which will hopefully result.

Larger plants, greater than 50 liters-per-second capacity, provide the greatest likelihood for rerating and generate the maximum benefit for the PDAM. It is estimated that the field exercise will require 3-5 days, depending upon its location and the size and configuration of the water plant.

Two volumes of training materials are provided to the participants: Volume I—The complete slide presentations in notes form; and Volume II—Hydraulic Data and References.

CHAPTER 2
DESCRIPTION OF RERATING TRAINING PROGRAM

2.1 General

The rerating training program was delivered from February 28 through March 8, 2000 to 19 trainees representing 19 PDAMs. A listing of trainees and their respective PDAMs is included in Table 2-1.

TABLE 2-1: List of Rerating Trainees: February 27—March 8, 2000

Name	PDAM	City
Korwil I		
Ir. M. Suheiri	PDAM Tirtanadi	Medan
Ir. Reri Lazuardi Tanjung	PDAM Kota Padang	Padang
Ir. Firdaus	PDAM Tirta Mayang	Jambi
Korwil II		
Ir. Elandha	PDAM Kota Bengkulu	Bengkulu
Achmad Syarifudin, BE	PDAM Way Rilau	Lampung
Ir. Masjuri Masri	PDAM Tirta Musi	Palembang
Ir. Agus Pudjiarto	PDAM Kabupaten Bandung	Bandung
Ir. A. Yusuf	PDAM Kota Bandung	Bandung
Korwil III		
Firmansah, BE	PDAM Kota Balikpapan	Balikpapan
Ir. RHS. Heru Binowo	PDAM Kota Semarang	Semarang
Orin Retnowati, ST	PDAM Kota Surakarta	Surakarta
H. Rachmansyah, BE	PDAM Kota Banjarmasin	Banjarmasin
Korwil IV		
Ir. Aldin J. Sinae	PDAM Kabupaten Donggala	Donggala
Ir. Kartia Bado	PDAM Kota Makasar	Makasar
Moch. Taher, BE	PDAM Kabupaten Sorong	Sorong
Korwil V		
Drs. Ashari Mardiono	PDAM Kota Surabaya	Surabaya
Ir. Mohamed Hasyim Affandi	PDAM Kota Surabaya	Surabaya
G.A.K.A. Mahawintang, ST	PDAM Kota Denpasar	Denpasar
Drs. H. Abdul Kadir	PDAM Menang Mataram	Mataram

The trainees represented a wide geographic range of Indonesia: coming from Java, Sumatra, Bali, Lombok, Kalimantan, Sulawesi, and West Papua.

2.2 Classroom Sessions

The training seminar was conducted at the Hotel Bintang Griya Wisata in Jakarta. A listing of the specific topics covered during the one-week seminar is included in Appendix A.

The topics were developed in both English and Bahasa Indonesia. Training was delivered in English, with consecutive translation in Bahasa Indonesia by WETTER co-trainers. Most participants appeared to understand the English presentation, though they preferred to ask questions in Indonesian.

All participants were urged at the beginning of the seminar to actively question and comment on the presentation as it proceeded. Most did so and all sessions kept the participants active and involved in the sessions.

2.3 Fieldwork

All participants traveled to Bandung in order to perform a "real" analysis on a water treatment plant. Participants were split into four working groups and were asked to take the necessary measurements of process tanks to perform the rerating analysis.

The measurements and analysis required two days, with the third day used for presentations by each group of their findings and recommendations.

CHAPTER 3
RERATING METHODOLOGY

3.1 General

The overall intent of the rerating methodology is to determine the "true" treatment capacity of the plant: the maximum volume of water which can be treated with little or no additional capital cost, and with no degradation of finished water quality.

3.2 Rerating Process Description

The rerating analysis is an iterative process consisting of three basic steps:

1. An **Existing Operations Analysis** of plant performance;
2. A **Process Evaluation** of each unit process at design flows and if operated at higher flow;
3. A **Hydraulic Evaluation** of the plant structures at the higher flow selected in the second step.

These steps are described below. The Plant Rerating Decision Tree diagram is shown in Figure 3-1.

Existing Operations Analysis. Before determining that a plant rerating is possible, the performance of the existing plant must be established. As part of the first step, existing operating records are reviewed to ensure that the plant already meets prescribed finished water standards, prior to rerating.

Failure to meet prescribed standards at the design flow is cause for concern and may result in "derating" a plant to an even lower flow. If the plant fails to meet specified performance standards, the analysis must focus on why these standards are not met whether due to poor operating practices or due to poor design. Poor operating practices may be corrected, whereas poor design work often cannot.

Another factor to be evaluated in the Existing Operations Analysis is the age and condition of structures and equipment to be rerated. Equipment life is often estimated at 10-12 years for tax purposes. Yet, with proper maintenance, timely over hauls and replacing critical parts, equipment life can often exceed 20 years. Similarly, structures are often assigned a 25-year life for tax purposes, but can routinely last 40-50 years.

Inherent in the rerating process is the assumption that a rerated plant will continue to function well into the future, 10-15 years or more. Therefore, the ability of the existing plant to remain in operation for another 15 years or so must be established if rerating is to have its maximum intended effect.

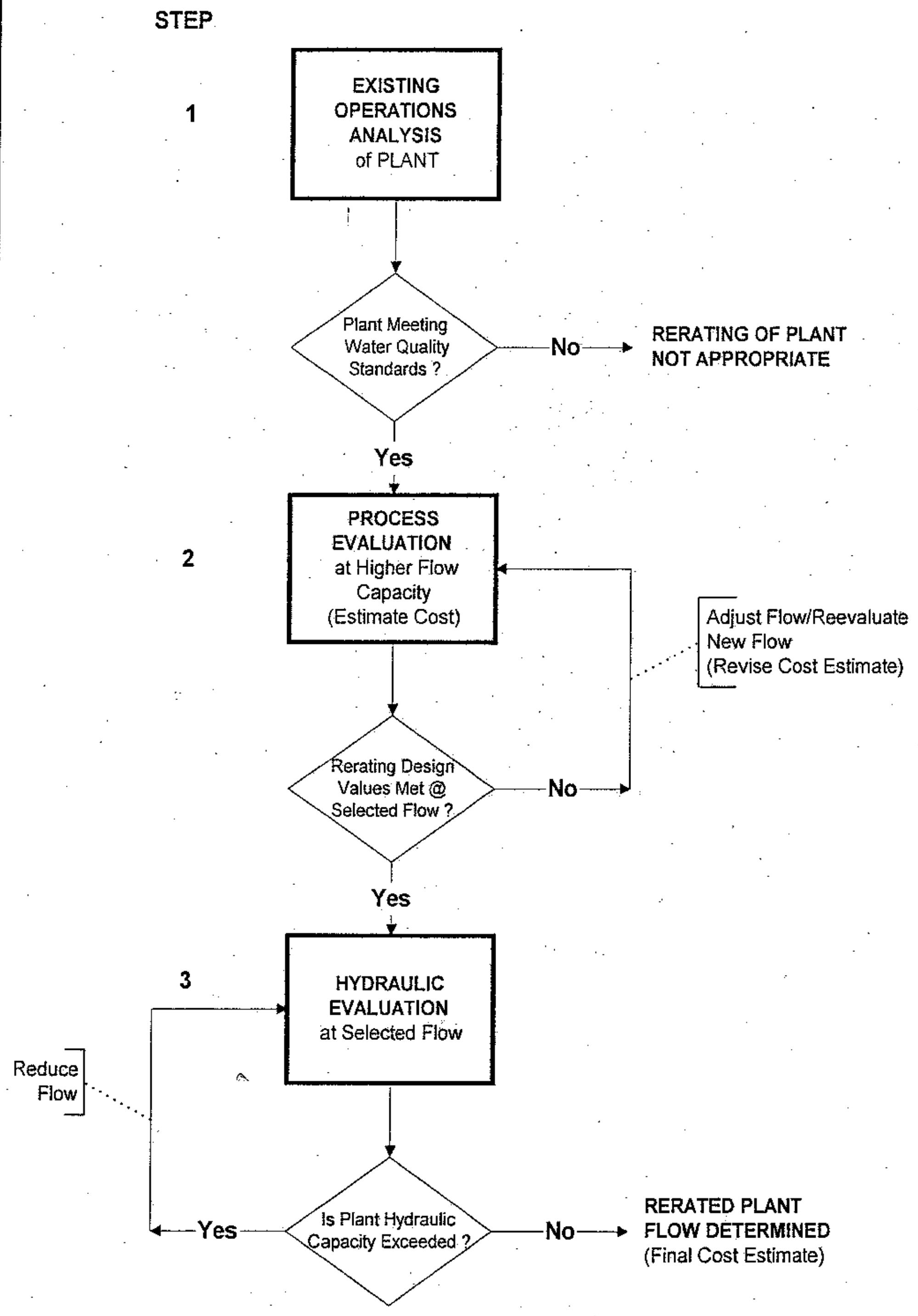

Figure 3-1. Plant Rerating Decision Tree

Process Evaluation. Following a successful Existing Operations Analysis, a Process Evaluation is performed on the water treatment plant. Each unit operation in the plant is first evaluated at the original design flow, using critical design parameters (e.g., for flocculators - minimum detention time at the design flow). These plant–specific design values are then compared to "typical" design values to ensure that the plant has adequate capacity for all unit operations.

Plant-specific design values that approach the typical, or "rerating" design values are noted, as these become the limiting criteria for the plant's ability to process more water. The process evaluation is then repeated again with higher flows, until the rerating design values are just met, but not exceeded.

Once the maximum process flow is determined, an initial estimate is made of the investment that may be required to achieve the proposed higher flow. It is possible that, while rerating design values are exceeded at the higher flow, additional plant capacity may be achieved with only minimal investment.

For example, a plant's capacity may be limited by its chemical addition facilities. For a small investment in an additional chemical pump cost of US$500, may be all that is necessary to provide for significant additional capacity. This capacity would be much more expensive to "purchase" by building new plant or in a plant expansion.

Another example of a relatively small investment that often produces big returns in additional capacity is the addition of tube-settler modules to existing sedimentation basins. These modules greatly increase the basins' flow capacity and overall effectiveness.

Other typical investments that are often easily justified for plant rerating include:

- Additional chemical feed pumps which are low in cost and require little space;
- Additional chemical feed points to optimize chemical mixing, flocculation and disinfection;
- Small air blowers, piping and diffusers to be used for supplemental air mixing and flocculation at higher flows;
- Small mechanical mixers to be used to increase chemical mixing efficiency;
- Simple baffle plates which are inserted at key points in sedimentation basins to eliminate short-circuiting of flow and which improve basin performance at higher flows;
- Replacing existing filter media during normal replacement with somewhat coarser media to reduce filter head loss at higher flows;
- Adjusting the height of various structures, using simple masonry block or brick, to accommodate higher water levels where required. This is often cost effective in channels and filter boxes;
- Adjusting the height and/or length of control weirs to reduce the effect of higher water levels at higher flows.

Once the most appropriate methods are selected for increasing plant capacity, a preliminary cost estimate is prepared to verify that obtaining needed additional capacity through rerating is indeed cost-effective.

In the event that the Process Evaluation determines that additional capacity could be obtained cost-effectively using these types of techniques, the rerating analysis continues to the Hydraulic Evaluation for a final feasibility determination.

Hydraulic Evaluation. Having determined the maximum process capacity that can be obtained with nominal investment, a Hydraulic Evaluation is performed to determine if the plant structures are capable of physically handling this additional flow without overflowing or flooding.

First, a hydraulic profile is prepared, using the proposed rerated capacity of the plant from the initial Process Evaluation. The hydraulic losses are calculated for the existing structures, using the proposed higher flow from the process evaluation step. These losses include friction losses in existing pipes, flow transition losses in pipe fittings and valves, additional losses over weirs and other flow controls, and other minor losses.

Using the higher flow from the Process Evaluation, a new water level (profile) is established for each unit operation. This new level is compared to critical (and fixed) structural elevations to ensure that units are not "flooded" by the Process Evaluation flow. In the event that minor water level problems are found, it is often cost-effective to merely "raise the wall" by several centimeters using concrete block, or to replace a small section of pipe to reduce head losses and the water level to remain within the structure.

However, it is often the hydraulic capacity of the plant that determines its rerating potential. Increasing the hydraulic capacity of the plant by installing larger pipes or relocating structures often cannot be justified. The costs are high, and the disruption to existing water service is inevitable and likely to be unacceptable.

For these reasons, the Hydraulic Evaluation usually determines the final rerating flow for a plant.

Once this final rerating flow has been established, the Process Evaluation is performed a final time to show the actual operating parameters for the treatment plant at the rerated flow. Also, a final cost estimate is made, based upon the calculated hydraulic capacity of the plant.

3.3 Raw Water Capacity vs. Finished Water Capacity

It is important to note the relationship between **raw water flow capacity** to the plant and the **finished water flow capacity**, which actually satisfies customer demand.

Most flow values used in the rerating analysis are **raw water** flows. Virtually all plant processes are actually sized using raw water flows.

However, Figure 2-1 shows how the raw water flow through a plant is reduced by recycle flows (settled sludge and filter backwash) from the plant processes. The resulting flow (raw water less recycle flows) is the **finished water flow capacity.**

The sludge and backwash flows typically represent 3-5% of the raw water flow, and are usually lost (returned) to the raw water source. This loss is unavoidable. This recycle water must be considered when determining the effect of rerating on serving future demand.

In fact, although raw water flows are used in the process and hydraulic calculations, the plant's rerated capacity is expressed in the finished water capacity which results after recycle flows are incorporated into the rerating calculations.

One potential effect of increasing the raw water flow to an existing plant is to increase the relative percentage of recycle flows. For example, if raw water flows are increased 15%, the plant filters may require backwashing twice as often. Thus, a 15% increase in raw water flow may only yield a 10% increase in finished water. These factors are weighed and accounted-for in the Process Evaluation step, when selecting a maximum flow value.

CHAPTER 4
RERATING ANALYSES FOR PDAM BANDUNG FACILITY

4.1 General

This chapter presents the results of the rerating analyses for IPA Cimahi plant of PDAM Bandung during the training program. IPA Cimahi is a conventional water treatment plant designed to treat 100 liters-per-second of raw water from the Cimahi River.

Constructed in 1991, the plant is a custom design, versus a package plant design. Steel package plants are often utilized in Indonesia for smaller flows. Package plants are highly susceptible to hydraulic upset and are generally poor candidates for rerating.

The data used in the rerating analyses included:

- Plant operating data;
- Raw water and finished water quality data;
- Field data (measured on-site by WETTER staff and training participants);
- Design data from as-built drawings;
- International and Asian design manuals;
- Construction drawings.

An Existing Operations Analysis was prepared for the Cimahi plant using raw water and finished water data for 1999. According to PDAM Bandung, IPA Cimahi produces high quality finished water which complies with Indonesian Drinking Water Standards.

The initial flow used for the Process Evaluation is the raw water flow necessary to produce a specified finished water flow, after recycle flows are subtracted. As indicated, the Cimahi plant was originally designed (rated) for a raw water flow of 100 liters-per-second (lps).

4.2 Existing Operations Analysis

WETTER staff and the trainees visited the Cimahi water treatment plant and observed plant operations, structures and equipment firsthand. In general, the plant appears to be well maintained and should continue to provide acceptable service in the years to come, if proper maintenance continues.

There is very little mechanical equipment, as raw water is fed to the plant by gravity and finished water is distributed by gravity. The flash mix and flocculation processes are completely hydraulic with no mechanical equipment. Chemicals are manually batched and fed by gravity. Even filter backwashing is accomplished hydraulically. Therefore, there is little or no mechanical equipment that might be susceptible to overloading or failure due to rerating.

Table 4-1 is a summary of typical raw water quality in 1999 from the Cimahi River source, typical plant performance parameters and the current Indonesian Drinking Water Standards promulgated by the Ministry of Health.

Table 4-1: Typical PDAM Bandung Raw Water and Finished Water Data—1999

Parameter	Raw Water (Cimahi River)	Finished Water	Indonesian Standards (1)
Color, units	5--21	1--3	15
Turbidity, NTU	2.1—14.5	0.3—2.5	5
pH, units	7.3—7.8	6.9—7.2	6.5--8.5
Organics, mg/L KMnO4	1.8—14.5	1.8—8.4	10

(1) Ministry of Health Regulation No. 416/MENKES/PER/IX/1990

All parameters are well within the Indonesian Drinking Water Standards.

The conclusion of the Existing Operations Analysis is that IPA Cimahi is operating well and should be evaluated further for rerating.

4.3 Process Evaluation

The IPA Cimahi plant is a conventional water treatment process, using the following processes:

- Flash Mix/Coagulation
- Flocculation
- Sedimentation
- Filtration
- Disinfection

Alum (aluminum sulfate) is added to promote coagulation and flocculation of turbidity. The floc particles are subsequently removed by sedimentation and filtration. Disinfection is accomplished with calcium hypochlorite and chlorine gas.

As indicated previously, the raw water fed to the plant and finished water distribution are both accomplished by gravity. No pumping is used.

The training team was broken down into 4 groups. Each group performed a Process Evaluation of the plant, beginning with its assumed 100 lps raw water design capacity. Each group took the physical measurements that it deemed necessary to perform the process evaluation and subsequent hydraulic calculations.

Each unit operation in the treatment plant was analyzed by the groups, using design parameters given in the training seminar, and compared to typical design values as described herein.

Each group was asked to present its findings to the other groups for comparison and critique. The results of the group presentations and discussion are shown in Table 4-2. The training instructor also performed a Process Evaluation, with the results also included in Table 4-2.

Table 4-2: IPA Cimahi Process Evaluation by Training Group

Group	1	2	3	4	Instructor
Group's Projected Rerated Flow, lps	**200**	**175**	**170**	**194**	**200**
Limiting Process	Flash Mix	Filter Backwash	Flash Mix/ Flocculation	Flocculation/ Sedimentation	Flocculation
Mitigating Measures Proposed by Group	Upstream Injection of Alum	Backwash Two Filters At Same Time	None	None	None

It was clear that most participants understood the issues and generally agreed upon the approximate process capacity of IPA Cimahi and the limiting process(es).

After a detailed discussion of each group's calculations and analysis, it was agreed that all groups would go forward to the Hydraulic Analysis using a flow of 200 lps.

4.4 Hydraulic Analysis

Following the Process Evaluation, each team performed a hydraulic analysis of IPA Cimahi at the proposed raw water flow of 200 lps. The Hydraulic Analysis was used to obtain the new water level (versus the rated flow) for each unit operation at the higher flow.

The hydraulic profile (water levels) through the plant changes primarily as a result of friction of water flowing in open channels and in the piping and valves. Other "losses" happen as a result of water flowing through filter media (sand) and over hydraulic control structures known as weirs.

Increased flows to the plant mean increased hydraulic losses, or a backup of water to a higher level. The purpose of the hydraulic analysis is to establish that the increased losses (backup) from the rerated flow will not cause overflows or flooding. The flow that produces flooding or overflow at any point in the plant then determines the hydraulic capacity of the plant.

To obtain the new hydraulic profile for the plant at the proposed rerated flow, a calculation of head loss was conducted by each of the four teams for each unit process in the plant. The calculation process moves from the downstream to the upstream direction or from the Clearwell back upstream to Flash Mix Tank.

Table 4-3 is a summary of the teams' presentations with their calculation of the limiting hydraulic flow and the point at which the hydraulic limitation occurs. The training instructor also performed a Hydraulic Evaluation, with results included in Table 4-3.

Table 4-3: IPA Cimahi Hydraulic Evaluation by Training Group

Group	1	2	3	4	Instructor
Group's Projected Rerated Flow, lps	**200**	**175**	**200**	**174**	**175**
Limiting Process	None	Clearwell--Filter Section	None	Clearwell--Filter Section	Clearwell--Filter Section

A detailed discussion concerning the assumptions and calculations followed each teams's presentation. Following these discussions, it was agreed that hydraulic capacity between the clearwell (reservoir) and the filters was the limiting hydraulic section and that <u>175 lps was the hydraulic capacity of the IPA Cimahi plant.</u>

4.5 Cimahi Rerating Conclusions

From the combination of the Process Evaluation and the Hydraulic Evaluation of the Cimahi Plant, it was agreed by the participants that:

1. **Process Capacity.** The process capacity of IPA Cimahi is 200 lps, with chemical mixing, coagulation and flocculation being the limiting processes. Little or nothing can be done to increase this capacity without significant capital improvements.

2. **Hydraulic Capacity.** The hydraulic capacity of IPA Cimahi is 175 lps, with the 250-mm pipeline between the filters and the downstream reservoir limiting capacity. An additional pipeline (approximately 750 meters) could be run to the existing clearwell or to a new one. Either step would allow the capacity of the plant to increase to 200 lps which is the process limit.

3. **Final Rerated Capacity.** Without any new investment, the rerated flow of IPA Cimahi is 175 lps. This is the raw water flow. **The estimated finished water output which results is approximately 167 lps, a 73% increase over the original finished water flow.**

These conclusions were formally presented to, the Director Utama of PDAM Bandung. Drs. Ishak was quite pleased with the results of the rerating analysis. The

Research and Development Director of PDAM Bandung, Ir. Joedi Herijanto, asked several questions relating to a proposed expansion of IPA Cimahi to 250 lps. A consultant is now looking at an expansion.

The value of the rerating analysis to both current revenues and avoided capital costs are discussed in the following chapter.

CHAPTER 5
COST: BENEFIT ANALYSIS OF CAPACITY RERATING

5.1 General

A major benefit of rerating a water treatment plant is the increased revenue from the sale of additional water. More water is available for sale, which increases revenue immediately to the PDAM.

A second major benefit is the reduction in the size and cost of any new treatment facilities, or postponing construction of new treatment facilities. This effect will reduce the water tariff impact on the consumer in the future.

5.2 Operating Revenue and Cost Impacts On PDAM Bandung

The rerating training has established a final raw water capacity of 175 lps for IPA Cimahi. The resulting finished water output is approximately 167 lps, or a **73% increase in finished water capacity** over the original design flow.

No structural modifications are required for the existing treatment plant or to the distribution system to achieve this increase in water sales.

The cost of chemical addition (alum and calcium hypochlorite) is the only cost that would increase as a result of rerating the plant. Table 5-1 shows the estimated increase in chemical costs for treating the additional 75 lps of raw water.

Table 5-1: Additional Chemical Costs From IPA Cimahi Rerating

Chemical	Dosage, mg/L	Increase in Usage, Kg/Year	Unit Cost, Rp/Kg	Increased Operating Cost, Rp/Year (000)
Alum	16.5 mg/L	39,107	Rp 1,100	43, 018
Chlorine	0.70 mg/L	1,643	Rp 4,000	6,570
Total Additional Chemical Cost				**Rp 49,588**

No additional electrical costs are incurred, since there is no raw water or finished water pumping in IPA Cimahi. Filter backwashing is also accomplished without pumping.

At the current tariff of Rp 700 per cubic meter, the additional revenue that result from a 73% increase in finished water is more than Rp 1.5 billion. However, like most PDAMs in Indonesia, PDAM Bandung operates with a high unaccounted-for-water level of about 40%. This means that 40% of the additional capacity is lost to leaks, meter inaccuracy, and theft.

Table 5-2 shows the net benefit of rerating to PDAM Bandung, after allowing for additional chemical costs and unaccounted-for-water.

Table 5-2: Total Marginal Revenue From Rerating IPA Cimahi (000)

Potential Gross Revenues	Rp 1,545,264
Less Unaccounted-For-Water @ 40%	(Rp 618,106)
Less Additional Chemical Costs	(Rp 49,588)
Total Marginal Revenue	**Rp 877,570**

The total marginal revenue to PDAM from the rerating of IPA Cimahi is Rp 878 million per year, or approximately $117,000 per year. This economic benefit is realized with no additional capital costs required to achieve the rerating of the plant.

5.3 Future Impacts of IPA Cimahi Rerating

As future water demand arises and even the rerated capacity of IPA Cimahi is exceeded, a new water treatment plant expansion will be required. PDAM Bandung's Research and Development Director has indicated that a consultant is currently evaluating an expansion of IPA Cimahi from 100 lps to 250 lps.

An expansion of existing clearwell capacity would most likely be required at this new flow. An additional pipeline from IPA Cimahi would also be required, removing the current hydraulic limitation of 175 lps and increasing the rerated capacity to the process limitation of 200 lps.

Thus, the required new plant capacity to achieve a total capacity of 250 lps would only be 50 lps, or 1/3 the new capacity required if the original plant capacity of 100 lps were used. While not calculated for this training program, the capital cost savings in this case are obviously significant.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS OF RERATING TRAINING PROGRAM

6.1 IPA Cimahi Rerating

Based upon a detailed Process Evaluation and a subsequent Hydraulic Evaluation, WETTER recommends that PDAM Bandung formally rerate the capacity of the IPA Cimahi plant.

WETTER recommends that IPA Cimahi be rerated to 175 lps. This rerated capacity represents a 73% increase in finished water capacity, when compared to the plant's original design capacity of 100 lps.

The **net increase in revenue** from rerating for PDAM Bandung is **Rp 878 million ($ 117,000) per year.**

The plant rerating will also reduce the cost of new facilities, and/or delay the need for new facilities. Both effects will have positive impacts on customer tariffs.

6.2 Trainee Evaluation of Rerating Training

All trainees were asked to complete a course evaluation questionnaire at the completion of the training course. A copy of the questionnaire is included in Appendix D, along with a summary of responses.

From the responses, it seems clear that most trainees found the rerating training to be relevant and helpful to their individual situations. All but two stated their intent to apply the training to rerate their plants, or at least to perform the analysis. The two trainees who stated they would not apply their training to the specific situations work at PDAM without central water treatment. In hindsight, these trainees may not have been appropriate candidates for this training course.

Virtually all trainees found the training materials to be suitable. Several trainees cited a desire for additional information on particular processes (e.g. Pulsator™ Clarifiers), which are not present in IPA Cimahi. However, the necessary information for rerating all conventional treatment processes was included in the training materials and would permit the trainees to rerate those plants.

While some participants felt that the training course (5 classroom days and 3 field days) should have been longer, all four training groups produced a detailed result within the eight days. This appears to indicate that the field time was appropriate. Future courses might require additional time for fieldwork, depending upon the sophistication of the trainees and the plant being evaluated.

Some participants cited the need for additional efficiency training, particularly in the area of unaccounted-for-water. While not the subject of this seminar, the impact of unaccounted-for-water on the benefits calculation for IPA Cimahi in Table 5-2 is testimony to the value of reducing unaccounted-for-water in distribution systems.

6.3 Application of the Rerating Process to Other Cities in Indonesia

The WETTER staff believes that this rerating analysis is valid for virtually all PDAMs with surface water treatment plants. If plant rerating is found to be feasible and the additional water saleable, the additional sales would be a significant new revenue source for PDAMs without raising tariffs or reducing staff. This additional revenue could be used to expand distribution systems, increasing revenue still further.

Rerating is only appropriate where the additional water produced by the rerating process can be sold. Sufficient demand and distribution capacities are the limiting factors for attempting rerating.

The rerating analysis can be used to verify that existing facilities are providing treated water of the proper quality. If not, the Process Evaluation can often determine the critical process that is responsible for poor performance. A recommended course of action can then be established. The Process Evaluation may establish that all unit processes are operating within acceptable design parameters. This may suggest raw water quality or poor operation as possible causes of poor performance.

The rerating analysis provides a systematic method for determining the maximum treatment capacity of the plant. Successfully rerating existing facilities for higher flow rates allows for a postponing construction, and a reducing the size of new facilities needed to meet future demand. Lower tariffs will result.

Engineers and technical PDAM personnel throughout Indonesia should be trained to conduct the rerating process and to train others within the PDAM. While 19 PDAMs received the initial rerating training, hundreds remain.

In the future, training priority should be given to larger PDAMs with extensive distribution systems. Larger plants have the most potential for rerating. Extensive distribution systems mean that the additional water produced from rerating can be sold. The effect on the PDAM "bottom line" will be felt within one month, when the new bills go out to customers.

The potential for similar or even greater savings than IPA Cimahi far exceeds the time and investment required. In time, rerating could become a standard process that a PDAM would undertake before considering a plant expansion or new plant construction.

6.4 Training Program Recommendations

The following are recommendations of the WETTER staff for developing and delivering future training on rerating.

A. Develop additional training materials on pumping hydraulics for raw water and finished water pumping systems.

B. Develop a prioritized listing of additional PDAMs to receive rerating training. Larger PDAMs with surface water treatment should be targeted.

C. Deliver training in blocks of about 20 PDAMs (people) to maximize training effectiveness and encourage trainee questions and participation.

D. Deliver training to 2 – 3 blocks to cover the likely number of PDAMs that would receive the maximum benefits from the rerating exercise.

E. Identify 2 -3 new sites for field training. The most appropriate sites would be:

- **Larger plants (> 100 lps)**
- **Near an airport (for ease in access for participants),**
- **A good candidate for rerating. Medan and Denpasar would both be good candidates and were represented by trainees in the first round of training. Pontianak would also be suitable.**

APPENDIX A
Rerating Training Outline

SUMMARY OF RERATING TRAINING TOPICS

Day One

- **Overview Of Water Treatment**
- **Troubleshooting Of Water Treatment Problems**
- **Special Water Treatment Problems**

Day Two

- **Disinfection Techniques**
- **Composite Performance Evaluation (CPE)**
- **CPE Case Study**

Day Three

- **Overview of Rerating Process**
- **Process Evaluation Techniques**
- **Principles of Plant Hydraulics**

Day Four

- **Hydraulic Evaluation Techniques**
- **Pump System Hydraulics**

Day Five

- **Rerating Case Study—Process Evaluation**
- **Rerating Case Study—Hydraulic Evaluation**

APPENDIX B
IPA Cimahi Process Evaluation

23-Mar-00

IPA CIMAHI--PROCESS EVALUATION

PROCESS	UNITS	DESIGN	RERATED FLOW	MINIMUM DESIGN VALUE	COMMENT
PLANT FLOWS					
Design/Rerated Raw Water Rate	M3/s	0.100	0.175		
Delivery Pipe Size	M	0.400	0.400		
Pipeline Velocity	M/s	0.80	1.39		Typical maximum velocity of 1.7 M/s
FLASH MIX					
Method		Hydraulic			
Number of Units	No	1	1		
Unit Length	M	1.70	1.70		
Unit Width	M	1.35	1.35		
Unit Depth (1.34 + Weir Depth from Table)	M	1.55	1.66		
Total Volume	Cu M	3.56	**3.81**		
Minimum Mixing Detention Time	**Mins**	**0.6**	**0.4**	**0.5**	**Marginal Capacity at Rated Flow**
Velocity Gradient (calculated)	**sec^{-1}**	**280**	**358**	**300**	**Adequate Capacity @ Rerated Flow**
Resulting GT		**9,953**	**7,787**		
FLOCCULATION					
Type		Hydraulic			
Number of Units	No	6	6		
Unit Area	Sq M	3.88	3.88		
Average Depth	M	5.75	5.75		From hydraulic profile
Total Volume	Cu M	133.9	133.9		
Flocculator Velocity	M/s	0.01	0.02		
Minimum Detention Time @ Rerated Capacity	**Mins**	**22.3**	**12.7**	**10**	**Adequate Capacity @ Rerated Flow**
Velocity Gradient (calculated)	**sec^{-1}**	**46**	**60**	**20-100**	
Velocity Gradient (estimated)	**sec^{-1}**	**50**	**50**		
Resulting GT		**61,058**	**46,156**	**11,250-72,000**	

23-Mar-00

IPA CIMAHI--PROCESS EVALUATION

PROCESS	UNITS	DESIGN	RERATED FLOW	MINIMUM DESIGN VALUE	COMMENT
CHEMICAL ADDITION--ALUM					
Maximum Feed Rate @ 20% Solution	kg/day	143	143		
Maximum Dosage Rate	**mg/L**	**17**	**9**	**50**	**Marginal Capacity @ Rerated Flow**
Storage at Maximum Dosing Rate	Days			30	
CHEMICAL ADDITION--LIME					
Maximum Feed Rate @ 10% Solution	kg/day	214	214		
Maximum Dosage Rate	**mg/L**	**25**	**14**	**As Required**	
Storage at Maximum Dosing Rate	Days			30	
SEDIMENTATION BASINS					
Type		Inclined-Plate			
Number of Units	No	2	2		
Unit Length	M	17	17		
Unit Width	M	4.46	4.46		
Unit Depth--Tank	M	4.15	4.15		
Unit Depth--Tubes	M	1.04	1.04		
Total Settling Area	Sq M	152	152		
Maximum Surface Loading Rate @ Firm Capacity	**M/hr**	**0.33**	**0.58**	**6.0**	**Adequate Capacity @ Rerated Flow**
Minimum Detention Time @ Firm Capacity	**Hrs**	**1.7**	**1.0**	**0.3**	**Adequate Capacity @ Rerated Flow**
Est. Sludge Production @ 0.075 kgs dry solids/M3	Kgs/Day	648	1,134		Estimated values
Sludge Production @ 1% Dry Solids	Cu M/Day	65	113		Estimated values
FILTERS					
Type of Filter Rate Control		Variable Declining Rate			

23-Mar-00

IPA CIMAHI--PROCESS EVALUATION

PROCESS	UNITS	DESIGN	RERATED FLOW	MINIMUM DESIGN VALUE	COMMENT
Number of Units	No	8	8		
Unit Length	M	5.2	5.2		
Unit Width	M	2.1	2.08		
Unit Area	Sq M	10.8	10.8		
Total Area	Sq M	87	87		
Media Depth					
Anthracite	M	0.45	0.45	0.6 M	
Sand	M	0.25	0.25	0.3 M	
Media Characteristics--Anthracite					
Effective Size	mm	1.6	1.6	1.0 - 1.6	
Uniformity Coefficient		1.35	1.35	1.2 - 1.4	
Media Characteristics--Sand					
Effective Size	mm	0.8	0.8	0.5 - 0.8	
Uniformity Coefficient		1.3	1.3	1.2 - 1.4	
Maximum Filter Loading Rate @ Firm Capacity--All Units	**M/hr**	**4.2**	**7.3**	**8.5**	**Adequate Capacity @ Rerated Flow**
Maximum Filter Loading Rate, 1 Out of Service	**M/hr**	**4.8**	**8.3**	**12**	**Adequate Capacity @ Rerated Flow**
Available Head Loss @ Maximum Filter Rate	M				
Estimated Filter Run Time	Hrs	96	36	12 - 36	Reduced run time @ rerated flow

23-Mar-00					
IPA CIMAHI--PROCESS EVALUATION					
PROCESS	**UNITS**	**DESIGN**	**RERATED FLOW**	**MINIMUM DESIGN VALUE**	**COMMENT**
Backwash Method	Gravity--No Surface Wash				
Backwash Rate	M/hr	58.17	58.17	36 -60	
Typical Backwash Duration	Mins	10	10	8 - 15	
Total Backwash Volume	Cu M/Day	210	559		
Total Backwash Volume, % of Raw Water	%	2.4%	3.7%	3 - 5%	
DISINFECTION					
Type		CaOHCl			Calcium Hypochlorite
Feed Capacity @ 20% Solution & 70% Available Chlorine	Kgs/day	17.4	17.4		
Minimum Dosage @ Maximum Flow	**mg/L**	**2.0**	**1.2**	**5**	**Marginal Capacity @ Rerated Flow**
Storage @ Maximum Flow	**Days**			**30**	
CLEARWELL					
Number of Units	No	2	2		
Reservoir 1	Cu M	1,000	1,000		
Reservoir 2	Cu M	2,000	2,000		
Total Reservoir Volume	Cu M	3,000	3,000		
Minimum Detention Time @ Firm Capacity	**Mins**	**50.0**	**28.6**		At Baffling Condition Factor of 0.1
Typical Free Chlorine Concentration	mg/L	0.5	0.6		Concentration can vary from 1 - 3 mg/l
Minimum CT Value at 1.5 log Reduction					
Minimum Temperature = 25 deg C & Maximum pH = 7.5	**mg/L-Mins**	**25.0**	**17.1**	**16**	**Adequate Capacity @ Rerated Flow**
FINISHED WATER DESIGN FLOW					
Raw Water Flow	M3/s	0.100	0.175		
less Sludge Flow	M3/s	0.001	0.001		
less Spent Backwash Flow	M3/s	0.002	0.006		
Finished Water Flow	M3/s	0.097	0.167		
Finished Water Flow	**l/s**	**97**	**167**		
% INCREASE IN FINISHED WATER ON RERATING	%	-	**73%**		

IPA Cimahi has been in operation for 9 years and was originally designed for a raw water capacity of 100 liters-per-second, with an estimated finished water capacity of 95 liters-per-second. The Process Evaluation of IPA Cimahi was prepared at a number of flows to determine the plant's maximum capacity at which water quality will be acceptable.

A process-by-process summary at 175 lps follows, along with the detailed analysis.

1. **Raw Water.** Raw water is introduced into IPA Cimahi by gravity through a 400-mm line with an estimated fall in elevation from the river to the plant of over 600 meters. Raw water feed is unlikely to be capacity limiting.

2. **Flash Mix/Flocculation.** The hydraulic flash mix design has the ability to handle the rerated flow since a typical minimum detention time of 30 seconds is not exceeded.

   Typical design guidelines suggest 10 to 30 minutes for proper flocculation. At the rerated flow, the detention time is almost 13 minutes, which is acceptable. In addition, the calculated velocity gradient (G) and 'GT' values, which are a measure of mixing effectiveness, are within the typical design values at both the design and rerated flows.

3. **Chemical Metering.** Alum is currently fed to the raw water by gravity from a tank above the Flash Mix Tank. There is no problem in adjusting this feed system to accommodate the rerated flow. Similarly, chlorine is fed by pressure to the finished water prior to the distribution system. There is no problem adapting this system to the rerated flow. Also, a calcium hypochlorite feed system is also available in the event that additional chlorine residual is desired at the higher flow.

4. **Sedimentation Basins.** Both the surface loading rate and detention time of sedimentation process are well within acceptable design values. At the design flow of 100 lps, the sedimentation basins were very conservatively designed. Even at the proposed rerated flow, the basins still have adequate capacity.

5. **Filters.** The filters are often the most critical unit operation in water treatment. The filters are responsible for capturing all floc particles and turbidity that escape the sedimentation basins. In addition to removal of solids, effective filtration improves the efficiency of subsequent disinfection, which is very sensitive to the level of solids in the finished water.

   The analysis of the filter process was conducted for two conditions of filter operations: all filter units in operation, and one unit out of service for cleaning. Cleaning occurs by first removing a dirty filter from service and then cleaning it by pumping clean water through the filter in the opposite direction. This operation is known as "backwashing" the filter. The length of time a filter operates between backwashes is known as the "filter run time." Both conditions occur every day in normal operation.

   The analysis shows that the IPA Cimahi Filter units have adequate capacity for both conditions at the rerated flow.

However, the filter run time at the higher rerated flow will likely decrease from the design value. As a result, the assumed filter run time was reduced from the current 96 hours to 36 hours between backwashing. This occurs because the filters will receive more solids to filter more quickly at the rerated flow. Therefore, the filter units will require backwashing more often.

The increased backwash frequency creates more recycle flow, thus reducing the amount of finished water that can be produced from a given amount of raw water. Nonetheless, the run time is still within the acceptable range at the higher flow.

6. **Disinfection / Clearwell.** IPA Cimahi uses two disinfection chemicals: chlorine gas and calcium hypochlorite. Calcium hypochlorite, which is similar to household bleach, is fed as a liquid by gravity, to the flash mix basin to control algae in the sedimentation basins. The chemical is readily soluble in water and can be made up to virtually any concentration, meaning that the calcium hypochlorite system can readily accommodate the rerated flow. The chemical contains 70 % available chlorine, which is the active agent used to kill or inactivate bacteria and viruses.

   IPA Cimahi also has been provided with gas chlorinators that feed chlorine by pressure. The gas chlorinators are capable of feeding the necessary chlorine dosage at the rerated flow.

   However, effective disinfection of drinking water relies both upon the dosage of chlorine and the time that the chlorine is in contact with the water before entering the distribution system. The product of these two variables: chlorine concentration (C) and disinfection time (T) is referred to as the "CT" value. In extensive studies the United States Environmental Protection Agency (USEPA) has determined that, with the processes found at IPA Cimahi, a CT value of 16 mg/L-minutes provides the necessary level of disinfection and contact time.

   Using the effective volume of the clearwell provided for finished water storage and the chlorine concentrations that can be provided to the finished water at IPA Cimahi, an acceptable CT value is realized at the proposed rerated plant capacity.

Summary. The Process Evaluation shows that the IPA Cimahi plant capacity may be rerated to produce a higher finished water output. The plant will conservatively process 200 lps of raw water, though the hydraulic capacity of the plant limits the rerated capacity to 175 lps.

APPENDIX C
IPA Cimahi Hydraulic Evaluation

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	**UNITS**	**DESIGN FLOW**	**RERATED FLOW**	**COMMENT**
Raw Water Flow Rate	*M3/s*	***0.100***	***0.175***	
Maximum Reservoir Water Elevation	M	**804.430**	**804.430**	
LOSSES--RESERVOIR TO FILTERS				
Losses to 250 MM pipe				
Q (full flow)	M3/s	0.100	0.175	
Pipe Diameter	M	0.25	0.25	
Pipe Area	M2	0.05	0.05	
Pipe Velocity	M/s	2.04	3.57	
Pipe Length	M	854	854	Estimated Length
Hazen Williams factor - C		100	100	
Friction Loss	M	21.62	60.89	
Velocity Head ($V^2/2g$)	M	0.212	0.648	
hf (Borda pipe entrance)	M	0.212	0.648	
hf--2-45 deg bends	M	0.085	0.259	
hf--4-90 deg bends	M	0.254	0.778	
hf--full size branch	M	0.318	0.973	
Q (half flow)	M3/s	0.050	0.088	
Pipe Diameter	M	0.40	0.40	

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	**UNITS**	**DESIGN FLOW**	**RERATED FLOW**	**COMMENT**
Pipe Area	M2	0.13	0.13	
Pipe Velocity	M/s	0.40	0.70	
Velocity Head ($V^2/2g$)--half flow	M	0.008	0.025	
hf--gate valve open	M	0.002	0.005	
hf--exit loss	M	0.008	0.025	
Total Reservoir to Filter Losses	M	22.501	63.578	
Water Surface at Filter Exit	M	**826.93**	**868.01**	
Weir Level At Filter Exit	M	**868.22**	**868.22**	**Not Flooded--Overflow at 868.42**
Loss at Filter Weir	M	0.13	0.19	Sharp Crested Weir; L = 0.9 M
Water Surface at Filter Weir	M	**868.35**	**868.41**	
Operating Water Level in Filters	**M**	**869.97**	**869.97**	
FILTER TO CLARIFIER LOSSES				
Open Channel to Butterfly Valve, Say	M	0.100	0.200	
Q (one seventh flow)	M3/s	0.014	0.025	1 Filter in backwash
Pipe Diameter	M	0.30	0.30	
Pipe Area	M2	0.07	0.07	
Pipe Velocity	M/s	0.20	0.35	
Velocity Head ($V^2/2g$)--one eigth flow	M	0.002	0.006	
hf (pipe entrance)	M	0.001	0.003	
hf exit	M	0.002	0.006	
hf--butterfly valve open	M	0.001	0.002	
Elevation At Bottom of Channel	**M**	**869.770**	**869.770**	

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	**UNITS**	**DESIGN FLOW**	**RERATED FLOW**	**COMMENT**
Water Surface at Sedimentation Basin Exit	M	**869.974**	**869.981**	Backwater in Channel
Elevation at Bottom of Gutters	**M**	**870.070**	**870.070**	Free fall from gutters to channel
CLARIFIER LOSSES				
Losses along gutter				
Q (one sixteenth flow)	M3/s	0.006	0.011	16 gutters; 8 per basin
Length	M	4.46	4.46	
Width	M	0.20	0.20	
Water depth in gutter	M	0.13	0.20	
Wetted Area	M2	0.03	0.04	
Velocity	M/s	0.24	0.27	
Head loss	M	0.021	0.019	
Water level at upstream of gutter	**M**	**869.92**	**869.99**	Top of gutter weir is at 870.37
Head Over Sedimentation Basin Weirs				
Q entering each basin	M3/s	0.050	0.088	
Number of Weirs/Gutter	No	80	80	
Total No. Weirs Per Basin	No	640	640	8 gutters per basin
Q through each weir	M3/s	0.0001	0.0001	
Head 90-notch weir	M	0.020	0.025	
Elevation of Bottom of weir	**M**	**870.320**	**870.320**	
Elevation of Water in Weir	**M**	**870.340**	**870.345**	
Top Level in Clarifier	**M**	**870.970**	**870.970**	**No Flooding in Sedimentation Basin**
FLOCCULATOR LOSSES				
Q (half flow)	M3/s	0.05	0.09	
No. of orifices per basin	No.	34	34	

IPA CIMAHI--HYDRAULIC EVALUATION

STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
Orifice diameter	M	0.175	0.175	
Pipe Area	M2	0.02	0.02	
Pipe Velocity	M/s	0.06	0.11	
Velocity Head ($V^2/2g$)	M	0.0002	0.0006	
hf (loss through orifices)	M	0.0005	0.0010	Qgpm = 19.636*(d)^2*H^0.5
Losses from sedimentation to flocculator No. 6				
Q (half flow)	M3/s	0.05	0.09	
Pipe Diameter	M	0.70	0.70	
Pipe Area	M2	0.38	0.38	
Pipe Velocity	M/s	0.13	0.23	
Pipe Length	M	17.90	17.90	
Hazen Williams factor - C		100	100	
Friction loss	M	0.0008	0.0024	
Velocity Head ($V^2/2g$)	M	0.0009	0.0026	
hf (bend 45)	M	0.0002	0.0005	
hf (entrance loss)	M	0.0004	0.0013	
Total Losses	M	0.0019	0.0052	
Water Level at Flocculator 6	**M**	**870.34**	**870.35**	Top slab of chamber is 870.82 M
Flocculator No. 6				
Design Flow	M3/s	0.100	0.175	
Depth of water	M	4.17	4.18	
Area	M2	3.88	3.88	As-built
Volume of water in chamber	M3	16.19	16.22	
Detention time each chamber	sec	162	93	
Velocity in chamber (straight) V1	cm/s	2.58	4.51	

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
G (velocity gradient)	sec^{-1}	30	50	
Head Loss	cm	1.25	1.98	
Velocity (bend/turning) V2	cm/s	21.9	27.5	
Area of opening	cm2	4,559	6,375	
Width	cm	85.00	85.00	
Height of opening	cm	17.00	17.00	

IPA CIMAHI--HYDRAULIC EVALUATION STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
Water Level at Flocculator 5	**M**	**870.35**	**870.37**	
Flocculator No. 5				
Design Flow	M3/s	0.100	0.175	
Depth of water	M	5.68	5.70	
Area	M2	3.88	3.88	
Volume of water in chamber	M3	22.06	22.12	
Detention time each chamber	sec	221	126	
Velocity in chamber (straight) V1	cm/s	2.58	4.51	
G (velocity gradient)	sec^{-1}	50	70	
Head Loss	cm	4.72	4.90	
Velocity (bend/turning) V2	cm/s	42.9	43.6	
Area of opening	cm2	2,329	4,017	
Width	cm	85.00	85.00	
Height of opening	cm	20.00	20.00	
Water Level at Flocculator 4	**M**	**870.40**	**870.42**	
Flocculator No. 4				
Design Flow	M3/s	0.100	0.175	
Depth of water	M	5.73	5.75	
Area	M2	3.88	3.88	
Volume of water in chamber	M3	22.24	22.31	
Detention time each chamber	sec	222	127	

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
Velocity in chamber (straight) V1	cm/s	2.58	4.51	
G (velocity gradient)	sec^{-1}	40	90	
Head Loss	cm	3.04	8.83	
Velocity (bend/turning) V2	cm/s	34.4	58.7	
Area of opening	cm2	2,903	2,983	
Width	cm	85.00	85.00	
Height of opening	cm	24.00	24.00	
Water Level at Flocculator 3	**M**	**870.43**	**870.51**	
Flocculator No. 3				
Design Flow	M3/s	0.100	0.175	
Depth of water	M	5.76	5.84	
Area	M2	3.35	3.35	
Volume of water in chamber	M3	19.30	19.56	
Detention time each chamber	sec	193	112	
Velocity in chamber (straight) V1	cm/s	2.99	5.22	
G (velocity gradient)	sec^{-1}	50	70	
Head Loss	cm	4.13	4.90	
Velocity (bend/turning) V2	cm/s	40.1	43.5	
Area of opening	cm2	2,492	4,025	
Width	cm	85.00	85.00	
Height of opening	cm	29.32	47.36	
Water Level at Flocculator 2	**M**	**870.47**	**870.56**	
Flocculator No. 2				

IPA CIMAHI--HYDRAULIC EVALUATION STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
Design Flow	M3/s	0.100	0.175	
Depth of water	M	5.80	5.89	
Area	M2	3.88	3.88	
Volume of water in chamber	M3	22.52	22.84	
Detention time each chamber	sec	225	131	
Velocity in chamber (straight) V1	cm/s	2.58	4.51	
G (velocity gradient)	sec^{-1}	60	80	
Head Loss	cm	6.94	6.40	
Velocity (bend/turning) V2	cm/s	52.1	49.9	
Area of opening	cm2	1,920	3,509	
Width	cm	85.00	85.00	
Height of opening	cm	22.58	41.28	
Water Level at Flocculator 1	**M**	**870.54**	**870.62**	
Flocculator No. 1				

IPA CIMAHI--HYDRAULIC EVALUATION				
STRUCTURE / HEAD LOSS	**UNITS**	**DESIGN FLOW**	**RERATED FLOW**	**COMMENT**
Design Flow	M3/s	0.100	0.175	
Depth of water	M	5.87	5.95	
Area	M2	3.88	3.88	
Volume of water in chamber	M3	23	23	
Detention time each chamber	sec	228	132	
Velocity in chamber (straight) V1	cm/s	2.58	4.51	
G (velocity gradient)	sec^{-1}	70	100	
Head Loss	cm	9.55	10.00	
FLOCCULATOR TO SPLITTER BOX/FLASH MIX				
Losses of pipe from flocculator to flash mix				
Q	M3/s	0.100	0.175	
Pipe Diameter	M	0.40	0.40	
Area	M2	0.13	0.13	
Pipe Velocity	M/s	0.80	1.39	

IPA CIMAHI--HYDRAULIC EVALUATION STRUCTURE / HEAD LOSS	UNITS	DESIGN FLOW	RERATED FLOW	COMMENT
Velocity Head ($V^2/2g$)	M	0.032	0.099	
hf (entrance loss)	M	0.016	0.049	
hf (exit loss)	M	0.032	0.099	
hf (2 standard elbows, 90)	M	0.025	0.077	
hf(butterfly valve)	M	0.010	0.030	
Pipe Length	M	3.50	3.50	
Hazen Williams factor - C		100	100	
Friction loss	M	0.009	0.025	
hf (entrance loss)	M	0.016	0.049	
Total Losses from Flocculator to Flash Mix	M	0.092	0.281	
Water Level Below Flash Mix Chamber Weir	**M**	**870.73**	**871.00**	**Acceptable level**
				Bottom of Weir at 871.79
FLASH MIX				
Q (total flow)	M3/s	0.100	0.175	
Head Loss Through Trapezoidal Weir	M	0.21	0.30	See Trapezoidal Weir Worksheet
Water Level At Flash Mix Chamber Weir	**M**	**872.00**	**872.09**	Acceptable level
				Top of weir plate is 872.39 M

The first step in constructing a new hydraulic profile for IPA Cimahi at the rerated flow is to calculate the losses from Clearwell back through the 250mm pipeline to the Filter units. The Hydraulic Evaluation shows the new water level at the Filter exit floods the Filter structure at a flow of 200 lps. This could only be corrected by installing a parallel pipeline that would be expensive and disruptive to plant operation. Therefore, the flow was reduced to the maximum that would pass through the pipeline without flooding. This flow was 175 lps.

Moving back upstream from the Filters to the Sedimentation Basins, it was found that that the water level for new flow at the exit of the Sedimentation Basins is acceptable. The water level in the Sedimentation Basin channel remains below the top of basin weir at the rerated flow, allowing the desired free fall of water from the weir to the channel.

Continuing upstream, the next critical structural elevation is at the Flocculator Basin. The Flocculator Basin actually consists of six consecutive basins, with Flocculator No. 6 furthest downstream relative to Flocculator No. 1. An adjustable gate that is used (adjusted) to produce the necessary level of mixing required for optimal flocculation separates each of the six basins.

The calculation of head loss from the Flocculator Basins to the Flash Mix Chamber showed that the new water level obtained in the Flash Mix Chamber will still allow for enough drop to create sufficient mixing.

The Hydraulic Evaluation shows that all unit processes in IPA Cimahi can handle a flow of 175 lps. Higher flows would lead to flooding, making the rerated flow of 175 lps the highest recommended capacity of IPA Cimahi.

APPENDIX D
Trainee Questionnaire Summary

EVALUATION QUESTIONNAIRE

Please fill in the following questionnaire so that we know what you have learned and found useful in this re-rating training. Thank you

Isilah pertanyaan-pertanyaan dibawah berikut ini sehingga kami mengetahui apa yang telah saudara pelajari di pelatihan re-rating ini.

Name/Nama (Organization/*Organisasi)* :

1. Orin Retnowati, ST (PDAM Kota Surakarta)
2. Ir. Agus Pudjiarto (PDAM Kabupaten Bandung)
3. Ir. M. Suheiri (PDAM TIRTANADI, TK I North Sumatera)
4. Ir. Moh. Hasyim Affandi (PDAM Kota Surabaya)
5. Ir. A.Yusuf (PDAM Kota Bandung)
6. Ir. Reri Lazuardi (PDAM Kota Padang)
7. Ir. Aldin J. Sinae (PDAM Kabupaten Donggala)
8. G.A.K.A Mahawintang, ST (PDAM Kota Denpasar)
9. Ir. Kartia Bado (PDAM Kota Makassar)
10. Achmad Syarifudin, BE (PDAM "Way Rilau" B. Lampung)
11. Ir. Masjuri Masri (PDAM Tirta Musi Palembang)
12. Ir. RHS Heru Binowo (PDAM Kota Semarang)
13. Drs. Ashari Mardiono (PDAM Kota Surabaya)
14. Firmansyah, BE (PDAM Kota Balikpapan)
15. Ir. Elandha (PDAM Kota Bengkulu)
16. Ir. Firdaus (PDAM Kota Jambi)
17. H. Rachmansyah (PDAM Banjarmasin)
18. Drs. H. Abdul Kadir (PDAM Menang Mataram)
19. Moch. D. Taher, BE (PDAM Kabupaten Sorong)

1. Was Rerating training helpful to you /*Apakah pelatihan rerating ini dirasakan berguna bagi saudara? Please explain /tolong jelaskan*

1. Yes, better knowledge on treatment plant.
2. Yes, because it could serve as reference for each treatment plant's process units so that its performance could be clearly known.
3. Useful to me, because it enables me to rerate treatment plant and apply the rerating directly in the field, and identify deficiencies at treatment plants in PDAM.
4. Very useful, it could serve as controlling references of process units at WTP in PDAM.
5. Useful, because of acquiring new knowledge on capacity increase efficiently.
6. Very useful, particularly in evaluating and increasing system.
7. Useful to me, although this is my first knowledge on production

particularly treatment (WTP), because I had never been in production section before.

8. Yes.
9. Useful, because through this training, methodology of rerating could be known.
10. Yes, because in this rerating training, I acquire a comprehension on how to increase clean water production capacity and make cost efficient for construction new plant, so that it could add customers in PDAM Lampung.
11. Very useful, because this rerating training has broadened my knowledge of WTP. And the rerating could optimize performance of existing WTP without big investment.
12. Yes, because it could enhance my knowledge so that I would not make any conventional mistakes.
13.
14. Useful, considering one of our plant's capacity is not as same as installed capacity, and tends to be lower.
15. Very useful.
16. Very useful, at least we could evaluate our own WTPs performance or as a first step to start to increase production capacity.
17. Very useful.
18. Very useful, because it could enhance PDAM's performance in O&M cost.
19. Very useful, because with this rerating we acquire knowledge on treatment system to enhance efectivity and efficiency.

Total Yes : 17
Total No : 1

2. Can you sell additional water if you increase capacity through rerating/ *Seandainya saudara meningkatkan kapasitas melalui rerating, dapatkah tambahan air tersebut dijual?*

	Yes	No, Explain/*jelaskan*
1.	Yes	PDAM Solo has limited raw water sources
2.	Yes	because service coverage still low
3.	Yes	Yes, because water produced is still lower than water demand, particularly in PDAM Tirtanadi
4.	Yes	By implementing rerating, water must be sold
5.	Yes	Many potential consumers to PDAM's piped water.
6.	Yes	Could add customers.
7.	Yes	Yes, expectedly could get added value from the current capacity.
8.	Yes	
9.	Yes	Only to one system that its distribution network is not interconnected to others. Present condition of water distribution is not 24 hrs/day (rotation of distribution)
10.	Yes	Because there are many application to connect to PDAM

still waiting.

11. Yes — Because current coverage stands at 47 % of total population in Palembang.
12. Yes — Logically yes! because demand is still far above production, but many other factors determining water sales.
13. No, Presently installed capacity is not distributed yet.
14. Yes — because many potential house connection are still pending to install.
15. Yes — our waiting list has reached app. 10,000 while capacity is very inadequate.
16. Yes — could be sold for our service coverage is not 100% yet.
17. Yes — Could be sold.
18. Yes — Could be sold for our service coverage is still app. 30%.
19. Yes — Yes, because capacity becomes bigger.

Total Yes : 18
Total No : 1

3. Did all your questions on the Re-rating get answered/ *apakah semua pertanyaan saudara mengenai rerating terjawab?*

Yes No, Explain/*jelaskan*

1.	Yes		
2.	Yes		because the lesson was given in an up to date manner.
3.	Yes		Yes, almost all.
4.	Yes		Generally were answered.
5.	Yes		Materials were already given.
6.	Yes		
7.	Yes		Yes, quite clear.
8.		No	I need a specific materials on Pulsator.
9.	Yes		The basis is known through this training.
10.	Yes		because I have had such lessons at college.
11.	Yes		because the instructor is experienced.
12.	Yes		
13.		No	Particularly on special treatment for detergent, organic matter, etc.
14.	Yes		What was given is good.
15.		No	If fund is required, how could we get funded.
16.		No	Not all.
17.	Yes		All were answered.
18		No	Not all, because we do not treat water.
19.	Yes		Yes, all were explained.

Total Yes : 14
Total No : 5

4. Will you attempt to rerate your plant/*maukah saudara mererating instalasi saudara?*

Yes	No, Explain/*jelaskan*	
1.	No	PDAM Solo has no Treatment Plant
2. Yes		To increase coverage
3. Yes		Yes, because it is very crucial to rerate.
4. Yes		God willing, if needed.
5. Yes		Capacity increase.
6. Yes		In line with the job in PDAM.
7. Yes		Yes, I will try together with production section.
8. Yes		
9. Yes		There are several plants that their service is not satisfactory.
10. Yes		Plant rerating would be much cheaper than construction new one.
11. Yes		Because the existing plant does not operate in optimum performance yet.
12. Yes		Certainly by adjusting existing WTP condition with the demand.
13. Yes		If the condition allows.
14. Yes		Because several equipment are there, yet financing is required.
15. Yes		So far we knew production capacity based only on design.
16. Yes		Surely will, depends on financial condition.
17. Yes		Yes.
18. Yes		Yes, because our system's deficiencies are identified after joining this rerating training.
19. Yes		Yes, we try to reevaluate.

Total Yes : 18
Total No : -

5. Would you recommend a follow up of this training of the trainer/*apakah saudara akan merekomendasikan kelanjutan dari pelatihan pelatih ini?*

1. Yes	Should cover other PDAMs in need of the training
2. Yes	For other units such as : energy saving, pumping, and distribution network
3. Yes	Yes, to have more various and detailed training materials.
4. Yes	It should.
5. Yes	
6. Yes	Very important for managers in PDAM.
7. Yes	Yes, we would try in KOMDA (PDAMs grouping in provincial level).
8. Yes	

9. Yes	To train other PDAMs.
10. Yes	Because this training gave no details, limited only to water treatment.
11. Yes	Because this training gave no detailed calculation, also needed for other system.
12. Yes	More specific on details of each parts of WTP.
13. Yes	
14. Yes	Particularly for smaller WTPs that we have.
15. Yes	
16. Yes	Necessary to follow up, could broaden our knowledge.
17. Yes	Continue the training in local level.
18. Yes	Yes, partly.
19. Yes	Yes, to improve human resources and PDAM's efficiency.

Total Yes : 19
Total No : -

6. Do you think that the trainer is very clear and systematic/*apakah instruktur pelatihan ini cukup jelas dan sistematis?*

1. Yes	
2. Yes	Always giving case study for application.
3. Yes	Yes, the materials are systematic and clear, yet not detailed enough.
4. Yes	Quite systematic.
5. Yes	Comprehension on training materials.
6. Yes	Well programed.
7. Yes	Yes, but the training period was too short.
8. Yes	
9. Yes	
10. Yes	Quite clear and systematic.
11. Yes	Because there were theories, case study, and application in the field.
12. Yes	Good, although the materials could be more concise.
13. Yes	Generally.
14. Yes	Because the materials are easy and clear.
15. Yes	
16. Yes	
17. Yes	Clear.
18. Yes	Yes, quite clear and systematic.
19. Yes	Yes, the materials were given in a clear and good manner.

Total Yes : 19
Total No : -

7. Were materials suitable/*apakah materi pelatihan sesuai?*

Yes	No, Explain/*jelaskan*
1. Yes	But need more on "Special Treatment"
2. Yes	What has been given is in line with proposed materials
3. Yes	Generally yes.
4. Yes	
5. Yes	In line with the plan to increase capacity/ production.
6. Yes	But not detailed enough, so that additional training is required for the present participants.
7. Yes	Yes, quite suitable.
8. Yes	
9. Yes	
10. Yes	Because it fits my job at Production Section.
11. Yes	Because the subject (WTP) is always a problem in every PDAM.
12. Yes	But the order of the materials need to be adjusted to avoid any noncompliance with the schedule.
13. Yes	Generally.
14. Yes	But the materials were not explained in details.
15. Yes	
16. Yes	Need additional basic modules for study by ourselves.
17. Yes	Suitable.
18. Yes	Yes, several.
19. Yes	Yes, because the evaluation and calculation are quite satisfactory.

Total Yes : 19
Total No : -

8. Was the length of training suitable/*apakah lamanya pelatihan sesuai?*

Yes	No, Explain/*jelaskan*	
1. Yes		
2. Yes		Because giving adequate time to participants to comprehend.
3. Yes		Yes, for this training materials.
4. Yes		
5.	No	Need longer period (4 weeks)
6. Yes		Fits the content of the materials.
7	No	No, given case study was not sufficient for different treatments.
8.	No	Further training is needed (Term 2, 3, …) to enable the rerating applicable to all PDAMs.
9.	No	
10.	No	Not too detailed in entire system.
11.	No	Because many more detailed calculation need to be

		given.
12. Yes		But basically could be shorter.
13. Yes		
14. Yes		Because the materials were given thoroughly and plenty of time
15. Yes		Could be better if there were more case study and more various type of WTP.
16. Yes		
17. Yes		We think so.
18. Yes		Yes, but it could be shorter.
19.	No	As we are from remote PDAM, we feel it was not long enough for our treatment systems are not well performing.

Total Yes : 12
Total No : 7

9. Would you recommend this training to other PDAMs/*apakah saudara akan merekomendasikan pelatihan ini kepada PDAM lainnya?*

1. Yes	Because the Rerating would benefit PDAMs to increase production capacity.
2. Yes	Because other PDAMs need to know the Rerating.
3. Yes	Yes, to disseminate the Rerating.
4. Yes	God willing.
5. Yes	To get the treatment plant increased.
6. Yes	To get KOMDA conduct similar training for PDAMs having treatment plant.
7. Yes	We would try.
8. Yes	
9. Yes	
10. Yes	If needed.
11. Yes	So far it is possible.
12. Yes	Particularly to PDAM with treatment plants.
13. Yes	
14. Yes	If PDAM requires, we could do our best.
15. Yes	
16. Yes	Would very much depend on human resources capability at PDAM
17. Yes	Certainly, particularly to PDAM in local level.
18. Yes	Yes, considering the capability of human resources in the field of clean water is insufficient, we feel we need to implement it.
19. Yes	Yes, if required.

Total Yes : 19
Total No : -

10. Is there any additional training need to be conducted to make you understand the re-rating ? if yes, please explain/*apakah anda memerlukan pelatihan tambahan untuk lebih memahami re-rating? Jika ya, tolong jelaskan*

1. No.
2. Yes, for other units rerating.
3. Yes, because the given materials are not detailed enough. Considering the present condition in the field and the given materials, a more comprehensive understanding on the treatment processes is required.
4. A comprehension on each treatment processes is required.
5. Yes, because the training period is limited. It seemed that training was given in a quick manner.
6. Extended rerating to better comprehend the calculation and the materials is required.
7. We very much need them, because implementation at field would not be as quick as predicted. It might need several trials to rerate the plant.
8. Yes, particularly to rerate our own treatment plant that has a slightly different features than those presented in the training materials (Term 1) (with Pulsator) and we want to serve as rerating consultant to neighboring PDAMs necessary to do the rerating.
9.
10. Yes, because we will conduct training for our colleagues of other PDAMs in the province.
11. Yes, because it is necessary to understand calculation of each system in detail, ie. filter media, sedimentation, pumps, and other systems such as piping network, etc.
12. Yes, because in applying rerating in the field, the problems in theory could be different than that in the field. More benefit could be acquired by knowing problems at different type of WTP.
13. In order that the result of rerating not to deteriorate produced water quality.
14. Yes, because several materials were not explained in detail, particularly on pumps.
15. For another training, participants should be notified beforehand to bring their own WTP's data to enable the rerating together with others. And participants could return with collective recommendations. And could present the result to their president director.
16. Need additional training, especially field application of rerating (field practice at different type of WTP).
17. Satisfactory.
18. Yes, and need to fit local condition, ie. for spring gravity fed or WTP, so that the discussion would be more specific.
19. Yes, if there is another training, either related to treatment system or others that can improve PDAM.

Total Yes : 17
Total No : 1

11. Do you feel that the field visit was very helpful to understand the Re-rating/apakah dengan adanya kunjungan lapangan dapat membantu anda dalam pemaham rerating?

1. Yes	More concrete in understanding and facing possible problems
2. Yes	To better comprehend between theory and application in the field
3. Yes	Yes, besides, actual condition in the field is very complex and it requires a detailed comprehension on Rerating.
4. Yes	To apply the theory.
5. Yes	To apply the theory.
6. Yes	Very helpful, particularly to have a more focused rerating evaluation.
7. Yes	Quite helpful.
8. Yes	
9. Yes	To recognize actual condition at field that not all processes shown in the drawing.
10. Yes	Because theory does not certainly fit actual field condition.
11. Yes	Because it could give a clear example in applying theory in the field.
12. Yes	Because practice would make a better understanding of the theory.
13. Yes	
14. Yes	To understand plant optimization and possibility to increase capacity through rerating.
15. Yes	
16. Yes	Would be better at a more complex WTP.
17. Yes	Very helpful.
18. Yes	Yes, very helpful.
19. Yes	Yes, because of acquiring data, understanding each process unit.

Total Yes : 19
Total No : -

PURSE/WET Project Office
Wisma Kodel, 8th Floor
Jl. H.R. Rasuna Said, Kav. B4
Jakarta 12920 INDONESIA
Tel: (62-21) 522-1461
Fax: (62-21) 522-1460
Email: chemonic@rad.net.id

Chemonics International, Inc.
1133 20th Street, NW, Suite 600
Washington, DC 20036 USA
Tel: (202) 955-3300
Fax: (202) 955-3400

in association with

Environmental and Managemet Program Support (EUP)
United States Agency for International Development
Washington, D.C

Institute for Public Private Partnerships (IP3)

PURSE/WET PROJECT

In December 1991 the U.S. and Indonesian governments signed an agreement to encourage private investment in the provision of public water supply, wastewater treatment and solid waste management services in urban areas throughout the archipelago. In recognizing that its capacity to finance the needed projects is severly strained, and that insufficient urban infrastructure will adversely affect public health and welfare and inhibit future economic growth, the Government has been looking increasingly to the private sector to participate in the provision of these essential services.

PURSE/WET is working with USAID/Indonesia's Office of Urban Environmental Management and several agencies of the Government of Indonesia through a combination of technical assistance and capacity building interventions to :

- develop policy consensus and a legal framework that clarifies current rules and formulates new or revised regulations pertaining to private investment in all aspects of municipal infrastructure development and/or provision of urban services,
- demonstrate the technical and contractual feasibility of various forms of Public-Private Partnerships through demonstration projects, and
- transfer knowledge and expertise to public sector officials in relevant technical, financial and managerial aspects of environmental infrastructure.

For more information on the PURSE/WET Project, please contact Chemonics International or the PURSE/WET Project at the addresses listed above.