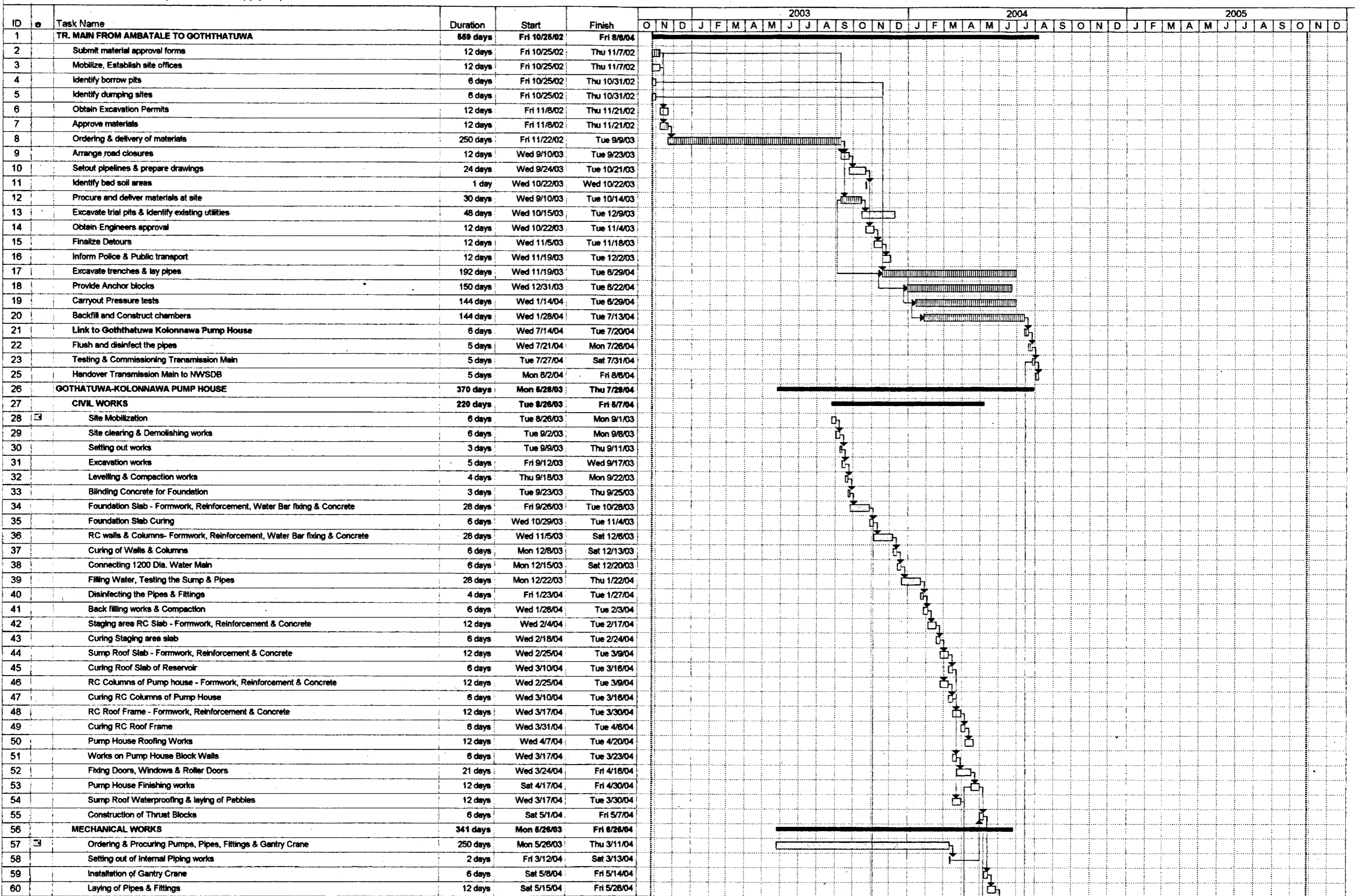


Figure 7-3 Kotikawatte-Mulleriyawa Water Supply Implementation Schedule



Project: KMU-P1
Date: Sun 1/7/01

Task [Bar] Critical Task [Hatched Bar] Milestone [Diamond] Rolled Up Task [Thick Bar] Rolled Up Milestone [Thick Diamond] Split [Dashed Line] Project Summary [Dotted Line]
Task Progress [Thin Bar] Critical Task Progress [Thin Hatched Bar] Summary [Thin Diamond] Rolled Up Critical Task [Thin Thick Bar] Rolled Up Progress [Thin Thick Diamond] External Tasks [Thin Dashed Line]

Figure 7-4 REHABILITATION OF MEDIUM AND LARGE DIAMETER PIPELINES (Typical crew output)

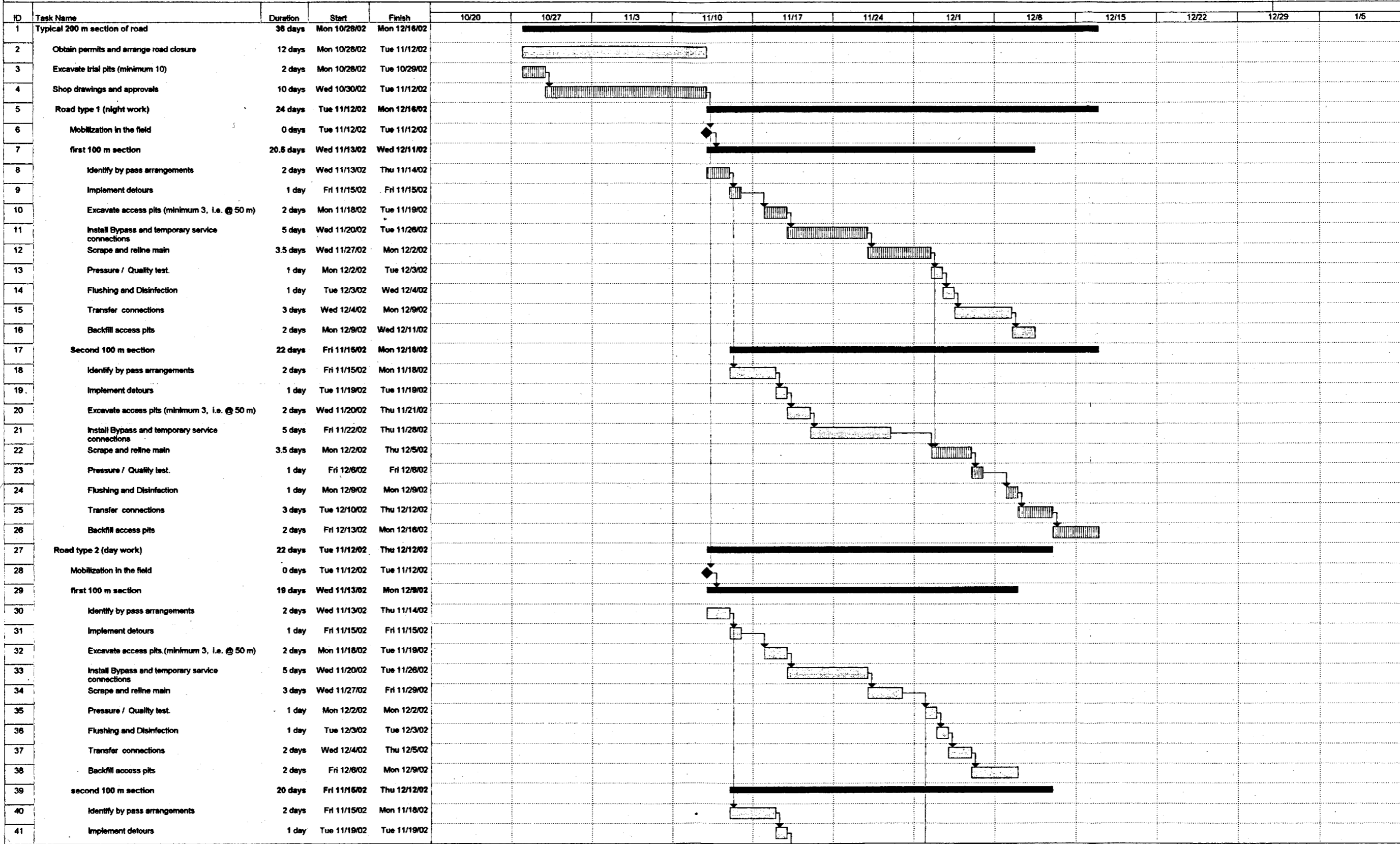


Figure 7-4 REHABILITATION OF MEDIUM AND LARGE DIAMETER PIPELINES (Typical crew output)

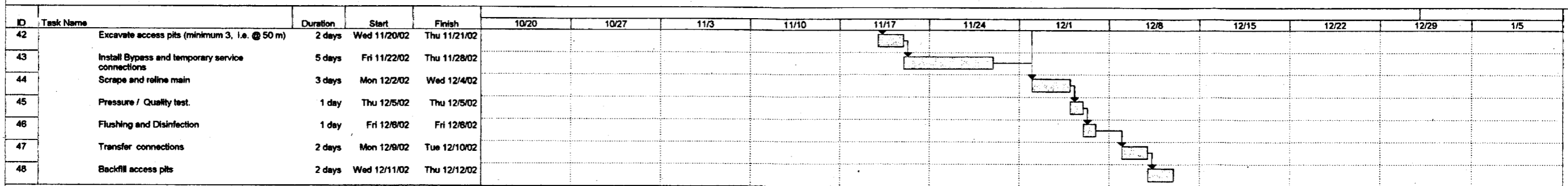
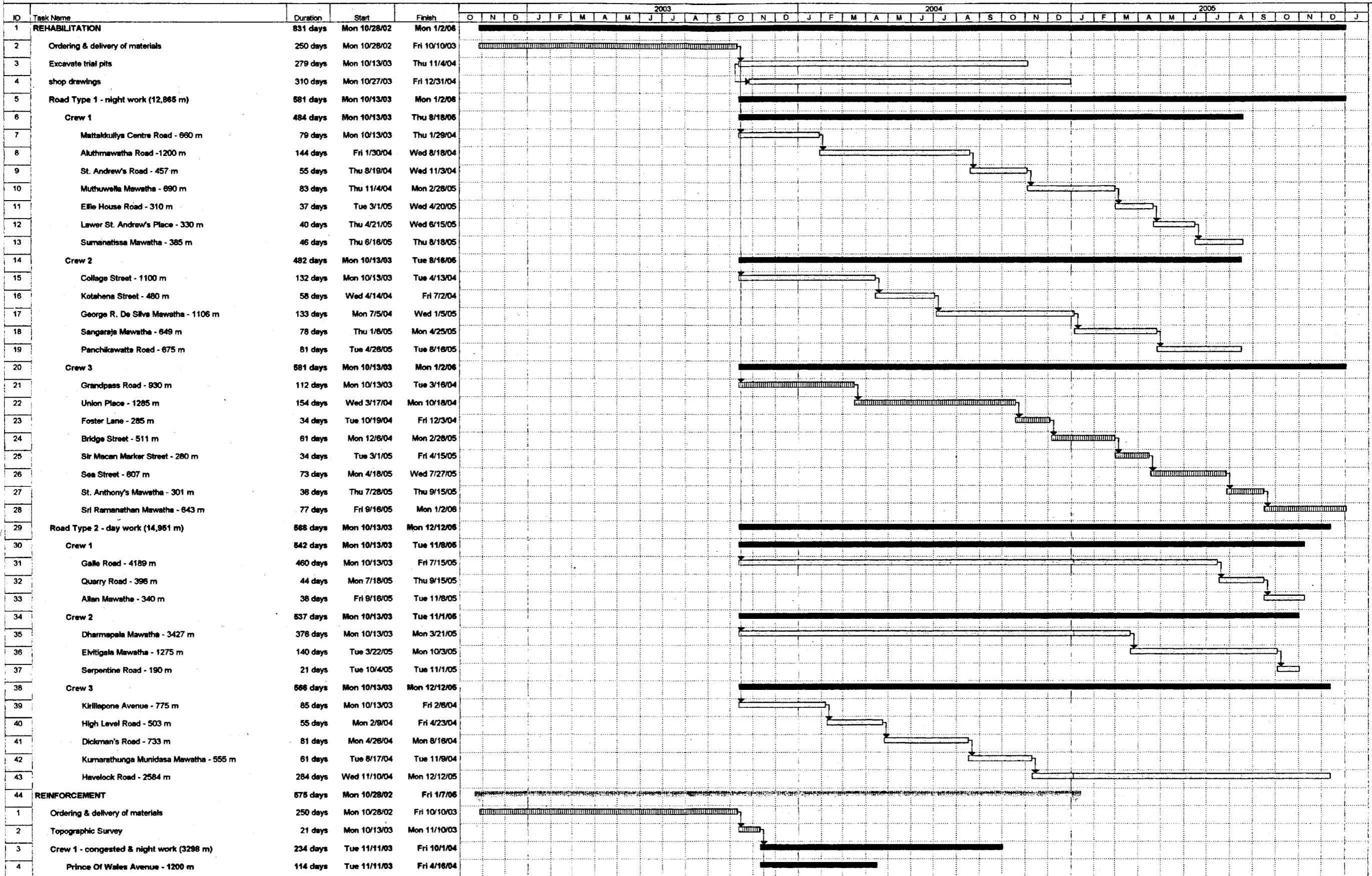


Figure 7-5 IMPLEMENTATION SCHEDULE FOR REHABILITATION & REINFORCEMENT of MEDIUM and LARGE DIAMETER MAINS IN CMC

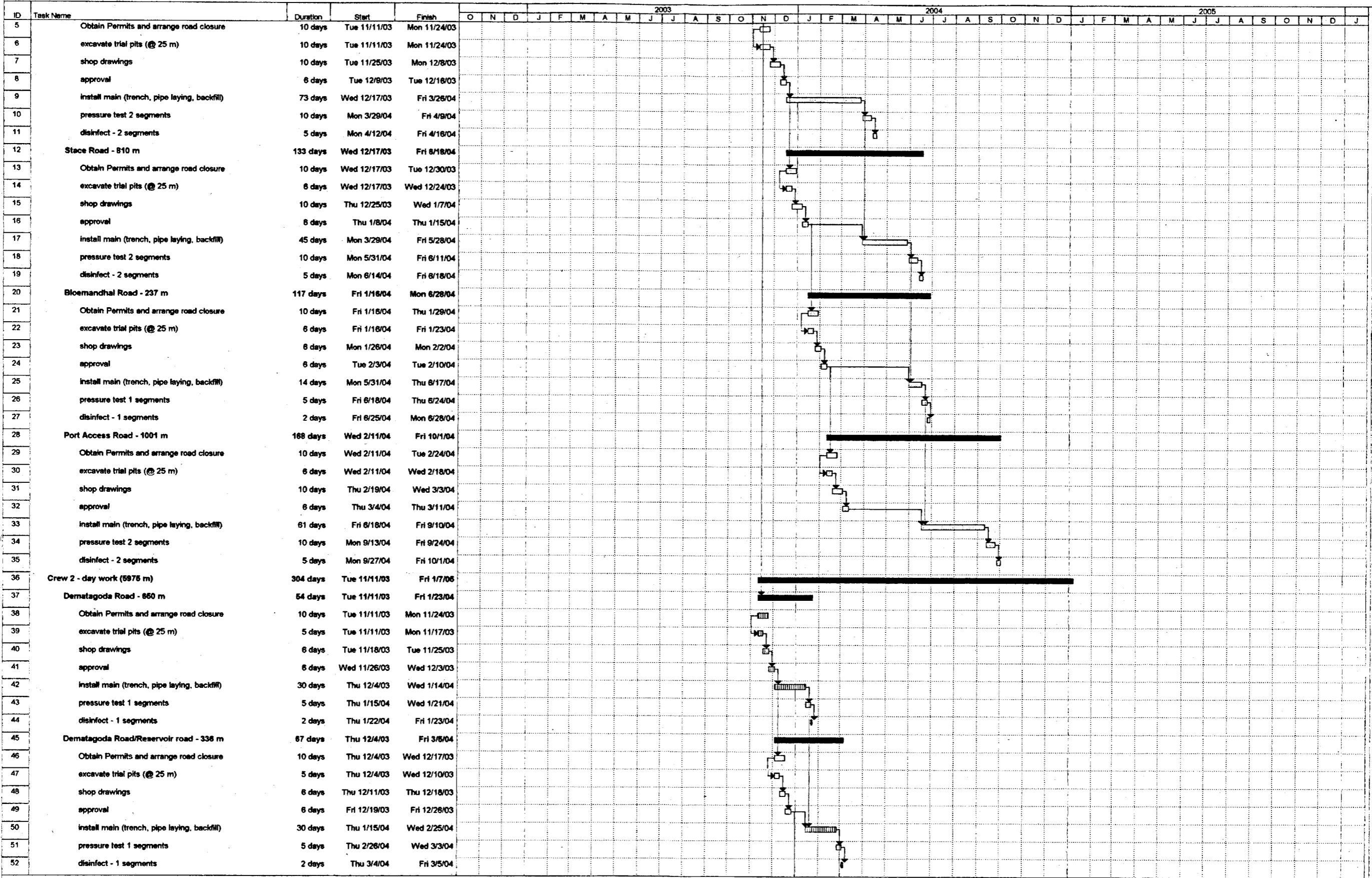


Project: PRJ4
Date: Sun 1/7/01

Task: [Symbol] Critical Task [Symbol] Milestone [Symbol] Rolled Up Task [Symbol] Rolled Up Milestone [Symbol] Split [Symbol] Project Summary [Symbol]

Task Progress: [Symbol] Critical Task Progress [Symbol] Summary [Symbol] Rolled Up Critical Task [Symbol] Rolled Up Progress [Symbol] External Tasks [Symbol]

Figure 7-5 IMPLEMENTATION SCHEDULE FOR REHABILITATION & REINFORCEMENT of MEDIUM and LARGE DIAMETER MAINS IN CMC



Project: PRJ4
Date: Sun 1/7/01

Task Critical Task Milestone Rolled Up Task Rolled Up Milestone SpR Project Summary

Task Progress Critical Task Progress Summary Rolled Up Critical Task Rolled Up Progress External Tasks

Figure 7-6 REHABILITATION OF SMALL DIAMETER PIPELINES (Typical crew output)

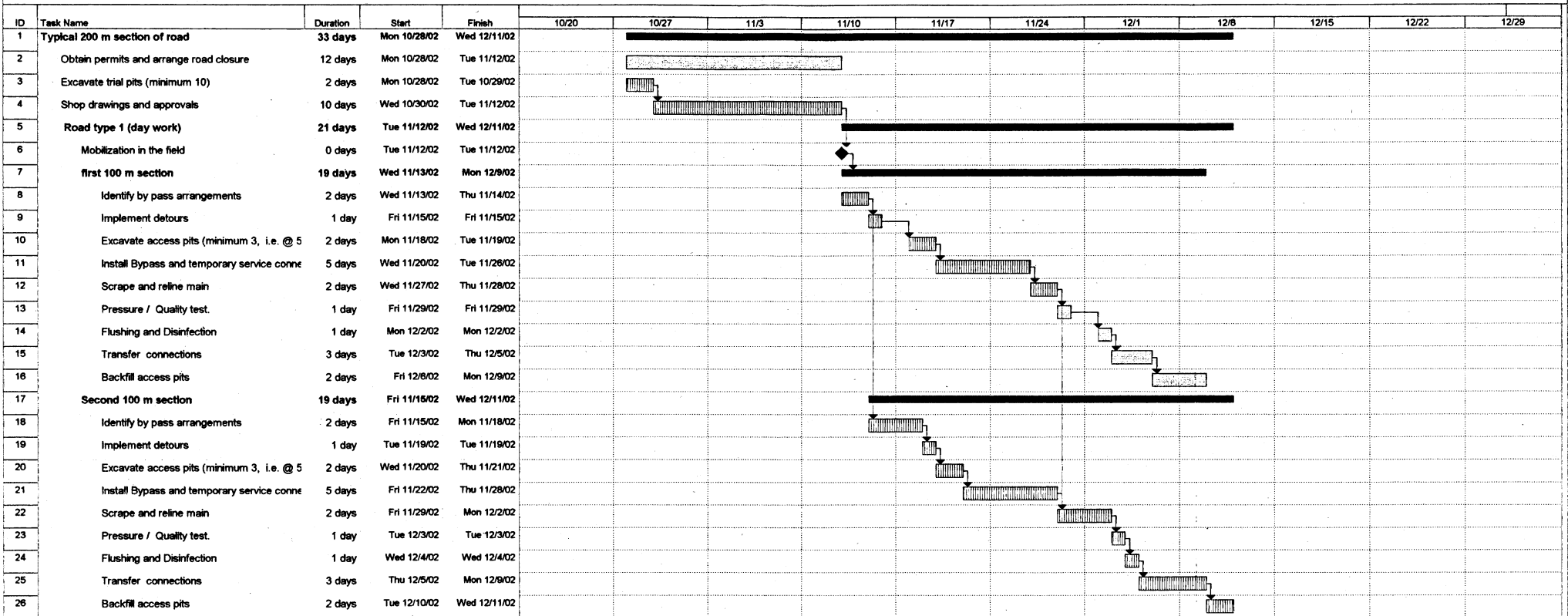


Figure 7-7 REPLACEMENT OF SMALL DIAMETER PIPELINES (Typical crew output)

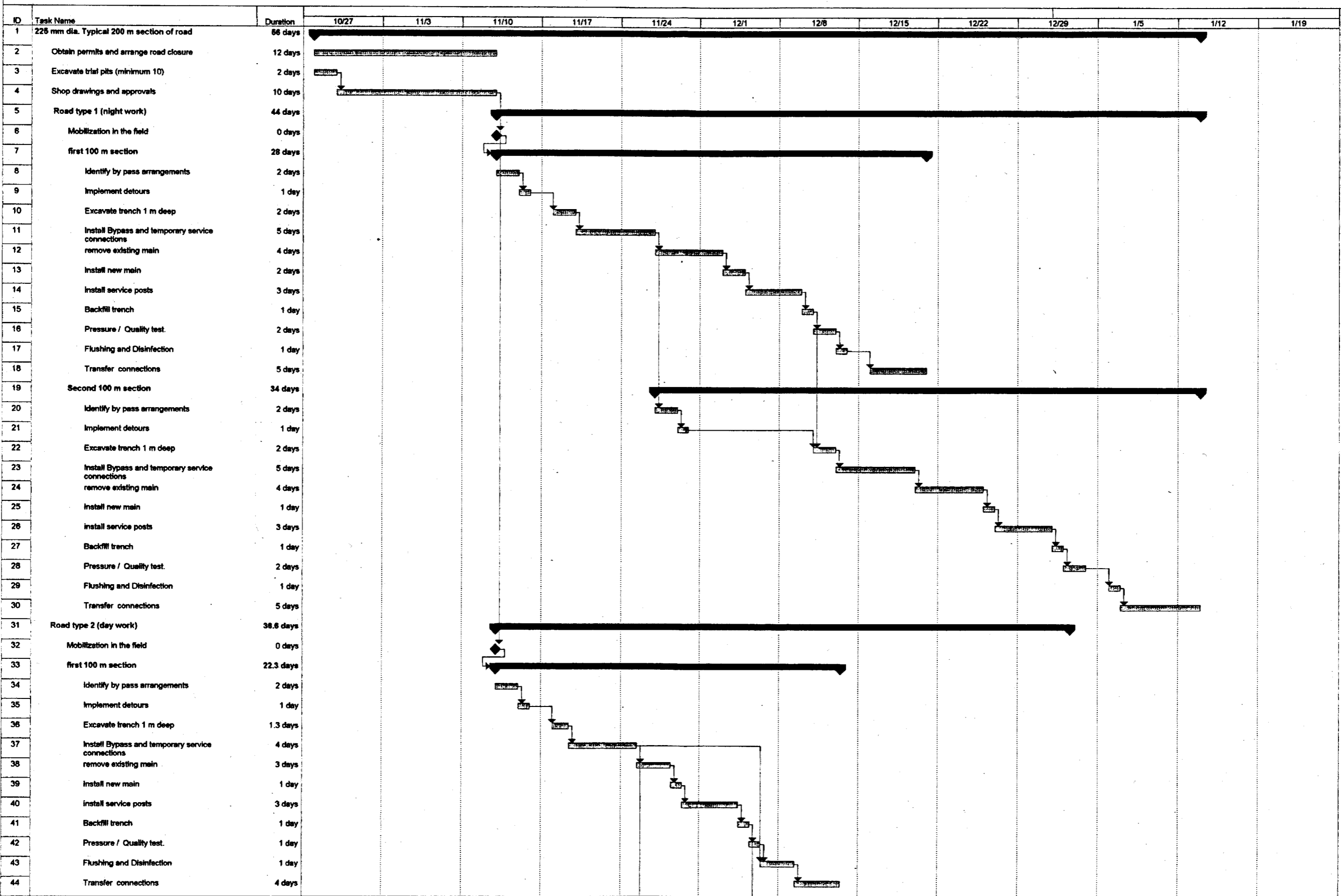


Figure 7-7 REPLACEMENT OF SMALL DIAMETER PIPELINES (Typical crew output)

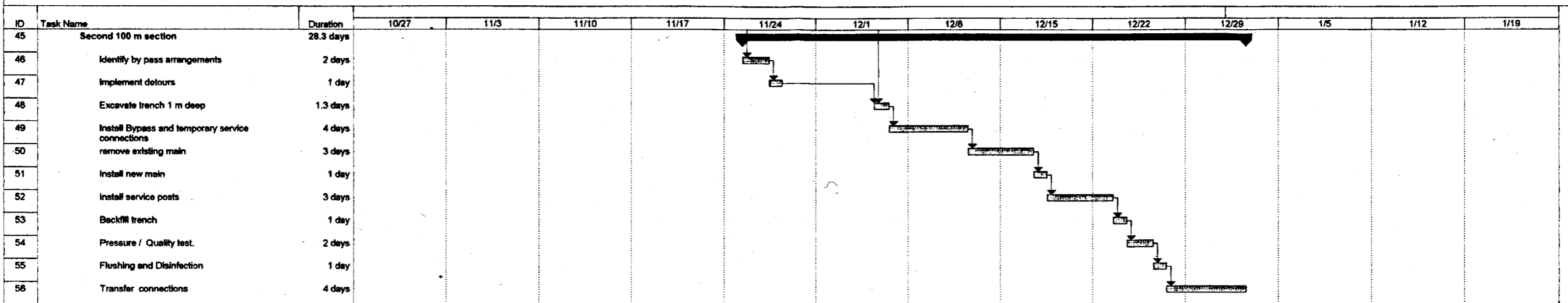
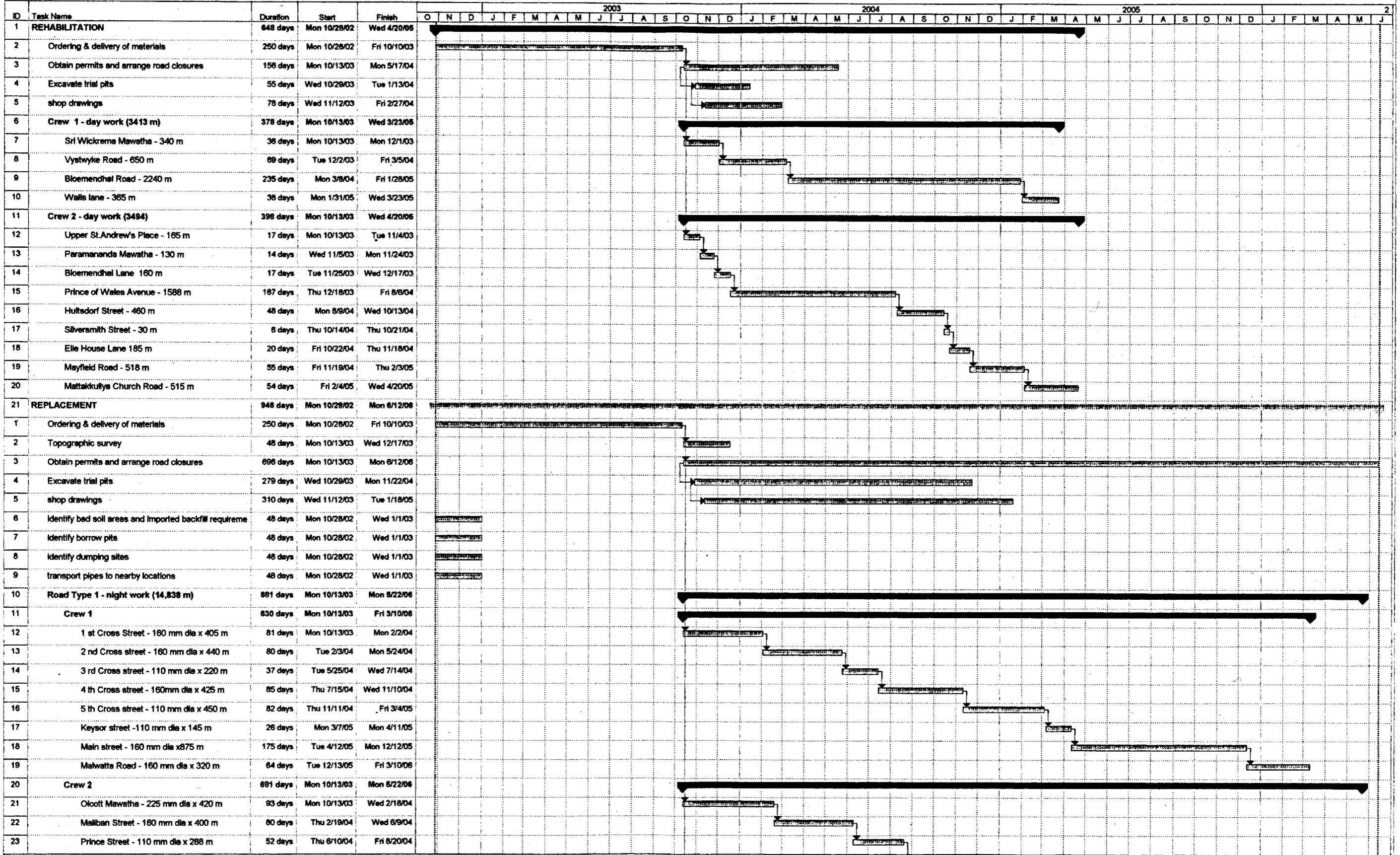


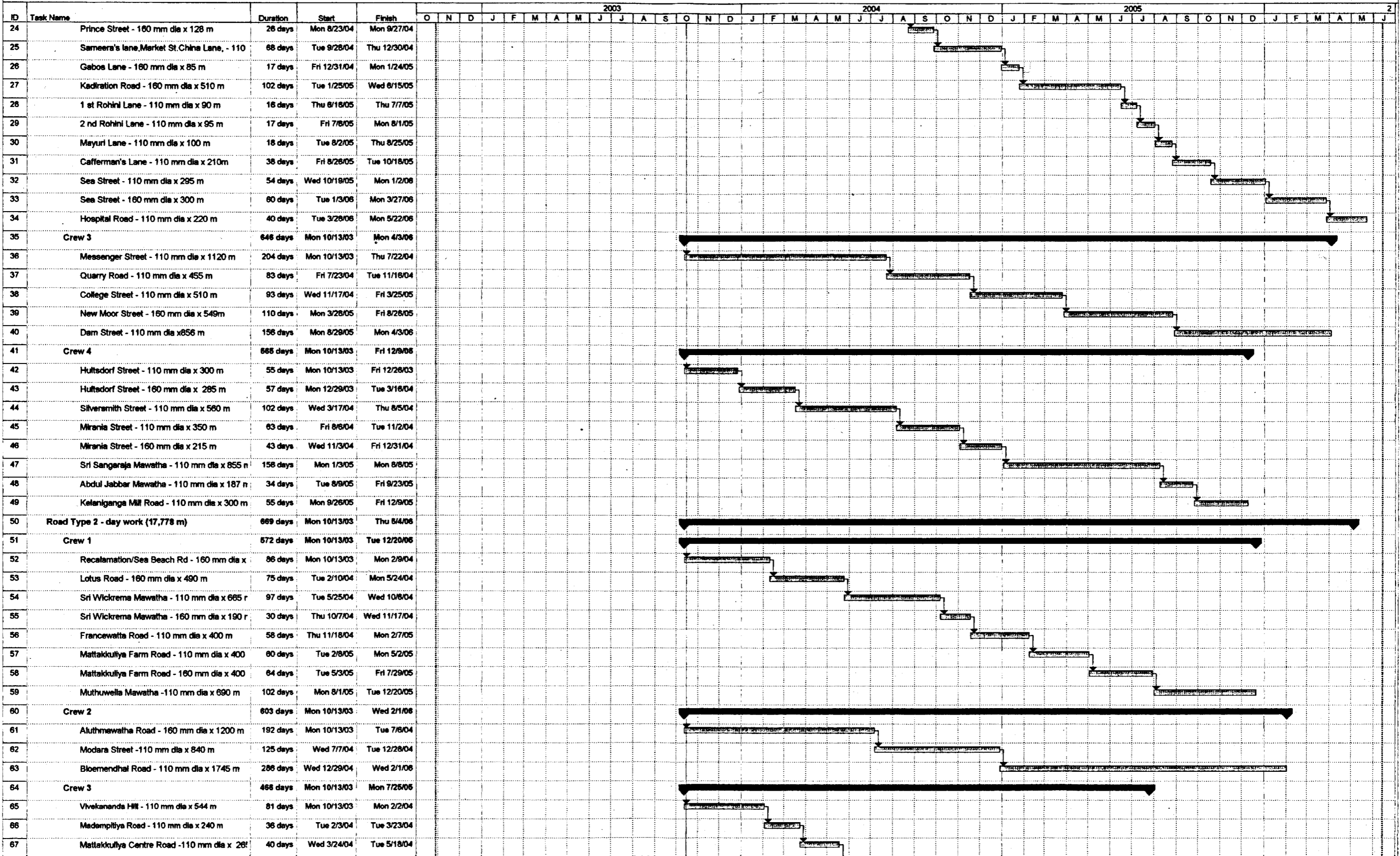
Figure 7-8 IMPLEMENTATION SCHEDULE FOR REHABILITATION AND REPLACEMENT OF SMALL-DIAMETER DISTRIBUTION MAINS



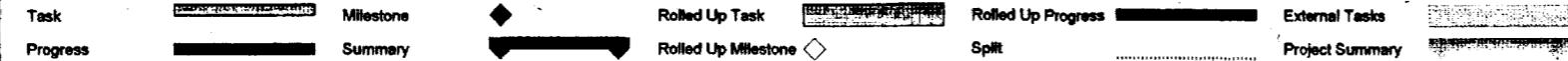
Project: PRJ4
Date: Sun 1/7/01

Task [Symbol] Milestone [Symbol]
Progress [Symbol] Summary [Symbol]
Rolled Up Task [Symbol] Rolled Up Milestone [Symbol]
Rolled Up Progress [Symbol] Split [Symbol]
External Tasks [Symbol] Project Summary [Symbol]

Figure 7-8 IMPLEMENTATION SCHEDULE FOR REHABILITATION AND REPLACEMENT OF SMALL DIAMETER DISTRIBUTION MAINS



Project: PRJ4
Date: Sun 1/7/01



CHAPTER 8

8 PROJECT COST

8.1 METHODOLOGIES AND ASSUMPTIONS USED FOR COST ESTIMATE

Methodologies, currency conversion rates and other basic assumptions used for estimating the project cost have been compiled in Appendix 8A.

8.2 PROJECT COST

The project cost has been estimated as shown in Table 8-1.

Table 8-1 Project Cost

No.	Item	Cost (Yen)
A	Civil Works Contract	3,573,164,788
A1	Preliminary and General Works	539,584,706
A2	Rehabilitation of Maligakanda Reservoir and Ellie House Reservoir	1,318,680,956
A3	Water Supply Enhancement in Kotikawatte and Mulleriyawa Area	846,292,757
A4	Rehabilitation and Reinforcement of Medium and Large Diameter Pipe Network in CMC Area	470,188,753
A5	Rehabilitation of Small Diameter Distribution Mains in CB1 Area	274,924,852
A6	Supply of Materials and Equipment for Reduction of NRW	123,492,764
B	Leak Repair Works Contract	154,849,512
C	Low Income Settlement Environmental Improvement Contract	20,257,613
Sub-Total for Three Contracts (A+B+C)		3,748,271,912
D	Consulting Service	389,177,139
E	Interest During Construction and Service Charge	177,049,549
Sub-Total for JBIC Loan Part		4,314,498,601
F	Project Administration Cost	64,717,555
G	Land Acquisition Cost	27,400,358
H	Custom Duties	244,736,783
I	GST (Goods and Services Tax)	446,646,072
Sub-Total for NWSDB Part		783,500,767
Total Project Cost		5,097,999,368

CHAPTER 9

9 PROJECT IMPLEMENTATION

9.1 CONTRACT PACKAGES

The project has been divided into three separate contracts as agreed between JBIC and the Sri Lankan Government

(1) Tender Package No.1 - Contract for Civil Works

The contract for civil works will be open to International Competitive Bidding (ICB) and contractors will be screened through a pre-qualification process.

The contract will include construction of all major civil/structural components, supply and installation of equipment and pipelines:

a) Rehabilitation/Reinforcement of Medium and large diameter pipe network in CMC area

- Scraping and re-lining existing distribution mains
- Laying of new distribution mains to reinforce the existing network
- Replacement of valves

b) Rehabilitation/Replacement of smaller diameter distribution mains in CB1 area

- Scraping and re-lining existing distribution mains
- Replacement of deteriorated distribution mains
- Replacement of service connection pipes
- Replacement of valves

c) Construction/Rehabilitation of Reservoir

- Construction of new reservoir at Ellie House
- Construction of new office building at Maligakanda
- Construction of new reservoir at Maligakanda
- Rehabilitation of old reservoir roof at Maligakanda

d) Water Supply Enhancement in Kotikawatte-Mulleriyawa Area

- Construction of new pumping station at Ambatale Treatment Plant
- Laying a new transmission main from Ambatale TP to Gothatuwa
- Construction of a new ground reservoir and pumping station at Gothatuwa
- Construction of a new water tower at Gothatuwa

- Laying of new distribution mains

(2) Tender package no.2 - Contract for Leak Repair Works

This contract is open to Local Competitive Bidding (LCB) and contractors will be screened through a pre-qualification process. The contract is for the installation only of materials supplied by NWSDB to repair leaks in distribution mains and service connections in CMC area.

(3) Tender package no. 3 - Contract for Low Income Settlement Environmental Improvements in

This contract is open to Local Competitive Bidding (LCB) and contractors will be screened through a pre-qualification process. The contract is for the installation only of materials supplied by NWSDB to provide individual service connections and disconnect common outlets in low-income settlements in CB1 area.

9.2 PROJECT IMPLEMENTATION SCHEDULE

The implementation schedule for the whole project is presented in Figure 9-1.

The Contract for Civil Works will be subject to international competitive bidding (ICB). The pre-qualification of international contractors should be finished by end of December 2001. The tender process is expected to take 301 working days from December 2001 to October 2002. The earliest possible construction start date for all components of the civil works contract is last week of October 2002. Construction will proceed on several job sites simultaneously and finish in November 2006.

	<u>Working Days</u>	<u>Finish</u>
• Maligakanda Office Building	:528	Aug, 2004
• Maligakanda Reservoir	:469	Dec, 2004
• Maligakanda Roof Rehabilitation	:461	Nov, 2006
• Ellie House Reservoir	:1,258	Oct, 2006
• Kolonnawa-Gothatuwa pump house	: 370	July, 2004
• Gothatuwa reservoir, pump house and water tower	: 633	Oct, 2005
• Gothatuwa Transmission main	: 559	Aug, 2004
• Gothatuwa distribution mains	: 712	Feb, 2005
• Large and medium mains scrapping and re-lining	: 831	Jan, 2006

- Large and medium mains reinforcement : 575 Jan, 2005
- Small mains scrapping and re-lining : 656 Apr, 2005
- Small mains replacement : 946 Jun, 2006

Contracts for leak repair works are subject to local competitive bidding and will take less time to pre-qualify and tender than the civil works contract. The LCB contract will be re-tendered after one year. Pre-qualification is only required once at the beginning and is not necessary for subsequent tender calls. The contract for low-income settlements is arranged in the same way and has the same schedule as the leak repair contract. The earliest start date for both contracts is January 2002.

9.3 PROJECT IMPLEMENTATION UNIT

9.3.1 Roles and Responsibilities for Project Implementation

The project is one of several large development projects being simultaneously implemented by the NWSDB. The need for consulting services has therefore been identified by the NWSDB to assist with tendering, project management and construction supervision. The project will also require CMC Water Works Department and coordination with several other authorities (e.g. road authorities, utilities, port authority). The project implementation team will consist of three key members:

- (1) NWSDB
- (2) CMC Water Works
- (3) Consultant

The roles of the team members as foreseen at the pre-tender stage are presented in Table 9-1. The apparent duplication of roles between NWSDB and CMC on some components is necessary to ensure the smooth implementation of the project since there are several authorities involved.

9.3.2 Organization of the Project Implementation Unit (PIU)

The NWSDB Project Implementation Unit assembled for the Detailed Designed Study will be re-structured for the construction stage. The PIU will be responsible for project management and coordination within NWSDB and with other authorities. Figure 9-2 shows the location of the PIU within the NWSDB Organization as well as internal and external relationships. The

PIU will remain under the principal direction of the Additional GM for Colombo Metropolitan Region.

The Construction Division and the Distribution Sections will support the PIU for the implementation of the civil works contract. The NRW section will continue to be involved with identification of leaks and implementation of the Leak Repair Contract and the contract for Improvements to Low Income settlements. The Regional Support Centre for Greater Colombo, RSC(GC), will provide coordination with CMC and monitor input from the NRW and Distribution Sections.

The Japan Project Unit will continue to provide liaison between the PIU and JBIC on matters regarding scope of work, processing payments and loan disbursement.

Figure 9-3 indicates the organizational structure and staffing needs of the PIU. The PIU will be divided into 4 major sub teams: 3 for the major construction components of the project and 1 for NRW reduction activities:

- (1) Pipeline Rehabilitation
- (2) Reservoir Rehabilitation
- (3) Kotikawatta-Mulleriyawa Enhancements
- (4) Non-revenue Water Reduction

Each sub-team will be staffed by NWSDB and supported by consultant services. For simplicity and effective management the organizational structure for the consultant mirrors that proposed for the NWSDB. Staffing levels will vary for each project component depending on the stage of completion. Duration of inputs and resources for consulting services are described in Section 9.4 Engineering Services.

9.4 ENGINEERING SERVICES FOR IMPLEMENTATION

9.4.1 Scope of works to be implemented

- (1) Rehabilitation Component

Execution of ICB contract for scraping, re-lining and installing reinforcement mains:

- Rehabilitation/reinforcement of Medium and large diameter pipe network in CMC area
- Rehabilitation/replacement of smaller diameter distribution mains in CB1 area

- Construction and Rehabilitation of Reservoirs

(2) Water Supply Enhancement in Kotikawatte-Mulleriyawa Area

Execution of ICB contract for water supply development scheme:

- Construction of new pumping station at Ambatale Treatment Plant
- Laying a new transmission main from Ambatale TP to Gothatuwa
- Construction of a new ground reservoir and pumping station at Gothatuwa
- Construction of a new water tower at Gothatuwa
- Laying of new distribution mains

(3) NRW Reduction Component

Execution of LCB contracts for:

- Repair of leaks in distribution mains and service connections in CMC area
- Provision of individual service connections and disconnection of common outlets in low-income settlements in CB1 area.

9.4.2 Consulting Services

(1) Assistance with Tendering

- Assistance in evaluation of pre-qualification applications
- Assistance with evaluation of bids and
- Assistance with contract negotiations

(2) Services required during construction (rehabilitation works)

- Assist in handing over of sites to the contractor
- Review the construction schedule proposed by the contractor
- Monitor the progress of work and instruct the contractor to update the schedule when required
- Assist NWSDB with progress meetings
- Prepare monthly and quarterly summary reports
- Advise the contractor on the interpretation of drawings and specifications and issue supplementary details and instructions during the construction period
- Review shop drawings submitted for general compliance with the design requirements
- Maintain a log of all shop drawings received for review and ensure that all required “final” shop drawings are submitted by the contractor

- Consider and advise on alternate methods, equipment and materials proposed by the contractor and permitted by the contract.
- Advise on the validity of charges for additions or deletions to the contract and issue change orders
- Process contractor's progress and final payment requisitions and issue progress certificates for NWSDB/JBIC approval
- Prepare operation and maintenance manual
- Assist with testing and commissioning
- Issue certificate of substantial completion in accordance with tender documents
- Ensure that "Final" as-built drawings are submitted by the contractor

(3) Resident Staff Services (civil works)

- Provide quality assurance and quality control during construction
- Maintain adequate data and records related to construction contracts to determine progress of work
- Maintain a "marked-up" set of drawings to show "as-built" works.
- Review shop drawings to verify that contractual requirements are met for materials and equipment
- Review contractor's request for payments as to progress, quantities of work and materials delivered to the site
- Provide reference lines and elevations to the contractor. Check contractor's line and grade as work progresses, at least once a week.
- Arrange for all necessary field testing, inspections or verification by specialist consulting or inspection firms to determine that materials and work conforms to design requirements and specifications
- Ensure that the contractor does not injure, jeopardize or upset the operation of existing production, storage and distribution facilities during the course of construction works
- Carry out site inspections to verify that the construction works and installation of equipment are in accordance with the contract documents
- Monitor environmental impact during construction and issue directives to the contractor to control
- Report to the project manager and make recommendations if the contractor is not carrying out his work in accordance with the contract documents
- Prior to substantial completion carry out and inspection of the facility with the contractor and NWSDB and prepare a master deficiency list

(4) Training for operation and maintenance (civil works)

- Prior to commissioning of any equipment, arrange with the supplier to instruct operating staff in the proper care, operation and maintenance of the equipment
- Prepare the operation and maintenance manuals for each facility at least one month before commissioning the works. Maintenance of equipment is related to the maintenance manual submitted by the Contractor. The manual shall include detailed specifications and operating procedures for all supplied equipment. Provide a process control narrative describing step-by-step procedures for proper operation of the facilities under various conditions and control modes.
- Instruct the operating staff in the proper monitoring, control and operation of the facilities. This will include response to abnormal conditions, alarms and equipment failures.
- Provide technical assistance with operation for a period of 2 months after commissioning the facilities
- Organize a post-mortem workshop to review lessons learned during construction and commissioning of the facilities

(5) Counterpart Training

In-house and overseas training for the following topics:

- NRW Reduction/ Leak Detection
- Billing and Collection Activities
- Planning and Design

(6) Services required during implementation of NRW program

The consultant will provide advisory/ management services on the NRW reduction activities as follows:

- Supervise LCB contracts for leak reduction and low-income settlement improvements.
- Assist NWSDB in establishing waste districts and measurement/monitoring of NRW ratio in CB1 area on a monthly basis
- Review NRW reduction programmes in CB1 area implemented by NWSDB, guide and advise NWSDB staff in formulating work plans and strategies towards achieving the project goal of 30% NRW ratio by the year 2005. NWSDB activities include:
 - Rectification of defective meters
 - Metering un-metered consumers

- Leakage detection and correction
- NRW reduction in low-income settlements and public stand posts by promoting individual service connections and closing common outlets
- NRW reduction in public housing schemes
- Deduction and remedial action for illegal connections
- Measurement of NRW ratio on a regular basis

9.4.3 Allocation of Resources and Inputs

Allocation of resources and inputs for consultant services during construction is presented in Figure 9-4. Duration of inputs is based on the estimated construction schedule.

Services during construction are required for a period of approximately 69 months (5.75 years). Consultant services should start September 2001 to coincide with the evaluation of pre-qualification submissions.

Local consultants can provide most of the services during construction however it is recommended that some of the key project management functions be carried out by foreign consultants with international experience in construction and commissioning of water supply systems:

- Overall project team leader
- Sub-team leader for Maligakanda and Ellie House reservoirs
- Structural engineer for appraisal of old Maligakanda reservoir
- Sub-team leader for water supply enhancements in Kotikawatte-Mulleriyawa (KMU) area
- Mechanical engineer for pump houses in KMU area
- Electrical engineer for KMU pump houses in KMU area
- Technical advisor for implementation of NRW program

9.5 RECOMMENDATIONS ON THE WAY FORWARD

9.5.1 Land acquisition and easements

- (1) Office building

The new office building is designed for the site at Maligakanda that was selected by mutual agreement between NWSDB and CMC. NWSDB is in the process of negotiating land

acquisition with CMC (the owner). Unfortunately CMC appears to be reversing its initial consent to use the land and NWSDB is now considering another site unless the terms of land acquisition can be settled with CMC.

Depending on the configuration and the geotechnical parameters at the final site, relocation could involve complete or partial re-design. Site selection and land acquisition must be resolved before the project can be tendered and sufficient time must be allowed for re-design or adjustment to the design drawings if required.

(2) Temporary easement for reservoir at Maligakanda

A temporary easement is required for the construction of the reservoir at Maligakanda. The proposed easement is to the S/W of the reservoir on land owned by CMC. The property has a large yard and is occupied by a bungalow. NWSDB will need to temporarily acquire part of the yard for the construction of the reservoir only and the land can be restored and returned to the owners afterwards.

The easement must be obtained before the project can be tendered.

(3) Land acquisition for Gothatuwa reservoir and tower

Part of the site for the reservoir, pump house and water tower is owned by the NWSDB and occupied by a 227 m³ water tower which will be kept in service. The remaining land, which is vacant except for one small bungalow, must be acquired from the Fever Hospital.

The N/E corner of the new reservoir will be located 3.5 m from the wall of a building owned by Fever Hospital. NWSDB has entered negotiations land acquisition but no decisions have been taken yet. The Fever Hospital has requested that the wall of the reservoir be moved to provide a minimum of 5 m from the building to the reservoir structure. Moving the wall would result in a reduced volume and would require an adjustment to the design drawings.

Land must be acquired before the project is tendered and sufficient time must be allowed for any adjustments to the design drawings if required.

9.5.2 Temporary relocation of CMC offices at Maligakanda

The new reservoir at Maligakanda is required in order to proceed with rehabilitation of the old reservoir. Since the new reservoir will be constructed in the space occupied by the CMC water works and drainage offices, CMC staff must be relocated elsewhere before work on the reservoir can begin.

In the initial planning concept the staff from CMC offices are to be relocated to the new office building before starting the construction of the reservoir. This sequence must be revised because construction scheduling indicates that the rehabilitation of old reservoir could not be finished until mid-2007 thereby exceeding the JBIC loan period.

Construction of the new reservoir must start before the new office building is finished. Therefore the staff from CMC offices will need temporary accommodations from approximately March 2003 to June 2004 until the new office building is ready for occupancy.

9.5.3 Assessment of Old Maligakanda Reservoir

A structural appraisal of the old reservoir is required before starting construction of the new roof to determine if the reservoir can in fact provide another 40 to 50 years of trouble free, water tight service. If the reservoir is deemed unsound or near the end of its service life then there will be no financial benefit for replacing the roof and the reservoir should be replaced entirely or abandoned.

A thorough inspection and appraisal of the structure will require a 4 to 5 month study period consisting of:

Before dewatering

- Geotechnical investigation
- Leakage test

After dewatering

- Initial visual inspection and appraisal
- Initial non-destructive testing
- Preliminary structural/geotechnical analysis and modelling
- Establish the cause of failure/deterioration
- Further testing as identified by results of preliminary analysis, destructive testing if required
- Identify remedial measures if required.
- Report

9.5.4 Confirmation of Geotechnical conditions at Gothatuwa

A complete geotechnical investigation was not possible during the detailed design because permission to access the property was not granted by the owners. Design of the reservoir foundations and walls is based on parameters obtained from nearby boreholes.

The NWSDB must carry out a Geotechnical investigation and assessment of the reservoir site to confirm the foundation design parameters and sufficient time must be allowed to make adjustments to the design.

9.5.5 Timing for Construction of a 600 mm Transmission Main to Kolonnawa New Reservoir

Route of the above main which is to be constructed by NWSDB under another contract passes through Angoda Road and Delgahawatta Road along which laying of distribution mains under this project will be carried out. Provision has been made for the 600 main in the canal crossing in Delgahawatta Road. There is also an existing 600 mm main along Delgahawatta the position of which has been taken into account in the this Study. NWSDB should coordinate the detailed design of 600 mm main in these roads and the timing of its construction to reduce inconvenience to the public.

9.5.6 As-built drawings and construction records

NWSDB is presently coping with a large number of water supply development projects around Colombo and in other major cities across the country. NWSDB is aware of the need to plan rigorous O&M programs to protect the significant investment in new infrastructure. The present documentation system is completely inadequate. Effective operations and maintenance of the water supply system requires accurate records and drawings of the distribution network, and these documents must be available to the operators and kept up to date for future reference.

A workable document management system needs to be implemented on an priority basis to ensure the sustainability of investments.

Table 9.1 Roles and Responsibilities for Implementation of the Project

Project component	Sub-component	Consultant	NWSDB	CMC	Contractors
Implementation of NRW reduction plan	Leak Repair Works in CMC Area	<ul style="list-style-type: none"> Evaluation of Bids Assistance in contract negotiations Inspect site to confirm leak and repair method Supervise repairs Approve as-built drawings and certify monthly progress billings Employ NGO to carry out baseline survey Recommend initial selection of tenement gardens for improvement Finalize tender documents Evaluation of Bids Assistance in contract negotiations Construction supervision Approval of shop drawings and certification of monthly progress billings Evaluation of pre-qualification applications Evaluation of Bids Assistance in contract negotiations 	<ul style="list-style-type: none"> Identify location and type of leak Site inspection to confirm the leak and repair method Provide materials to the contractors Supervise the repair 	<ul style="list-style-type: none"> Assist with location of leaks Coordinate planned service interruptions and provide public relations during construction 	<ul style="list-style-type: none"> Excavate and repair 2,340 leaks in distribution mains and 9,000 leaks in service mains Obtain excavation permits Provide monthly as-built drawings
	Low Income Settlement Environmental Improvements	<ul style="list-style-type: none"> discuss initial selection of tenement gardens and confirm with other agencies final decision of tenement gardens for improvement prepare designs for piping layouts and cost estimates supply of materials Coordination with community leaders 	<ul style="list-style-type: none"> Assist with location of leaks Design of drainage improvements to coordinate with NWSDB water supply improvements 	<ul style="list-style-type: none"> Implement improvements to approx. 30 TGs Excavate/backfill pipe trench to boundary of settlement (residents are responsible for carrying out excavation/backfill activities within settlement boundaries) Lay distribution pipe materials and fittings throughout the settlement and make connection to existing distribution mains 	
	Supply of materials and equipment for implementation of NRW reduction plan	<ul style="list-style-type: none"> Tender and award of supply contract Receive training 	<ul style="list-style-type: none"> Supply equipment and materials in accordance with specification documents 		

Table 9.1 Roles and Responsibilities for Implementation of the Project

Project component	Sub-component	Consultant	NWSDB	CMC	Contractors
Construction and Rehabilitation of Reservoirs	Maligakanda Office Building	<ul style="list-style-type: none"> Evaluation of pre-qualification applications Evaluation of Bids Assistance in contract negotiations Services during construction Technical assistance for training period 	<ul style="list-style-type: none"> Acquire land Obtain permits and approvals Review of shop drawings and final selection of materials, finishes, fittings, colors etc.... Supply and install all office fittings and furniture Supply and install telecom system. 	<ul style="list-style-type: none"> Demolition of existing buildings and removal of tress and services Construction of new office building: coordinating all civil, structural, mechanical and electrical trades 	
	Maligakanda New Reservoir	<ul style="list-style-type: none"> Improve water supply to Maligakanda site to fill existing and new tank Coordinate planned service interruptions and provide public relations during construction Formulation of risk management plan for safe handling of chlorine and emergency response to chlorine leak 	<ul style="list-style-type: none"> Relocate staff and equipment to new building prior to construction of reservoir Coordinate reservoir operations during construction Implementation of risk management plan for chlorine safety Receive training on operation and maintenance 	<ul style="list-style-type: none"> Demolition of existing buildings and removal or relocation of services Construction of a post tensioned concrete water retaining structure, testing and commissioning Modification to existing yard piping, supply and installation of new yard piping Construction of new valve house Rehabilitation of existing chlorination facility and supply and installation of chlorine equipments Coordination of activities to minimize disruption in services 	
	Rehabilitation of the existing reservoir roof structure at Maligakanda	<ul style="list-style-type: none"> Evaluation of pre-qualification applications Evaluation of Bids Assistance in contract negotiations Services during construction Prepare operation and maintenance manual Technical assistance for training 	<ul style="list-style-type: none"> Inspection and evaluation of existing reservoir structure to determine stability and water tightness prior to construction of new roof Rehabilitation of walls if necessary (sealing cracks and applying protective bituminous coating) 	<ul style="list-style-type: none"> Emptying and cleaning out the existing reservoir prior to inspection and evaluation 	<ul style="list-style-type: none"> Demolition of existing roof structure and removal of debris Construction of new roof Cleaning, disinfection and commissioning

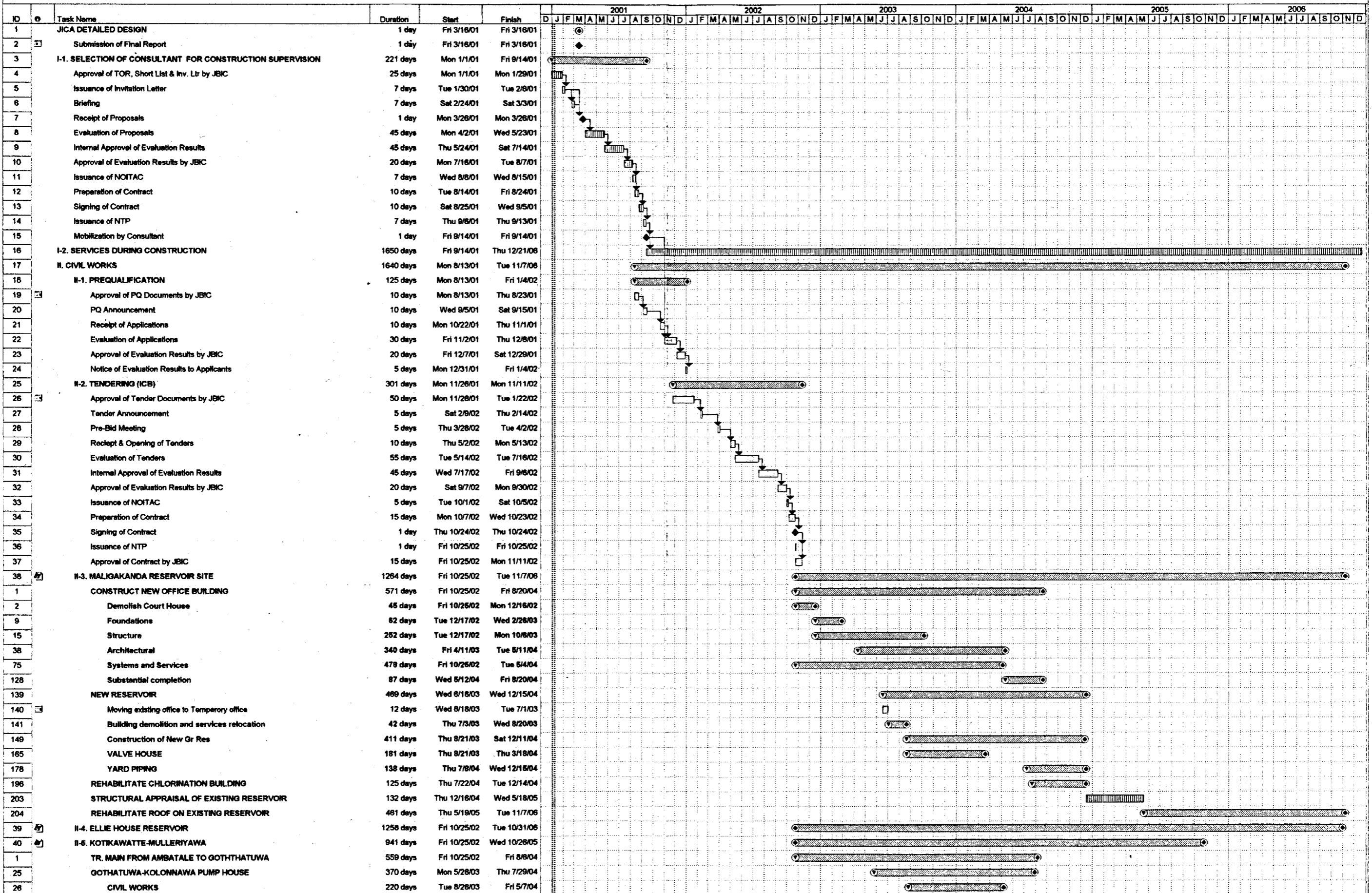
Table 9.1 Roles and Responsibilities for Implementation of the Project

Construction and Rehabilitation of Reservoirs	Ellie House New Reservoir	<ul style="list-style-type: none"> Evaluation of pre-qualification applications Evaluation of Bids Assistance in contract negotiations Services during construction Technical assistance for training period 	<ul style="list-style-type: none"> Coordinate planned service interruptions and provide public relations during construction Formulation of risk management plan for safe handling of chlorine and emergency response to chlorine leak 	<ul style="list-style-type: none"> Coordinate reservoir operations during construction Implementation of risk management plan for chlorine safety Receive training on operation and maintenance 	<ul style="list-style-type: none"> Demolition of existing reservoir and removal of debris Construction of a new concrete water retaining structure, testing and commissioning Modification to existing yard piping, supply and installation of new yard piping Construction of new valve house and office building New chlorination facility and supply and installation of chlorine equipments Coordination of activities to minimize disruption in services
	Gothatuwa-Kolonnawa Pump House	<ul style="list-style-type: none"> Upgrade treatment plant electrical distribution and provide service connection point Planned shutdown of treatment process for connection to treated water main 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Construction, testing and commissioning of pump house Coordination of activities to minimize disruption in services 	
Water Supply Enhancement in Kotikawatte and Mulleriyawa Area	Gothatuwa Transmission Main	<ul style="list-style-type: none"> Evaluation of pre-qualification applications Evaluation of Bids Assistance in contract negotiations Services during construction Prepare operation and maintenance manual Technical assistance for training period 	<ul style="list-style-type: none"> Coordinate traffic disruptions with appropriate authorities and provide public relations during construction Obtain approvals and easements Coordinate with other authorities and utilities 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Supply and installation of transmission main Testing and disinfection, coordinated with completion of pump house and reservoir Traffic control and coordination of road closures
	Gothatuwa Ground Reservoir and Pump House		<ul style="list-style-type: none"> Acquire land Provide operating staff Receive training on operation and maintenance 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Sequential construction, testing and commissioning of reservoir, pump house and water tower Coordination of activities to minimize disruption in services
	Gothatuwa New Water Tower		<ul style="list-style-type: none"> Obtain approvals and easements Coordinate with other authorities and utilities 	<ul style="list-style-type: none"> None 	
	Distribution Mains in Kotikawatte and Mulleriyawa Area			<ul style="list-style-type: none"> None 	

Table 9.1 Roles and Responsibilities for Implementation of the Project

Rehabilitation/ Reinforcement of Medium and Large Diameter Pipe Network in CMC	Scraping and lining of Medium and Large Diameter Mains	<ul style="list-style-type: none"> • Evaluation of pre-qualification applications • Evaluation of Bids • Assistance in contract negotiations • Services during construction 	<ul style="list-style-type: none"> • Public relations during service interruptions • Coordinate authorities and utility services concerned to facilitate the work 	<ul style="list-style-type: none"> • Coordination of temporary by-pass water supply • Coordination of road closures and traffic control 	<ul style="list-style-type: none"> • Scraping and cement mortar lining of distribution mains (250 to 450mm ND) • Supply and install new ductile iron distribution mains (300 to 500mm ND) • Replace valves attached to the mains that are rehabilitated • Temporary by-pass and service connections • As-built plan and profile drawings
	Installation of reinforcement mains				
	Rehabilitation of valves				
Rehabilitation/Repla cement of Small Diameter Distribution Mains in CB1	Replacement of Small Diameter Distribution Mains	<ul style="list-style-type: none"> • Evaluation of pre-qualification applications • Evaluation of Bids • Assistance in contract negotiations • Services during construction 	<ul style="list-style-type: none"> • Public relations during service interruptions • Coordinate authorities and utility services concerned to facilitate the work 	<ul style="list-style-type: none"> • Coordination of temporary by-pass water supply • Coordination of road closures and traffic control 	<ul style="list-style-type: none"> • Replace existing cast iron mains with PVC mains (75 to 150mm ND) • Supply and installation of materials • Temporary by-pass and service connections • As-built plan and profile drawings
	Scraping and lining of Small Diameter Distribution Mains				
	Replacement of service connections				
	Replacement of valves				
Project Management	Implementation and construction	<ul style="list-style-type: none"> • Provide services during construction • Provide technical advice during implementation • Contract administration and cost control • Monitor performance and progress of contractor 	<ul style="list-style-type: none"> • Coordinate implementation of programs • Coordination with other authorities 	<ul style="list-style-type: none"> • Coordinate implementation of programs • Coordinate operation of reservoirs and mains during rehabilitation 	<ul style="list-style-type: none"> • Submit documentation for approval in accordance with specifications • Coordinate construction activities and schedules

Figure 9-1 Project Implementation Schedule

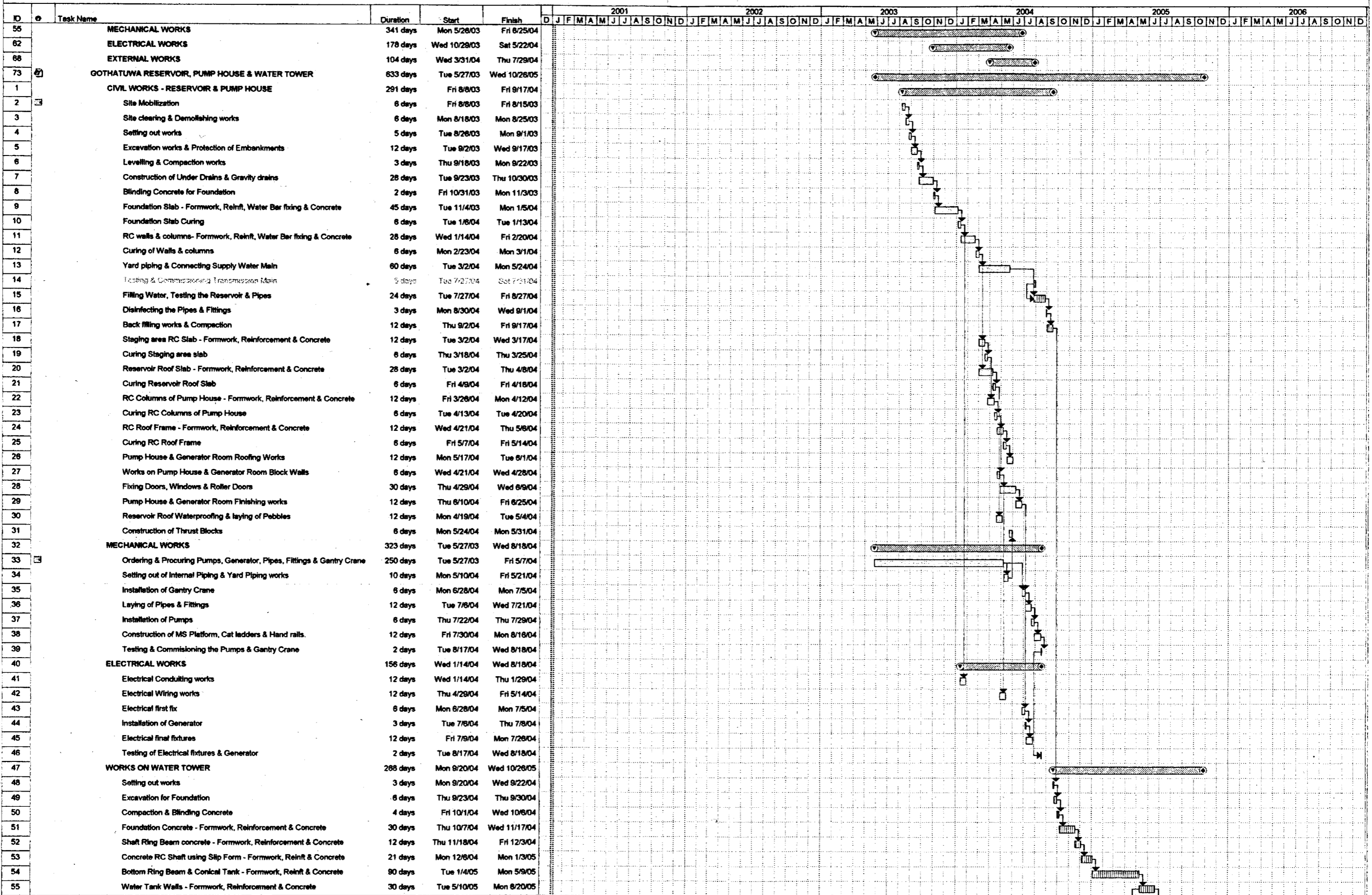


Project: Pre-construction Date: Sun 1/7/01

Task: Critical Task: Milestone: Rolled Up Task: Rolled Up Milestone: Split: Project Summary:

Task Progress: Critical Task Progress: Summary: Rolled Up Critical Task: Rolled Up Progress: External Tasks:

Figure 9-1 Project Implementation Schedule



Project: Pre-construction Date: Sun 1/7/01

Task: [] Critical Task: [] Milestone: [] Rolled Up Task: [] Rolled Up Milestone: [] Split: [] Project Summary: []

Task Progress: [] Critical Task Progress: [] Summary: [] Rolled Up Critical Task: [] Rolled Up Progress: [] External Tasks: []

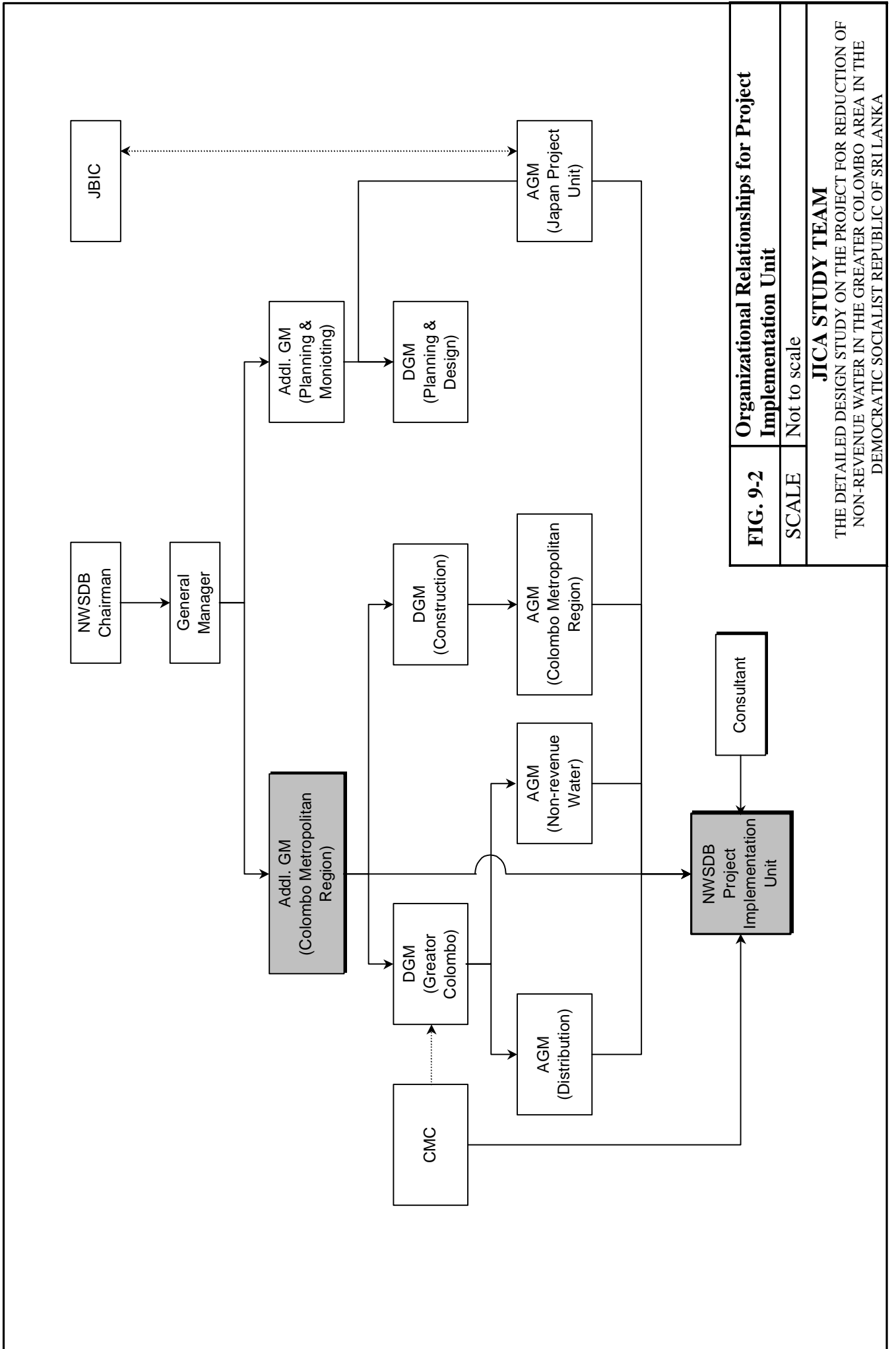


FIG. 9-2 Organizational Relationships for Project Implementation Unit

SCALE Not to scale

JICA STUDY TEAM

THE DETAILED DESIGN STUDY ON THE PROJECT FOR REDUCTION OF NON-REVENUE WATER IN THE GREATER COLOMBO AREA IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

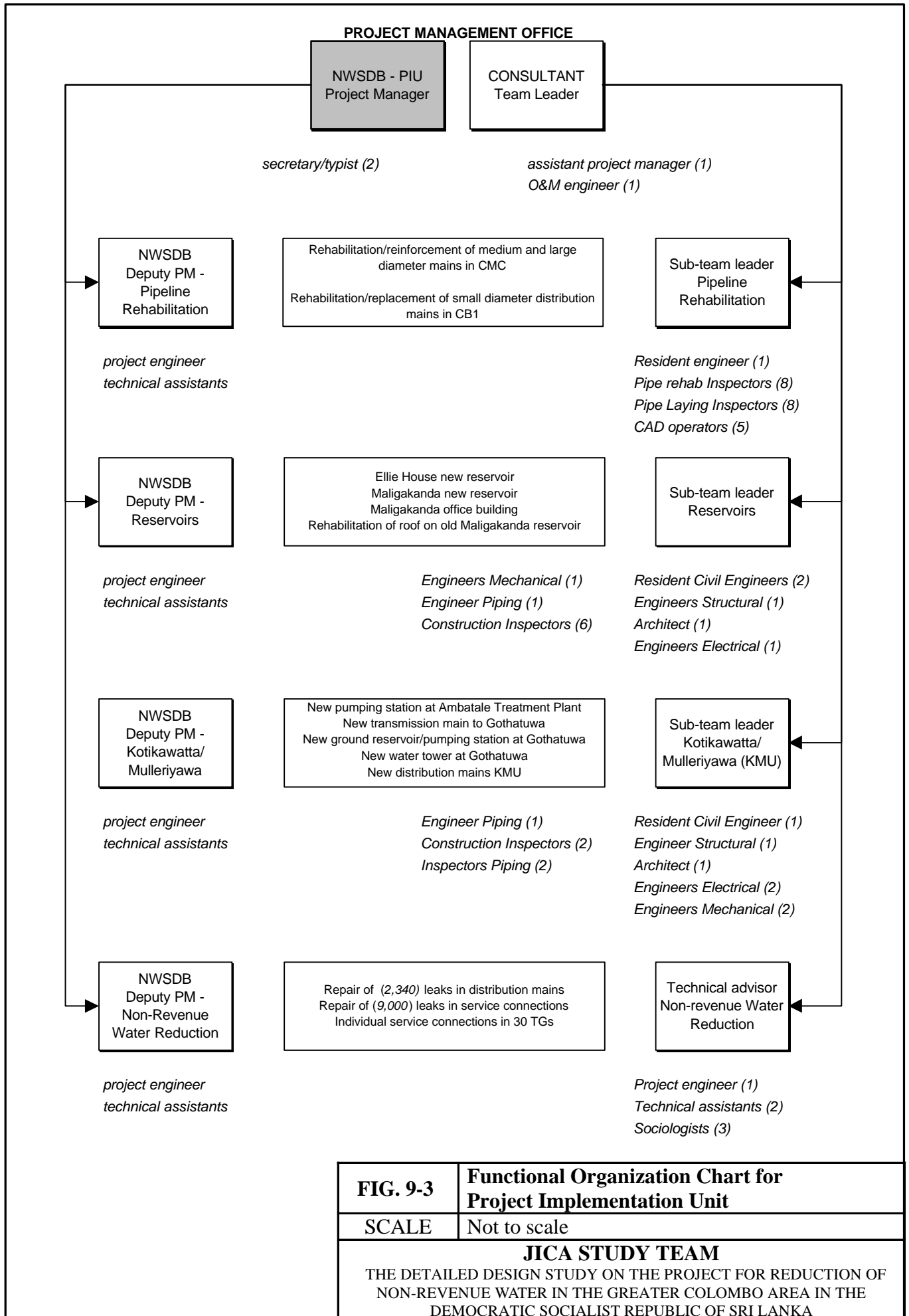


Figure 9-4 Engineering and Personnel Input Breakdowns for Implementation

Positions /Resources	Service provider	Required man months										Total Man-Months		
		2001	2002	2003	2004	2005	2006	2007	Foreign	Local				
1) PROJECT MANAGEMENT OFFICE														
1-1 Tendering Civil Works (ICB)														
1-2 Tendering (LCB)														
Consultant Services - Team Leader	Foreign Consultant	1	3	2	2	2	2	2	2	2	2	2	2	28
Assistant Team Leader - scheduling, documentation, cost control	local consultant	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	31.5
O&M Engineer - manuals, and training	Foreign Consultant						3	2						5
Secretary/typist (2)	local consultant	2	6	6	6	6	6	6	6	6	6	6	6	122
office boy	local consultant	1	3	3	3	3	3	3	3	3	3	3	3	61
per diems F/C														33
car rentals (1)														
2) MALIGAKANDA and ELLIE HOUSE RESERVOIRS														
Sub-team leader - civil/structural engineer	Foreign Consultant	2	2	3	2	2	2	2	2	2	2	2	2	23
per diems														
car rentals (1)														
2-1 Maligakanda Office Building														
2-2 Maligakanda New Reservoir														
2-3a Maligakanda roof rehabilitation														
Resident - civil/structural engineer	Local Consultant	2	2	2	2	2	2	2	2	2	2	2	2	31
structural engineer	Local Consultant	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	22.5
architect	Local Consultant	1	1	1	2	2	2	2	2	2	2	2	2	12
electrical engineer	Local Consultant													6
mechanical engineer	Local Consultant				2	2	2	2	2	2	2	2	2	6
pipng engineer	Local Consultant				1	1	1	2	2	2	2	2	2	9
construction inspectors - structural (1)	Local Consultant	2	3	3	3	3	3	3	3	3	3	3	3	44
construction inspector - electrical	Local Consultant				1	2	2	2	2	2	2	2	2	9
construction inspector - mechanical	Local Consultant				2	2	2	2	2	2	2	2	2	7
construction inspector - building trades	Local Consultant			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	9
construction inspector - piping	Local Consultant				3	3	3							9
2-3b Structural appraisal old Maligakanda reservoir														
structural engineer - appraisal and rehabilitation specialist	Foreign Consultant													4
structural engineer	Local Consultant													5
geotechnical engineer	Local Consultant													2
car rentals (1)														
per diems														4
2-4 Ellie House Reservoir														
Resident - civil/structural engineer	Local Consultant	2	2	2	2	2	2	2	2	2	2	2	2	34
pipe engineer	Local Consultant				1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	11.5
structural engineer	Local Consultant				1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	10.5
architect	Local Consultant				1.5	1.5								4.5
electrical engineer	Local Consultant				1	1								2
mechanical engineer	Local Consultant				1	1								2
construction inspector - structural (1)	Local Consultant	2	3	3	3	3	3	3	3	3	3	3	3	32
construction inspector - electrical/mechanical	Local Consultant				1	1								2
construction inspector - piping	Local Consultant				3	3	3							17
3) WATER SUPPLY ENHANCEMENT in KOTIKAWATTE and MULLERIYAWA AREA														
3-1 Gothatuwa transmission main														
3-2 Gothatuwa-Kolonnawa Pump House														
3-3 Gothatuwa Reservoir, Pump House and New Water Tower														
3-4 Gothatuwa Distribution mains														
Sub-team leader - civil/structural engineer	Foreign Consultant				3	1	2	2	2	2	2	2	2	13
Resident - civil/structural engineer	Local Consultant	1	1	2	2	2	2	2	2	2	2	2	2	20
mechanical engineer	Foreign Consultant				2	1								3
mechanical engineer	Local Consultant				1	2	2	2	2	2	2	2	2	7
electrical engineer	Foreign Consultant				2	1								3
electrical engineer	Local Consultant				1	2	2	2	2	2	2	2	2	7
pipeline engineer	Local Consultant	1	1	1	3	3	3	3	3	3	3	3	3	20
architect	Local Consultant				1	1	1	1	1	1	1	1	1	5
construction inspector - structural (1)	Local Consultant	2	3	3	3	3	3	3	3	3	3	3	3	24
construction inspector - electrical/mechanical	Local Consultant				2	2	2	2	2	2	2	2	2	8
construction inspectors - piping (2)	Local Consultant				2	6	6	6	6	6	6	6	6	34
per diems F/C														19
car rentals (2)														
4) REHABILITATION AND REINFORCEMENT OF MEDIUM AND LARGE DIAMETER PIPE NETWORK														
rehabilitation														
reinforcement														
Sub-team leader - water supply/pipeline engineer	Local Consultant				1	3	3	3	3	3	3	3	3	28
Assistant Resident Engineer	Local Consultant				1	3	3	3	3	3	3	3	3	28
pipe scrapping and relining inspectors (4)	Local Consultant				4	12	12	12	12	12	12	12	12	112
pipe laying inspectors (4)	Local Consultant				4	12	12	12	12	12	12	12	12	80
CAD Operators (2)	Local Consultant				6	6	6	6	6	6	6	6	6	54
per diems F/C														0
car rentals														
5) REHABILITATION/REPLACEMENT OF SMALL DIAMETER DISTRIBUTION MAINS														
rehabilitation														
reinforcement														
pipe scrapping and relining inspectors (4)	Local Consultant				4	12	12	12	12	12	12	12	12	80
pipe laying inspectors (4)	Local Consultant				4	12	12	12	12	12	12	12	12	160
CAD Operators (3)	Local Consultant				3	9	9	9	9	9	9	9	9	84
per diems F/C														0
car rentals														
6) IMPLEMENTATION OF NRW REDUCTION														
6-1 Leak Repair Works														
6-2 Low Income Settlement Environmental Improvements														
6-3 Supply of materials and equipment														
6-4 Advisory and management services on NRW Program														
Technical advisor - NRW/water supply engineer	Foreign	1	3	2	2									8
Project Engineer	local consultant	1	3	3	3	3	3	3	3	3	3	3	3	25
Technical assistants (2)	local consultants	2	6	6	6	6	6	6	6	6	6	6	6	50
Sociologists (3)	Local Consultant/NGO				9									18
per diems F/C														8
car rentals (1)														
TOTAL														151
														1,346

CHAPTER 10

10 PROJECT EVALUATION

10.1 TECHNICAL EVALUATION

10.1.1 Operation and Maintenance of Project Facilities

(1) General

The new water supply facilities must be properly maintained and operated to ensure efficient delivery of safe potable water in sufficient quantities and adequate pressure.

The facilities have been designed to simplify operations and to minimize the amount of preventive maintenance required. Nevertheless operations staff will require training and a preventive maintenance program will need to be implemented to ensure reliable delivery of water.

(2) Work Program for operation and maintenance

Operation activities can normally be classified into daily or periodical functions. Maintenance is classified as preventive or corrective. Most operation and maintenance activities can be planned for and scheduled however there will occasionally be a need to carry out corrective maintenance when equipment fails. Planned operation and maintenance activities for the new facilities are described in Table 10-1.

Table 10-1 Operation and Maintenance Requirements of New Facilities

Facility	Operations	Maintenance
Pump Houses	<ul style="list-style-type: none"> • Reading and recording instruments • Operation of electrical and mechanical systems • Responding to alarm conditions • Manual override of automatic systems (periodic) • Adjusting start and stop schedule and sequence 	<ul style="list-style-type: none"> • Visual inspection of M&E equipment • Weekly test of diesel generator • Preventive maintenance to M&E equipment
Transmission Main	<ul style="list-style-type: none"> • Adjust flow control to match reservoir operations 	<ul style="list-style-type: none"> • visual inspection of valves, and pipe bridges (monthly) • air valve maintenance (monthly)
Ground Reservoirs	<ul style="list-style-type: none"> • Check residual chlorine at outlet (daily) • Adjust chlorine dosage (weekly) • Water quality examination in reservoir (weekly) • Adjust position of inlet valves • Adjust position of distribution valves 	<ul style="list-style-type: none"> • Operate inlet valves (weekly) • Operate sluice gates (weekly) • Visual inspection (annual) • Cleaning (annual) • Grass cutting etc...
Elevated Tank	<ul style="list-style-type: none"> • Check residual chlorine at outlet (daily) 	<ul style="list-style-type: none"> • Visual inspection (annual) • Cleaning (annual) • Operate by-pass valve (monthly)
Distribution Mains	<ul style="list-style-type: none"> • Water quality examination at end points (monthly) • Flush mains (annually) • Operate valves (semi-annually) 	<ul style="list-style-type: none"> • Leakage detection and correction • Repair and replacement of pipe and meters • Repair covers and clean out valve chambers (annual)

(3) Organization for Operation and maintenance

Although the water board is ultimately responsible for all aspects of water supply in Metropolitan Colombo, some aspects of service delivery and maintenance within CMC are contracted out to CMC Water Works Department. Responsibility for operation and maintenance of the new facilities will be as follows:

Table 10-2 Organizations Responsible for Operation and Maintenance

Facility	Organization Responsible	Organizational Unit
Kolonnawa-Gothatuwa Pump House	<ul style="list-style-type: none"> • NWSDB 	<ul style="list-style-type: none"> • AGM Production
Gothatuwa Pump House & Ground Reservoir	<ul style="list-style-type: none"> • NWSDB 	<ul style="list-style-type: none"> • AGM Distribution Section 1 • Manager Towns East
Gothatuwa Elevated Water Tower	<ul style="list-style-type: none"> • NWDSB 	<ul style="list-style-type: none"> • AGM Distribution Section 1 • Manager Towns East
Kolonnawa-Gothatuwa Transmission Main	<ul style="list-style-type: none"> • NWSDB 	<ul style="list-style-type: none"> • AGM Distribution Section 1 • Manager Towns East
Distribution mains in Kotikawatte-Muleriyawa	<ul style="list-style-type: none"> • NWSDB 	<ul style="list-style-type: none"> • Manager Towns East
Maligakanda Ground Reservoir	<ul style="list-style-type: none"> • CMC 	<ul style="list-style-type: none"> • Water works office
Ellie House Ground Reservoir	<ul style="list-style-type: none"> • CMC 	<ul style="list-style-type: none"> • Water works office
Distribution Mains (CB1, CB2, CB3)	<ul style="list-style-type: none"> • NWSDB • CMC 	<ul style="list-style-type: none"> • AGM Distribution Section 2 • Manager Colombo City

Table 10-3 Staffing Required for Operation and Maintenance of New Facilities

Facility	Staff position	No. of persons	O&M Functions
Kolonnawa-Gothatuwa Pump House Maintenance	Operators	2	<ul style="list-style-type: none"> • Operation of pumping system
	Superintendent	Use existing treatment plant staff	<ul style="list-style-type: none"> • Planning and scheduling maintenance works
	Mechanic		<ul style="list-style-type: none"> • Preventive and corrective maintenance
	Electrician		
	Laborers		
Gothatuwa Pump House, Ground Reservoir and Elevated Tower	Operators	2	<ul style="list-style-type: none"> • Operation of pumping system and reservoir
	Superintendent	Use existing treatment plant staff	<ul style="list-style-type: none"> • Planning and scheduling maintenance works
	Mechanic		<ul style="list-style-type: none"> • Preventive and corrective maintenance • Reservoir cleaning
	Electrician		
	Laborers		
Kolonnawa-Gothatuwa Transmission Main Maintenance	Foreman	1	<ul style="list-style-type: none"> • Visual inspections • Preventive and corrective maintenance
	Pipe fitters	1	
	Laborers	2	
Kottikawatte-Muliyawa distribution mains	Foremen	2	<ul style="list-style-type: none"> • Operation & Maintenance of valves • repair of leaks • Connection of new services
	Pipe fitters	2	
	Drivers	2	
	Laborers	4	
Maligakanda Ground Reservoir	Operator	Use existing CMC staff	<ul style="list-style-type: none"> • Operation of reservoir and distribution valves
	Mechanic		<ul style="list-style-type: none"> • Preventive and corrective maintenance • Reservoir cleaning
	Laborers		
Ellie House Ground Reservoir	Operator	Use existing CMC staff	<ul style="list-style-type: none"> • Operation of reservoir and distribution valves
	Mechanic		<ul style="list-style-type: none"> • Preventive and corrective maintenance • Reservoir cleaning
	Laborers		
Distribution Mains (CB1, CB2, CB3)	Foremen	Use existing CMC staff	<ul style="list-style-type: none"> • Maintenance of valves and repair of leaks • Connection of new services
	Drivers		
	Pipe fitters		
	Laborers		

(4) Training

Pump operation and flow control

Pump maintenance

Chlorination system operation and Emergency response to chlorine leakage

Reservoir operations

(5) O&M costs

Power

Chemicals

Staffing

Equipment

10.1.2 Roles and Responsibilities of NWSDB and CMC

(1) Present Situation

Maintenance and operation of the water supply system in Colombo lacks clear definition of roles and responsibilities. Maintenance of the distribution mains is predominantly carried out by CMC Water Works Department under a service contract to the NWSDB. Maintenance and repair of service connections is carried out by both CMC and NWSDB (Area offices/NRW unit).

(2) Problems noted during the study

Problems noted during the study indicate that duplication of roles and responsibility will be a significant impediment to the successful implementation of leakage detection and correction:

- There is inadequate sharing of information between the two organizations and record keeping is poor
- There is no systematic leakage detection or correction program in either CMC or NWSDB. Repair teams are dispatched in response to public complaints or reports.
- There is no single agency to receive complaints or reports on leakage from the public. The confusion leads to non-reporting.

(3) Recommendations for future NRW efforts

As long as NRW remains high, NWSDB should be the sole agency responsible for operation and maintenance of the water supply system including leakage detection and correction.

10.2 FINANCIAL EVALUATION

10.2.1 Quantifiability of Project

Costs and benefits of each component can be identified in comparison between “With Project” and “Without Project” situations as shown in Table 10-4.

Table 10-4 Costs and Benefits of Components

Component	Cost	Benefit
Rehabilitation of reservoirs	Zero for rehabilitation of existing reservoirs Capital expenditure of a new reservoir (quantifiable)	Avoidance of opportunity loss due to water supply cut that will occur if no preventive rehabilitation is made now (quantifiable) Profit increase from newly constructed reservoir (quantifiable)
Rehabilitation and strengthening of distribution facilities	Capital expenditure (quantifiable)	Profit increase from newly supplied water (quantifiable)
NRW Action Plan	Equipment cost, mass media campaign cost, etc. (quantifiable)	Decrease of variable cost incurred at WTPs attributable to production decrease caused by NRW reduction (unquantifiable) Profit increase from newly billed water (unquantifiable)
Rehabilitation of distribution pipe network	Capital expenditure (quantifiable)	Ditto

10.2.2 Financial Evaluation

The financial viability of each component will be evaluated by three indicators, which are the Net Present Value (NPV), the Benefit Cost Ratio (B/C) and the Internal Rate of Return (IRR). The results of computation of NPV, B/C, and IRR and NPV are summarized in Table 10-5. Detailed computations are shown in Appendix 10A.

NPV is computable for “ Rehabilitation of reservoirs component”, and “ Rehabilitation and strengthening of distribution facilities component”. B/C and IRR are computable only for “ Rehabilitation and strengthening of distribution facilities component”.

“ Rehabilitation of reservoirs component” is regarded financially viable because of its positive NPV. “ Rehabilitation and strengthening of distribution facilities component” is not financially viable if it is implemented alone. However if “ Rehabilitation of reservoirs component” and “ Rehabilitation and strengthening of distribution facilities component” are implemented together, or all of the four components are combined, the overall NPV would exceed Rs. 911 million. Therefore the financial viability is justifiable.

Table 10-5 Summary of Financial Indicators

Component	NPV	B/C	IRR
Rehabilitation of reservoirs	Rs. 1,091 M	Incomputable	Incomputable
Rehabilitation and strengthening of distribution facilities	- Rs. 180 M	0.5	6.4 %
NRW Action Plan Rehabilitation of distribution pipe network	Incomputable	Incomputable	Incomputable
Total Project	Over Rs. 911 M	Incomputable	Incomputable

“ NRW Action Plan component” and “ Rehabilitation of distribution pipe network component” cannot be judged as financially sound from NPV, B/C, or IRR. However they must have more benefits than costs. Those unquantifiable benefits are, for example:

- Reduction of road maintenance cost
- Reduction of fire loss
- Alleviation of household chores
- Improvement of health condition

- Increase of land prices
- Ripple effect on local and national economy

10.3 SOCIOECONOMIC EVALUATION

10.3.1 Affordability and Willingness of Low Income Settlements

The report on Pilot Projects in Low Income Settlements adequately demonstrates the affordability of the householders to pay for an individual water connection and to pay the monthly water bill at a reasonable level of consumption. The minimum charge for 10 m³ per month is Rs 35. The average monthly income of families in the pilot sites at Rs 7,858 is well above the perceived poverty line of Rs 1,500 and indeed above the government minimum monthly salary of Rs 6,000 quoted at mid 2000.

Over the last few years NWSDB has reduced the concessionary connection fee to Rs 4,160 (including application form costs and stamp duties), and it allows payment of Rs 3,000 of this amount to be made over 30 months at the rate of Rs 100 per month. To some extent this has been achieved by the requirement that the communities provide all labour for excavation and backfilling free of charge for the reticulation system and the household connections.

The householders are willing to pay this amount for individual connections, particularly when NGO intervention is able to strengthen existing CDCs and gain the confidence of the community in general.

Householders are also willing to pay for the monthly charges, but this will only be successful over time when NWSDB are able to organise the regular and accurate reading of water meters and the timely distribution of monthly bills. Of particular importance is the timely receipt of the first monthly bill for two reasons. Firstly, there is a tendency for new customers to over use the facility resulting in too high a payment. Secondly, if the first bill is received late and is for several months of supply, it is likely that the family will not have the cash to cover such a large bill. In communities such as those found in settlements, families live on a monthly, weekly or even a daily basis when it comes to ready cash and there are rarely any savings to finance sudden, unexpected demands such as a high water bill.

NWSDB would also be well advised to educate these new consumers on the economic use of water or possibly face a greater NRW problem than originally existed. This may also occur if

the disconnection powers of NWSDB for non-payment are not exercised. This situation exists at the moment due to external interventions.

Communities were also found to be willing to contribute cash as well as labour for sanitation and drainage improvements, although this was not put to the test on these projects since these improvements were not carried out for the reasons stated in Section 4.6 of this report. In the Community Attitude Survey over 85% of the households stated that they could assist the project by giving cash contributions for both construction activities and for maintenance of completed infrastructure facilities.

Should such works become necessary to avoid environmental damage by the installation of individual water connections, NWSDB should recognise that it is in its best interest as well as that of the community to combine environmental improvement works with the water supply installation.

For the planned forthcoming projects in the northern part of CMC, most environmental improvements will have to be of a low cost, short-term nature in settlements designated for re-location, and implementation by the community will reduce costs to a minimum. This should guarantee the health and hygiene situation until such times as settlements are subject to re-location. The variety of conditions likely to be met in the settlements makes it impossible to estimate with any accuracy, the likely cost. However, with the goodwill of NWSDB and the communities this should not be considered an obstacle, and both parties will benefit from the improved conditions, increased revenue and reduction in NRW.

10.3.2 Increase in Public Awareness

Public awareness of most aspects of water supply was found to be lacking by the questionnaire survey carried out on a representative sample of 1,000 customers. However, the survey also found that the public was eager to learn more about the subject hence there is a large audience which is both ready and willing to be educated on the subject of water supply.

Implementation of the Water Awareness Mass Media Campaign should go a long way to increasing the public awareness regarding the water supply to Colombo. It is specifically designed to raise the profile of NWSDB and to develop co-operation between NWSDB and the public. Conservation of water resources is to be introduced early in the campaign to set the scene for the need to avoid misuse of water and the need to pay for the provision of water.

The mass media campaign will be able to reach all sections of the public, as it comprises of television and radio broadcasts, information booklets and a variety of posters and stickers. Also, the campaign is designed to be an ongoing procedure, since this is the only way to maintain a high level of awareness and hence sustain the interest, involvement and co-operation of the public.

In addition, the pilot projects in low-income settlement have made an initial start on raising the awareness of this very large group of people to the plan by NWSDB to install individual household connections. These projects have raised awareness on the procedures required to obtain a connection, the concessionary connection cost and the monthly charges for water. The use of an NGO to facilitate the communities has proved successful in raising the awareness of communities to the benefits of household connections, the need to remove standpost supplies and the need to maintain the remaining toilet taps and to ensure they are used for the correct purpose.

By the continuation of these projects by NWSDB, through the current JBIC loan, and by means of further loans, the awareness of the settlement communities will continue to be enhanced, to the benefit of NWSDB in resolving the issue of non-revenue water from settlement standposts.

10.3.3 Necessity for Eliminating External Interventions

Perhaps the most pressing problem faced by NWSDB today is the high level of NRW. This Study seeks to assist NWSDB in its endeavours to reduce considerably the NRW, particularly in the CB1 area of CMC.

Many of the NRW components are linked to consumers; illegal connections and non-payment of monthly water bills are clear examples of this. In its 1999 annual Report, NWSDB recognised that the problem of illegal connections was much more serious than previously thought. This Study has confirmed the seriousness of the situation in both the general housing areas and in the Tenement Gardens (settlements). The pilot projects in the settlements showed a high number of illegal connections, but also a willingness of these households to have their connections legalised. This conversion process did not create any problems and has been a success in the one settlement completed so far.

There are a great number of domestic customers, who have not paid their water bills, and are still connected. The NWSDB senior management holds an extensive list of such defaulters.

There appears to be a reluctance to resolve the matter of defaulters, particularly in low- income groups due to external interventions.

A case in point was mentioned in the NWSDB 1999 report involving the Mahawatta Housing Scheme where NWSDB instituted legal proceedings as only 87 out of 222 customers were paying their bills. Court action was successful on a trial case of four customers, but this was never extended to the remaining defaulters on the intervention of a higher authority who suggested discussion to resolve the issue. Discussions duly agreed on a reduced penalty with payment by instalments but the defaulters never fulfilled their undertaking. This is not an isolated case and there are other examples of external intervention in the day to day running of NWSDB.

The National Water Supply and Drainage Board (Amendment) Act, No 13 of 1992, details the composition of the Board and lays down the requirement that board members shall have wide experience and capability in engineering, finance, public health, and administration and law, and these members will be supported by officers from several related ministries. The Board's powers and duties are clearly defined and intervention by the Minister is, quite rightly, allowed for matters that affect the national interest.

Clearly such a Board, supported by competent senior staff within NWSDB should have no problem in handling all matters related the functions of the organisation. NWSDB need a powerful legal right to combat malpractice's such as non-payment of water bills, and this is provided for under the Act, although some revision is needed to allow for a one stop decision through the courts.

In reality, the staff of NWSDB has shown that in the majority of cases of non-payment, illegal connections etc. such matters can be resolved quickly and quietly without recourse to legal action, which is exactly as it should be.

This Study recommends a Mass Media Campaign on water awareness and seeks to improve the relationship between NWSDB and the public it serves. The acceptance by the Board and the staff of NWSDB of this policy will enable the co-operation of the customers to become a reality, and an atmosphere created to attend to many outstanding issues. The campaign also needs the support of government at all levels, and if this is obtained then the acceptance of the need to pay for water will be confirmed.

Accordingly, it will no longer be necessary for external interventions in matters such as payment of water bills and disconnection of illegal connections, since the general public,

including politicians and government officials at all levels, will have been sensitised to the need to pay for water to ensure the future of NWSDB.

As a result of this project, and the direct labour works of NWSDB, thousands of new customers in low-income areas will be created in the next few years. In addition, the re-location of low-income earners to High Rise Buildings will also increase the customer base. It would be a catastrophe of massive proportions if these new customers, with enhanced living conditions, were to revert to a policy of not paying for water, particularly since the affordability and willingness to pay has already been established.

Therefore there must be a political consensus on the policy of payment for the provision of water by individual connections, and no intervention in the due process of disconnection of defaulters. The very existence of NWSDB as a viable agency depends on this.

It is very much in the hands of the Board and its senior staff to ensure that, by creating awareness in the general public, including government officials and politicians, particularly on the need to pay for water, there would be no reason for intervention by ministers and others in the political arena.

10.4 ENVIRONMENTAL EVALUATION

10.4.1 General

The project is exempt from a formal Environmental Impact Assessment by agreement between GOJ and GOSL. The project will have no major environmental impacts since there is no new water abstraction or treatment process. Nevertheless, identification of potential environmental impacts during construction and recommended countermeasures is a requirement of the JICA TOR for the detailed design study. To meet the requirements the JST has prepared an Environmental checklist presented in Table 10-6 at the end of this Chapter.

The construction and operation of works planned under this project will involve some minor impacts that can be mitigated:

- High noise and vibration levels during construction caused by engine operation, power generators and pumps
- Dust generated by demolition and construction activities
- Transport and Disposal of demolition and construction waste
- Impacts on air quality caused by emissions from construction equipment
- Impact on surface drainage during construction, and discharge of chlorinated water during disinfections of water mains
- Disruption to pedestrian and vehicular traffic during construction
- Health and safety of the public during construction
- Potential health and safety risk from chlorination facilities during operations

10.4.2 Traffic and Safety

The proposed project involves additional vehicle movements to the various construction sites, and the closure of roads for pipe laying activities. These activities will obstruct traffic movement causing some delays and inconvenience.

In all cases, disruptions to traffic and road closures will be coordinated with the appropriate authorities to obtain approval before proceeding. Suitable routes will be identified for traffic diversions where possible.

Safety should be the primary concern at all job sites. Improved safety conditions will help ease traffic movement. Safety during construction can be improved in the following ways:

- Properly barricading the construction site
- Proper fencing along trenches

- Illumination at night for all barricades and safety fences
- Direction signs and flagmen for traffic control and pedestrian safety
- Flagmen to assist drivers of construction vehicles

Details of service lines should be made available for contractors to avoid possible damage. Where details are not available the contractor is required to carry out field surveys and trial pits to locate water mains and services.

10.4.3 Removal, Transport and Disposal of Demolition and Construction Waste

Materials generated during construction will have a temporary impact. Most of the material remove from excavation site can be safely disposed of at municipal dumpsites or used as fill. Construction debris and excavated materials should not be allowed to accumulate in public places (in the case of trenching in CMC area).

Demolition debris, consisting mainly of broken concrete, will need to be hauled to an approved dumpsite where there will be no negative environmental impact.

Construction activities such as demolition, excavation and hauling of materials will result in some dust. The impact will be small and the contractor can control dust by the following measures:

- Keeping exposed earth surfaces moist with water
- Covering dusty materials during transit or when stockpiling

10.4.4 Noise and Vibration

During normal operation of the pump houses, noise impacts will be minimal and will not be detectable outside the property boundary. The only exception will be at Gothatuwa pump house during periods when the emergency power generator is operated. Considering the relatively isolated location of the pump house, noise during operation of the generator is not expected to represent a problem for neighbouring communities.

Noise impacts may be relatively important and unavoidable during the construction period at the reservoir and pump house sites, and during laying of the transmission and distribution mains. Most of the sites are located in urban residential areas. Noise during construction should be limited to 70 dB during the day and 50 dB at night by using low noise emission equipment.

The following actions can be taken to avoid public nuisance:

- Inform the community about the work to be done, period of execution and noise inconvenience
- Avoid operation of highly noisy equipment (like jack hammers) in particularly sensitive areas during specific hours (i.e. school hours is working close to school)
- Avoid the use of highly noisy equipment in hospital zones even for short periods of time
- Do not use highly noisy equipment in residential areas at night
- Limit the period of time during which highly noisy works are carried out

10.4.5 Discharge of Chlorinated Water Used to Disinfect Mains and Reservoirs

Water mains and reservoirs will be disinfected using strongly chlorinated water (10 mg/L). After successful disinfection the chlorinated water must be drained off to a nearby surface drain or sewer. The contractor must take special measures when discharge chlorinated water since it may be toxic to the natural environment at high concentrations. The discharge of chlorinated water must be carefully controlled so it is not discharged in large quantities. Water used for disinfecting should not be discharged until it has lost some of its strength (about 2 mg/L) or until it can be diluted during wet weather periods.

10.4.6 Operation of Chlorination Facilities

Water is chlorinated at the water treatment plants and transmitted to service reservoirs throughout Greater Colombo. NWSDB adds chlorine to the water in service reservoirs at Maligakanda and Ellie House to maintain water quality within the reservoir and boost free residual in the distribution system. Existing chlorine installations lack any safety standards and pose a significant threat to neighbouring communities in close proximity to the reservoirs. The 900 kg cylinders are stored outdoors, unprotected from damage and impossible to contain in case of a leak. Furthermore there are no established procedures for dealing with an emergency or evacuating the public.

A comparison of safer chlorination options and costs was presented to the NWSDB. The study team recommended the use of sodium hypochlorite instead of chlorine, however, Sodium hypochlorite would be about 3.4 times more expensive than 900 kg cylinders.

The NWSDB has instructed the study team to design a gas chlorination system because there is no experience in Sri Lanka with sodium hypochlorite and because commercial availability of hypochlorite may be unreliable. Therefore in order to reduce the risk to the public, the study team has designed chlorination facilities for improved safety by:

- using smaller 68 kg chlorine gas cylinders to reduce the amount of gas released if a cylinder leaks
- storing a smaller quantity of chlorine at the reservoir site, 680 kg instead of 900 kg
- providing gas detection and alarm system
- providing safety equipment and means to neutralize a chlorine leak

Table 10-6 Environmental Checklist

AREA OF CONCERN	ITEMS	MAJOR	SMALL	NONE	NOT CLEAR	PROBLEM	PROPOSED COUNTERMEASURE
POLLUTION	1. Air pollution resulting from chlorination operations						
	2. Soil erosion following tree removal or re-grading as a result of constructing the facility and consequent deterioration of water quality downstream						
	3. Noise and vibration around pumping stations during operations					<ul style="list-style-type: none"> • Gothatuwa pumping station 	
	4. Ground subsidence						
	5. Treatment of sludge from water treatment plant						
NATURAL RESOURCES	1. Impact of the facility on ecology						
	2. Impact on the landscape						
HUMAN ENVIRONMENT	1. Impact the facility will have on the cultural and historical assets						
	2. Impact on existing infrastructure					<ul style="list-style-type: none"> • Potential damage to other utilities 	
	3. Effect on other water uses					<ul style="list-style-type: none"> • Noise, vibration and dust during construction • Disposal of chlorinated water during construction • Disposal of demolition and construction waste • Disruption to Traffic • Disruption to water supply 	
OTHERS	1. Effect on the environment during construction period						
	2. Environmental Monitoring						