THE STUDY
ON
VIENTIANE WATER SUPPLY DEVELOPMENT PROJECT IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

FINAL REPORT

Volume I : Executive Summary

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ABBREVIATIONS

ADB	Asian Development Bank
AFD	French Development Agency
B/C	Benefit/Cost Ratio
CPC	Committee for Planning and Cooperation
CPI	Consumer Price Index
DCTPC	Department of Communication, Transport, Post and Construction, Vientiane Capital City
D/D	Detailed Design
DGM	Deputy General Manager
DHUP	Department of Housing and Urban Planning, MCTPC
DSCR	Debt Service Coverage Ratio
DSR	Debt-service Ratio
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GDP	Gross Domestic Product
GM	General Manager
GOJ	Government of Japan
GOL	Government of Lao PDR
GRDP	Gross Regional Domestic Product
GVA	Gross Value Added
Hhlds	Households
JICA	Japan International Cooperation Agency
Lao PDR	Lao People's Democratic Republic
LDCD	Leakage Detection and Control Division, NPVC
LLCR	Loan Life Debt Service Coverage Ratio
LLDC	Least Less Developed Countries
lpcd	litre per capita day, unit water consumption per day per capita
LRAC	Long-Run Average Cost
MCTPC	Ministry of Communication, Transport, Post and Construction
MOF	Ministry of Finance
MPH	Ministry of Public Health
NPL	Nam Papa Lao
NPSE	Nam Papa State-Owned Enterprise
NPVC	Nam Papa Vientiane Capital City, Water Supply Company of the Vientiane Capital City
NPV	Net Present Value
NPVC Master Plan	Master Plan: Vientiane Water Supply Development Project, November 1999
NRW	Non Revenue Water

NSC	National Statistical Centre
ODA	Official Development Assistance
OECD	Organization for Economic Cooperation and Development
PPP	Public Private Partnership
popn	Population
ROE	Return on Equity
ROI	Return on Investment
S/V	Construction Supervision
UFW	Unaccounted-for Water
UNCHS	United Nations Centre for Human Settlements
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
URI	Urban Research Institute, MCTPC
V. C. City	Vientiane Capital City
VUDAA	Vientiane Urban Development and Administration Authority
VUDMP	Vientiane Urban Development Master Plan
WASA	Water Supply Authority, DHUP, MCTPC
WRCC	Water Resources Coordination Committee
WTP	Water Treatment Plant

ບົດສະຫລຸບສັງລວມ
ການປະຕິບັດວຽກງານ

1. ຄວາມເປັນມາ

ລັດຖະບານຂອງ ສປປ ລາວ ໄດ້ຮຽກຮ້ອງຕ້ອງການໃຫ້ມີການສຶກສາຄົ້ນຄວ້າກ່ຽວກັບໂຄງການພັດທະນານ້ຳປະປາວຽງຈັນ ຊຶ່ງເລີ່ມມາແຕ່ ເດືອນມີນາ 2003 ແລະ ຈະໃຫ້ສຳເລັດເສັດສິ້ນໃນ ເດືອນມັງກອນ 2004 ປະຕິບັດໂດຍອົງການໄຈກ້າ, ຊຶ່ງເປັນອົງການຂອງລັດທີ່ຮັບຜິດຊອບກ່ຽວກັບການປະຕິບັດງານຕາມແຜນການຕ່າງໆທີ່ກ່ຽວກັບຄວາມຮ່ວມມືທາງດ້ານເຕັກນິກ ຂອງລັດຖະບານຍີ່ປຸ່ນ.

ວັດຖຸປະສົງຂອງການສຶກສາຄົ້ນຄວ້າມີຄື:

1. ເພື່ອກະກຽມແຜນການສັ່ງລວມໄລຍະຍາວສຳລັບນ້ຳປະປາວຽງຈັນ. ປີເປົ້າໝາຍຂອງແຜນການສັ່ງລວມນີ້ແມ່ນປີ 2020; ປີເປົ້າໝາຍຂອງແຜນການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳປະປາແມ່ນປີ 2015.
2. ເພື່ອສຶກສາຄວາມເປັນໄປໄດ້ກ່ຽວກັບໂຄງການບູລິມະສິດ ທີ່ຖືກຈຳແນກໄວ້ໃນແຜນການສັ່ງລວມ.
3. ເພື່ອຖ່າຍທອດວິທະຍາການໃຫ້ແກ່ຄູ່ປະສານງານ ທີ່ເຮັດວຽກຮ່ວມກັນ ໃນແຕ່ລະດ້ານຕາມຫລັກສູດຂອງ ການສຶກສາຄົ້ນຄວ້າ.

ການສຶກສາຄົ້ນຄວ້າແມ່ນກວມເອົາຂອບເຂດພື້ນທີ່ໃຫ້ການບໍລິການນ້ຳປະປາໃນປະຈຸບັນ ແລະ ຂອບເຂດສະໜອງນ້ຳປະປາທີ່ວາງແຜນໄວ້ໃນ "ໂຄງການພັດທະນານ້ຳປະປາວຽງຈັນ, ປີ 1999" (ໃນຕໍ່ໜ້າຈະເອີ້ນວ່າ ແຜນການສັ່ງລວມ ນປວ).

2. ແຜນການສັ່ງລວມ

ຄວາມຕ້ອງການນ້ຳໃນອະນາຄົດຊຶ່ງໄດ້ວາງແຜນໄວ້ສຳລັບຄວາມຕ້ອງການນ້ຳໃຊ້ໃນຄົວເຮືອນ ແລະສຳນັກງານອົງການແລະຂົງເຂດທຸລະກິດໂດຍແຍກຕ່າງຫາກ. ສຳລັບຄວາມຕ້ອງການນ້ຳໃຊ້ພາຍໃນຄົວເຮືອນ, ຄວາມຕ້ອງການນ້ຳໃນອະນາຄົດແມ່ນຄິດໄລ່ຈາກຈຳນວນປະຊາກອນໃນລະດັບບ້ານ, ອັດຕາສ່ວນຂອງບໍລິການ, ປະຊາກອນທີ່ໄດ້ຮັບການບໍລິການຕາມທີ່ຄິດໄລ່ໄວ້ ແລະ ການບໍລິໂພກນ້ຳຕໍ່ຫົວຄົນ. ຄວາມຕ້ອງການນ້ຳໃຊ້ສຳລັບ ສຳນັກງານອົງການແລະຂົງເຂດທຸລະກິດ ແມ່ນອອກວາງແຜນຕາມທິດທາງທີ່ຜ່ານມາ ແລະ ການພັດທະນາພື້ນທີ່ອຸດສາຫະກຳ ຊຶ່ງວາງແຜນໂດຍກຳແພງນະຄອນວຽງຈັນ. ຕາຕະລາງທາງລຸ່ມນີ້ແມ່ນສະແດງໃຫ້ເຫັນສະຫລຸບການວາງແຜນຄວາມຕ້ອງການນ້ຳໃນອະນາຄົດ.

ສະຫລຸບການວາງແຜນຄວາມຕ້ອງການນ້ຳ

	ຫົວໜ່ວຍ	2000	2005	2010	2015	2020
ປະຊາກອນ	ຄົນ	599,000	687,084	788,165	902,716	1,034,521
ປະຊາກອນທີ່ໄດ້ຮັບບໍລິການ	ຄົນ	215,522	275,567	370,269	466,981	564,648
ສັດສ່ວນບໍລິການ	%	36%	40.1%	47%	51.7%	54.6%
ປະຊາກອນໃນພື້ນທີ່ບໍລິການ	ຄົນ	297,575	380,342	499,737	586,710	662,441
ສັດສ່ວນບໍລິການໃນພື້ນທີ່ບໍລິການ	%	72.4%	72.5%	74.1%	79.6%	85.2%
ລວມຍອດຈຳນວນຂໍ້ຕໍ່	nos	39,305	50,081	66,662	83,940	101,842
ການບໍລິໂພກຕໍ່ຫົວຄົນ	lpcd	174	172	170	170	170
ລວມຍອດຄວາມຕ້ອງການນ້ຳ	ม^3/ວັນ	67,862	85,177	109,957	137,885	168,783
ສັດສ່ວນຂອງນ້ຳເສຍ	%	33%	28%	25%	25%	25%
ສະເລ່ຍຄວາມຕ້ອງການນ້ຳຕໍ່ວັນ	ม^3/ວັນ	101,286	118,302	146,609	183,847	225,044
ຄວາມຕ້ອງການນ້ຳສູງສຸດຕໍ່ວັນ	ม^3/ວັນ	111,415	130,132	161,270	202,232	247,548

ເພື່ອຕອບສະໜອງຄວາມຕ້ອງການນ້ຳໃນອະນາຄົດທີ່ກຳລັງເພີ່ມຂຶ້ນ, ທາງເລືອກຕ່ໄປນີ້ແມ່ນຖືກປຽບທຽບ ແລະ ແຜນການທີ່ເປັນທາງເລືອກທີ່ດີທີ່ສຸດຈຶ່ງຖືກຄັດເລືອກ.

1. ການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳຈືນາຍໂມ້ປະຈຸບັນ,
2. ການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວປະຈຸບັນ,
3. ການກໍ່ສ້າງໂຮງງານຜະລິດນ້ຳໃໝ່ທ່າງ່ອນ, ແລະ
4. ການລວມທັງສາມທາງເລືອກທາງເທິງ.

ຜົນຂອງການສຶກສາຄົ້ນຄວ້າປຽບທຽບ, ແຜນການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວປະຈຸບັນ ແມ່ນນອນຢູ່ໃນຂັ້ນຕອນທີໜຶ່ງ (ພາຍໃນປີ 2007) ແລະການກໍ່ສ້າງໂຮງງານຜະລິດນ້ຳໃໝ່ທ່າງ່ອນແມ່ນຢູ່ໃນຂັ້ນຕອນທີສອງ (ພາຍໃນປີ 2012) ໄດ້ຮັບການຄັດເລືອກໃຫ້ເປັນທາງເລືອກທີ່ດີທີ່ສຸດ.

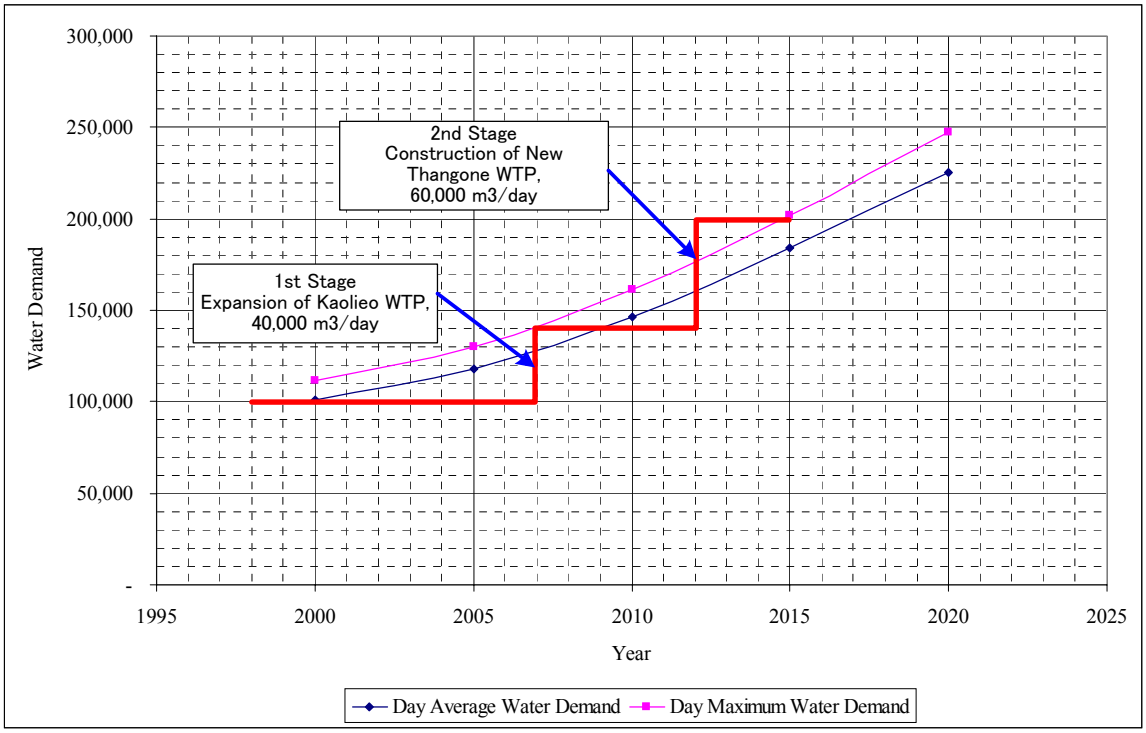
<u>ຂັ້ນຕອນທີ 1: ການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວປະຈຸບັນ</u>

- ສະຖານີສູບນ້ຳ: ການກໍ່ສ້າງສະຖານີສູບນ້ຳຈາກແມ່ນ້ຳຂອງ.
- ໂຮງງານຜະລິດນ້ຳ: ການຂະຫຍາຍໃຫ້ໄດ້ 40,000 ม^3/ ວັນ.
- ທໍ່ສົ່ງນ້ຳສະອາດ: ການຕິດຕັ້ງທໍ່ນ້ຳມີຄວາມຍາວ 2.2 ກິໂລແມັດ.
- ສະຖານີສູບສົ່ງເພີ່ມແຮງດັນນ້ຳ: ການປັບປຸງສະຖານີສູບສົ່ງເພີ່ມແຮງດັນນ້ຳຢູ່ຫລັກ 6.
- ທໍ່ແຈກໃຫ່ຍ: ການຕິດຕັ້ງທໍ່ແຈກນ້ຳມີຄວາມຍາວ 24.2 ກິໂລແມັດ.

ຂັ້ນຕອນທີ 2: ການກໍ່ສ້າງໂຮງງານຜະລິດນ້ຳແຫ່ງໃໝ່ຢູ່ທ່າງ່ອນ

- ສະຖານີສູບນ້ຳ: ການກໍ່ສ້າງສະຖານີສູບນ້ຳ ອັນໃໝ່ເພື່ອສູບນ້ຳຈາກນ້ຳງື່ມ.
- ໂຮງງານຜະລິດນ້ຳ: ການກໍ່ສ້າງເພື່ອເພີ່ມຄວາມສາມາດໃນການຜະລິດໃຫ້ໄດ້ 60,000 ມ^3/ ວັນ.
- ທໍ່ສົ່ງນ້ຳສະອາດ: ການຕິດຕັ້ງທໍ່ນ້ຳມີຄວາມຍາວ 10.6 ກິໂລແມັດ.
- ສູນຈ່າຍນ້ຳ: ການກໍ່ສ້າງສູນຈ່າຍນ້ຳໃໝ່ທີ່ສາມາດຈ່າຍນ້ຳໄດ້ 60,000 ມ^3/ ວັນ.
- ສະຖານີສູບສົ່ງເພີ່ມແຮງດັນນ້ຳ : ການປັບປຸງສະຖານີສູບສົ່ງເພີ່ມແຮງດັນນ້ຳ ຢູ່ຫລັກ 12.
- ທໍ່ແຈກໃຫ່ຍ: ການຕິດຕັ້ງທແຈກ່ນ້ຳມີຄວາມຍາວ 73.6 ກິໂລແມັດ.

ແຜນການຂະຫຍາຍລະບົບນ້ຳປະປາ ແມ່ນສະແດງຢູ່ໃນຮູບເສັ້ນສະແດງທາງລຸ່ມນີ້. ຂັ້ນຕອນທີ 1 ຂອງໂຄງການຈະສຳເລັດພາຍໃນປີ 2007 ແລະ ຂັ້ນຕອນທີ 2 ຂອງໂຄງການຈະສຳເລັດພາຍໃນປີ 2012.



ຄ່າໃຊ້ຈ່າຍເບື້ອງຕົ້ນປະເມີນໄວ້ສຳລັບຂັ້ນຕອນທີ 1 ແລະ 2 ສະແດງຢູ່ທາງລຸ່ມນີ້.

ຄ່າໃຊ້ຈ່າຍເບື້ອງຕົ້ນປະເມີນໄວ້ສຳລັບແຜນສັງລວມ(X1,000 USD)

ຂັ້ນຕອນ	ລວມຍອດຄ່າໃຊ້ຈ່າຍ	ຄ່າໃຊ້ຈ່າຍຕ່າງປະເທດ	ຄ່າໃຊ້ຈ່າຍທ້ອງຖິ່ນ
ຂັ້ນຕອນທີ 1	35,732	22,549	12,823
ຂັ້ນຕອນທີ 2	66,050	44,316	21,749

ໃນຈຳນວນໂຄງການທີ່ໄດ້ຮັບການກວດກາ, ໂຄງການບູລິມະສິດຕໍ່ໄປນີ້ ແມ່ນຖືກຄັດເລືອກ ອີງ ຕາມຄວາມສຸກເສີນ ແລະ ຄວາມສຳຄັນຂອງແຕ່ລະໂຄງການເພື່ອການປັບປຸງນ້ຳປະປາ. ລະດັບ ໂຄງການແມ່ນຖືກກວດສອບຢ່າງລະອຽດ ຊຶ່ງພິຈາລະນາເຖິງຄວາມອາດສາມາດທາງດ້ານການ ເງິນຂອງນ້ຳປະປາວຽງຈັນ ແລະ ການກຳນົດອັດຕາຄ່ານ້ຳໃນອະນາຄົດ. ໂຄງການບູລິມະສິດທີ່ ຖືກຄັດເລືອກແມ່ນສະແດງຢູ່ທາງລຸ່ມນີ້.

- ການຟື້ນຟູໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວປະຈຸບັນ, ໃຫ້ມີຄວາມສາມາດໃນການຜະລິດນ້ຳໄດ້ 20,000 ມ^3/ ວັນ.
- ການປັບປຸງໂຮງງານຜະລິດນ້ຳຈືນາຍໂມ້, ໃຫ້ມີຄວາມສາມາດໃນການຜະລິດນ້ຳໄດ້ 80,000 ມ^3/ ວັນ.
  - ❑ ການຂະຫຍາຍອ່າງເກັບນ້ຳ (10,000 ມ^3) ລວມເຖິງສິ່ງອຳນວຍຄວາມສະດວກເພີ່ມ ເຕີມທີ່ໃຊ້ໃນການຈ່າຍນ້ຳ.
  - ❑ ການຕິດຕັ້ງທໍ່ສົ່ງນ້ຳຈາກໂຮງງານຜະລິດນ້ຳຈືນາຍໂມ້ໄປຍັງທໍ່ສົ່ງນ້ຳທີ່ມີຢູ່ (ການແຍກທໍ່ ສົ່ງນ້ຳ ແລະ ລະບົບທໍ່ແຈກຈ່າຍນ້ຳ).
- ການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວ ໃຫ້ຜະລິດໄດ້ເພີ້ມຂຶ້ນອີກ 40,000 ມ^3/ ວັນ.
- ສະຖານີສູບສົ່ງເພີ່ມແຮງດັນນ້ຳຢູ່ຫລັກ 6.
- ການຕິດຕັ້ງທໍ່ສົ່ງນ້ຳມີຄວາມຍາວ 2.2 ກິໂລແມັດ.
- ການຕິດຕັ້ງທໍ່ຈ່າຍນ້ຳມີຄວາມຍາວ 15.2 ກິໂລແມັດ.

ໃນບັນດາຜົນປະໂຫຍດຕ່າງໆຂອງນ້ຳປະປາ, ຜົນປະໂຫຍດທີ່ເປັນຮູບປະທຳແມ່ນຖືກຄັດເລືອກ ໄວ້ສຳລັບການປະເມີນຜົນທາງເສດຖະກິດ ແລະ ແບ່ງອອກເປັນ 3 ອົງປະກອບ ດັ່ງຕໍ່ໄປນີ້: (1) ແຫລ່ງນ້ຳທີ່ສະໜອງຜົນປະໂຫຍດໄວ້ໃຫ້ຜູ້ບໍລິໂພກນ້ຳປະເພດຄົວເຮືອນ, (2) ການປັບປຸງ ດ້ານສາທາລະນະສຸກ, ແລະ (3) ແຫລ່ງນ້ຳທີ່ສະໜອງຜົນປະໂຫຍດໄວ້ໃຫ້ຜູ້ບໍລິໂພກນ້ຳສຳລັບ ສຳນັກງານອົງການແລະຂົງເຂດທຸລະກິດ. ແຫລ່ງນ້ຳທີ່ສະໜອງຜົນປະໂຫຍດ ເກີດຂຶ້ນຈາກການ ກຳຈັດຂອງລະບົບຈັດຫານ້ຳ, ໃນກໍລະນີຕ່າງໆຢູ່ບ່ອນທີ່ລະບົບນ້ຳປະປາໄດ້ຮັບການແນະນຳຢູ່ໃນ ພື້ນທີ່ຂອງໂຄງການ. ເງື່ອນໄຂທາງເສດຖະກິດທີ່ວາງແຜນໄວ້ສຳລັບອະນາຄົດພາຍໃນປີ 2020, ນອກເໜືອໄປກວ່ານັ້ນ, ຜູ້ບໍລິໂພກນ້ຳປະເພດຄົວເຮືອນຈະໄດ້ປັບປຸງລະບົບຈັດຫານ້ຳຂອງຕົນ ຕາມສັດສ່ວນ ເພື່ອເຮັດໃຫ້ມາດຖານການດຳລົງຊີວິດຂອງເຂົາເຈົ້າດີຂຶ້ນ ເນື່ອງຈາກການເຕີບໂຕ ດ້ານເສດຖະກິດຂອງຊາດຕາມທີ່ໄດ້ວາງແຜນໄວ້. ດັ່ງນັ້ນ, ເງື່ອນໄຂເຫລົ່ານີ້ຈະຊ່ວຍເພີ່ມໜ່ວຍ ຜົນປະໂຫຍດໃນອະນາຄົດ.

ການປະເມີນຜົນດັດຊະນີຕ່າງໆ ໃນກໍລະນີກ່ຽວກັບການເຕີບໂຕທາງດ້ານເສດຖະກິດໃນອະນາຄົດແມ່ນ 12.8% ຂອງ ຜົນຕອບແທນທາງດ້ານເສດຖະກິດ EIRR, 2.96 ລ້ານໂດລາສະຫະລັດ ຂອງ ນປວ ແລະ 1.06 ຂອງອັດຕາສ່ວນລະຫວ່າງຜົນປະໂຫຍດແລະຕົ້ນທຶນ B/C. ໂຄງການໜ້າຈະດຳເນີນຕໍ່ໄປໄດ້ຈາກມຸມມອງທາງເສດຖະກິດ, ເພາະວ່າ EIRR ຂອງໂຄງການແມ່ນເກີນຄ່າສະແຫວງຫາໂອກາດຂອງທຶນ.

ລາຍການ	EIRR (%)	ນປວ* (ລ້ານໂດລາ)	B/C*
ພາຍໃຕ້ເງື່ອນໄຂປະຈຸບັນ	8.5	- 10.9	0.77
ດ້ວຍເງື່ອນໄຂການເຕີບໂຕດ້ານເສດຖະກິດ	12.8	3.0	1.06

ໝາຍເຫດ: * ລົດ 12%

ລາຍຮັບປະຈຳປີສ່ວນໃຫຍ່ໄດ້ມາຈາກການຈຳໜ່າຍນ້ຳ, ການຕິດຕັ້ງໜ້ແທກນ້ຳ ແລະ ຄ່າເຊົ່າໜ້ແທກນ້ຳ ໃນການປະຕິບັດໂຄງການໃໝ່. ການໃຊ້ລາຍຮັບ ແລະ ຄ່າໃຊ້ຈ່າຍທີ່ປະເມີນໄວ້ໃນມູນຄ່າຕະຫລາດ, ການວິເຄາະທາງການເງິນແມ່ນໄດ້ຮັບການປະຕິບັດ, ແລະ ໃຫ້ຄວາມສຳພັນລະຫວ່າງອັດຕານ້ຳ ແລະ ຄ່າໃຊ້ຈ່າຍທາງດ້ານການເງິນຊຶ່ງສະແດງໄວ້ໃນຕາຕະລາງທາງລຸ່ມນີ້:

ກໍລະນີ	**ຄ່າໃຊ້ຈ່າຍທາງການເງິນ**		**ອັດຕານ້ຳສະເລ່ຍ**	
	ອັດຕາ ດອກເບ້ຍ (%)	ໝາຍເຫດ	ຄ່ານ້ຳ (US$/ม^3)	ສັດສ່ວນຕໍ່ປະຈຸບັນ ອັດຕາ
ກໍລະນີທີ 1	0.0%	ເງິນອຸດໜູນເຕັມສ່ວນ	0.19	3.8 ທຶນ
ກໍລະນີທີ 2	3.0%	ການຂະຫຍາຍຈີນາຍໂມ້	0.25	5.0 ທຶນ
ກໍລະນີທີ 3	6.3%	ກູ້ຢືມສາກົນ	0.34	6.8 ທຶນ
ກໍລະນີທີ 4	9.9%	ກູ້ຢືມທະນາຄານເອກະຊົນ	0.45	9.0 ທຶນ

ອີງຕາມການສຳຫລວດທີ່ລຳດັບໄວ້ໃນຕາຕະລາງທາງລຸ່ມ, ຄ່ານ້ຳສະເລ່ຍສຳລັບຜູ້ບໍລິໂພກນ້ຳພາຍໃນຈະຢູ່ໃນລະຫວ່າງ 1.0% ຫາ 1.6% ຂອງລາຍໄດ້ຄອບຄົວ. ຄວາມອາດສາມາດໃນການຈ່າຍຄ່ານ້ຳແມ່ນໄດ້ຮັບການພິຈາລະນາໄວ້ວ່າບໍ່ຫລາຍກວ່າ 5% ຂອງລາຍໄດ້ຄອບຄົວ, ດັ່ງທີ່ໄດ້ແຈ້ງໄວ້ ແລະ/ຫລື ລາຍງານໂດຍເຈົ້າໜ້າທີ່.

ອັດຕາສ່ວນຄ່ານ້ຳຕໍ່ລາຍໄດ້ຄອບຄົວໃນກໍລະນີທີ 1 ແມ່ນ 4.0% ຊຶ່ງຢູ່ພາຍໃນຂອບເຂດຄວາມສາມາດທີ່ຈະຈ່າຍລະຫວ່າງ 3% ຫາ 5%, ດັ່ງນັ້ນ ໜ້າຈະພິຈາລະນາໄດ້ວ່າກໍລະນີທີ 1 ແມ່ນເປັນການຍຸຕິທຳຕໍ່ປະຊາຊົນ. ໃນກໍລະນີທີ 2, ເຖິງແມ່ນວ່າອັດຕາຈະແມ່ນ 5.4% ຊຶ່ງສູງກວ່າຂອບເຂດເລັກໜ້ອຍ, ກໍ່ໜ້າຈະສາມາດຈ່າຍໄດ້ຫາກອັດຕາຄ່ານ້ຳສຳລັບຜູ້ຊົມໃຊ້ປະເດພຄົວເຮືອນ

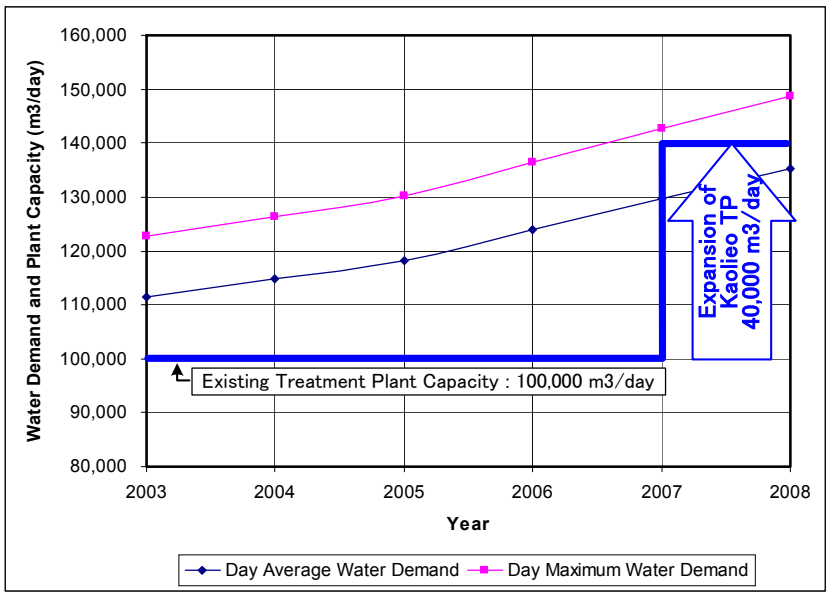
ແມ່ນ ຖືກກຳນົດໂດຍຜ່ານການໃຫ້ເງິນອຸດໜູນເຕັມສ່ວນເພື່ອຮັບໄປຈັດລົງບັນຊີ ຕາມຄວາມສາມາດຈ່າຍຂອງພວກກ່ຽວ. ນອກຈາກນັ້ນ, ນປອ ເຄີຍມີປະສົບການກ່ຽວກັບຄ່າໃຊ້ຈ່າຍທາງການເງິນອັນດຽວກັນຄື 3.0% ໃນໂຄງການຂະຫຍາຍໂຮງງານຈິນາຍໂມ້.

3. ການສຶກສາຄວາມເປັນໄປໄດ້

ເປົ້າໝາຍປີຂອງການສຶກສາຄວາມເປັນໄປໄດ້ແມ່ນຖືກກຳນົດໄວ້ໃນປີ 2007, ຊຶ່ງເປັນເວລາທີ່ຈະຕ້ອງເຮັດໃຫ້ ໂຄງການບູລິມະສິດ ສຳເລັດຕາມຂັ້ນຕອນທີ 1 ຂອງໂຄງການ. ປະຊາກອນ, ປະຊາກອນທີ່ໄດ້ຮັບບໍລິການນ້ຳປະປາ, ອັດຕາສ່ວນການບໍລິການ ແລະ ຄວາມຕ້ອງການນ້ຳໃນອະນາຄົດ ແມ່ນຖືກປະເມີນ ແລະ ຄິດໄລ່ໄວ້, ສະແດງຢູ່ທາງລຸ່ມນີ້:

ປະຊາກອນ, ປະຊາກອນທີ່ໄດ້ຮັບບໍລິການ ແລະ ສັດສ່ວນການບໍລິການ

	ຫົວໜ່ວຍ	2003	2004	2005	2006	2007
ປະຊາກອນໃນກຳແພງນະຄອນ	ຄົນ	651,850	669,467	687,084	707,300	727,516
ປະຊາກອນທີ່ໄດ້ຮັບບໍລິການ	ຄົນ	251,549	263,558	275,567	294,508	313,448
ສັດສ່ວນບໍລິການໃນກຳແພງນະຄອນ	%	38.5%	39.3%	40.1%	41.5%	42.9%
ປະຊາກອນໃນພື້ນທີ່ບໍລິການ	ຄົນ	347,235	363,789	380,342	404,221	428,100
ສັດສ່ວນບໍລິການໃນພື້ນທີ່ບໍລິການ	%	72.4%	72.4%	72.5%	72.8%	73.1%
ລວມຍອດສຸດທິຄວາມຕ້ອງການນ້ຳ	ມ^3/ວັນ	78,251	81,714	85,177	90,133	95,089
ສັດສ່ວນນ້ຳເສຍ	%	30.0%	29.0%	28.0%	27.4%	26.8%
ຄວາມຕ້ອງການນ້ຳສະເລ່ຍຕໍ່ວັນ	ມ^3/ວັນ	111,496	114,899	118,302	123,963	129,625
ຄວາມຕ້ອງການນ້ຳສູງສຸດຕໍ່ວັນ	ມ^3/ວັນ	122,645	126,389	130,132	136,360	142,587



ເພື່ອຈະໃຫ້ໄດ້ຕາມຄວາມຕ້ອງການນ້ຳສູງສຸດຕໍ່ວັນໃນປີ 2007, ໄດ້ວາງແຜນການເພື່ອຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວປະຈຸບັນໃຫ້ມີຄວາມສາມາດເພີ່ມຂຶ້ນອີກ 40,000 ມ3 ຕໍ່ວັນ, ຈະພາໃຫ້ ລວມຍອດ ຄວາມສາ

ມາດໃນການສະໜອງນ້ຳປະປາສູງຂຶ້ນເຖິງ 140,000 ມ^3/ ວັນ, ຊຶ່ງເປັນການເຮັດໃຫ້ໂຄງການບູລິມະສິດສຳເລັດສົມບູນ. ດັ່ງທີ່ສະແດງຢູ່ໃນຮູບພາບນີ້, ຈະເຫັນໄດ້ວ່າຄວາມສາມາດໃນການສະໜອງນ້ຳປະປາທີ່ມີຢູ່ໃນປະຈຸບັນ ແມ່ນ 100,000 ມ^3/ ວັນ, ຊຶ່ງໜ້ອຍກວ່າຄວາມຕ້ອງການນ້ຳສູງສຸດຕໍ່ວັນ. ເພື່ອຈະບັນເທົາ ຫລື ຫລຸດຜ່ອນສະພາບຂອງຂາດນ້ຳໃນອະນາຄົດອັນໃກ້ນີ້, ຈຶ່ງຂໍແນະນຳໃຫ້ມີການຫລຸດສັດສ່ວນນ້ຳເສຍ (UFW) ແລະເລີ່ມສິ່ງເສີມການປະຢັດນ້ຳ ແລະ ແຜນງານຄຸ້ມຄອງຄວາມຕ້ອງການນ້ຳ.

ແບບແຜນເບື້ອງຕົ້ນສຳລັບສິ່ງອຳນວຍຄວາມສະດວກ ທີ່ລວມຢູ່ໃນໂຄງການບູລິມະສິດຖືກອອກແບບເພື່ອຄາດຄະເນຄ່າໃຊ້ຈ່າຍຂອງໂຄງການ. ສິ່ງອຳນວຍຄວາມສະດວກທີ່ລວມຢູ່ໃນໂຄງການໂຄງການບູລິມະສິດຖືກອອກແບບໂດຍຜ່ານການກວດສອບທາງດ້ານເຕັກນິກຢ່າງລະອຽດ ແລະ ໂຄງການກໍ່ບໍ່ໄດ້ຮຽກຮ້ອງຕ້ອງການວິທະຍາການໃໝ່ໆ, ຊັ້ນສູງ ແລະ ກ້າວໜ້າສຳລັບການປະຕິບັດງານ ແລະ ການບຳລຸງຮັກສາ.

ຂອບເຂດຂອງໂຄງການບູລິມະສິດທີ່ທຳການສຶກສາຄົ້ນຄວ້າ ພາຍໃຕ້ບົດວິພາກເສດຖະກິດນີ້ ແມ່ນຄືກັນກັບຂອບເຂດຂອງໂຄງການຕ່າງໆ ທີ່ໄດ້ຮັບການຈຳແນກໄວ້ໃນແຜນການສັງລວມທີ່ຜ່ານມາ ຍົກເວັ້ນສຳລັບລະບົບທໍ່ສົ່ງນ້ຳ.

ລະຫວ່າງການກະກຽມແຜນການສັງລວມ, ຄວາມຍາວຂອງທໍ່ນ້ຳທີ່ຖືກສະເໜີໄວ້ແມ່ນໄດ້ຮັບການປະເມີນຈາກຮູບແຕ້ມທີ່ສະໜອງໂດຍ ນປວ. ອີງຕາມຜົນໄດ້ຮັບຂອງການສຳຫລວດພາກສະໜາມໃນລະຫວ່າງທີ່ມີການສຶກສາຄວາມເປັນໄປໄດ້, ຊຶ່ງໄດ້ພິຈາລະນາເຖິງຜົນໄດ້ຮັບຂອງການຄົ້ນຄວ້າຢ່າງລະອຽດ ແລະ ອີງຕາມໂຄງການທີ່ກຳລັງດຳເນີນຢູ່, ຄວາມຍາວຂອງທໍ່ທີ່ສະເໜີໄວ້ໄດ້ຮັບການປະເມີນໃນລະຫວ່າງທີ່ມີການດັດແກ້ແຜນການສັງລວມ, ຊຶ່ງສະແດງຢູ່ໃນຕາຕະລາງຫາງລຸ່ມ. ສຳລັບການວິເຄາະລະບົບທໍ່ນ້ຳຂອງໂຄງການຂັ້ນຕອນທີ 1, ຄວາມຍາວຂອງທໍ່ຈະເອົາໄດ້ຈາກການສຳຫລວດດັ່ງທີ່ສະແດງຢູ່ໃນຕາຕະລາງທີ່ໃຊ້ກັນຜ່ານມາ. ລະບົບການຈ່າຍນ້ຳ ແມ່ນໄດ້ຮັບການສຶກສາຄົ້ນຄວ້າໂດຍໂຄງການ AFD ແລະ ຄວາມຕ້ອງການນ້ຳໜ້ອຍທີ່ສຸດທີ່ຈຳເປັນຕ້ອງໄດ້ຂະຫຍາຍທໍ່ແຈກໃຫ່ຍ ຊຶ່ງລວມຢູ່ໃນໂຄງການຂັ້ນຕອນທີ 1 ຄື ຄວາມຕ້ອງການທໍ່ຈ່າຍນ້ຳທີ່ໜ້ອຍທີ່ສຸດແມ່ນໄດ້ ຈາກການຂະຫຍາຍໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວ.

ຄວາມຍາວທໍ່ສຳລັບຄວາມຕ້ອງການທໍ່ຈ່າຍນ້ ແລະ ສິ່ງຜ່ານນ້ທີ່ໜ້ອຍທີ່ສຸດ

ໜ້າຕັດ (ມມ)	ຄວາມຕ້ອງການທໍ່ຈ່າຍນ້ ທີ່ໜ້ອຍທີ່ສຸດ (ກມ)	ທໍ່ສິ່ງຜ່ານນ້ (ກມ)
150	4.57	-
250	3.24	-
400	4.65	-
450	-	1.88
600	1.62	-
700	0.50	0.72
ລວມຍອດ	14.58	2.60

ຕ້ອງໄດ້ທຸ້ມເທຄວາມໃສ່ໃຈໃຫ້ແກ່ການຄຸ້ມຄອງຄວາມຕ້ອງການນ້ ທີ່ກຳລັງເພີ່ມຂຶ້ນເລື້ອຍໆ, ເພື່ອເຮັດໃຫ້ເກີດຄວາມສົມດຸນໄລຍະຍາວຢ່າງຍືນຍົງ ລະຫວ່າງນ້ທີ່ສາມາດຜະລິດໄດ້ກັບຄວາມຕ້ອງການນ້ໃນລັກສະນະທີ່ມີຄວາມຍຸດຕິທຳ. ດ້ວຍເຫດນີ້, ການປະຢັດນ້ ແລະ ແຜນງານຄຸ້ມຄອງຄວາມຕ້ອງການນ້ຄວນໄດ້ຮັບຄວາມສຳຄັນ ໃນການພັດທະນານ້ປະປາຢູ່ໃນກຳແພງນະຄອນວຽງຈັນ.

ແຜນການສົ່ງລວມສຳລັບການຄຸ້ມຄອງຄວາມຕ້ອງການນ້ ຈະລວມເອົາອົງປະກອບທາງດ້ານຊ໊ອບແວ ແລະ ຮ໊າດແວ ດ້ວຍ. ມາດຕະການຫລັກສຳລັບການຄວບຄຸມຄວາມຕ້ອງການອາດຖືກແບ່ງອອກໄປໄດ້ດັ່ງນີ້: 1) ມາດຕະການສຳລັບການປະຢັດນ້, 2) ມາດຕະການສຳລັບການຄິດໄລ່ຄ່ານ້, 3) ມາດຕະການກ່ຽວກັບຂໍ້ມູນຂ່າວສານ ແລະ ການສຶກສາ ແລະ 4) ມາດຕະການທາງດ້ານກົດໝາຍ.

ຄ່າໃຊ້ຈ່າຍທີ່ຕ້ອງການສຳລັບໂຄງການບູລິມະສິດໄດ້ຮັບການປະເມີນໄວ້ ສະແດງຢູ່ທາງລຸ່ມນີ້:

ຄ່າໃຊ້ຈ່າຍສຳລັບໂຄງການບູລິມະສິດ (x 1,000 ໂດລາສະຫະລັດ)

ລາຍລະອຽດ	ລວມຍອດຄ່າໃຊ້ຈ່າຍ	ຄ່າໃຊ້ຈ່າຍຕ່າງປະເທດ	ຄ່າໃຊ້ຈ່າຍທ້ອງຖິ່ນ
ການກໍ່ສ້າງ	20,312	13,341	6,971
ວິສະວະກອນທີ່ປຶກສາ	1,422	934	488
ເງິນແຮໂຄງການ	4,637	3,064	1,537
ຄ່າບໍລິຫານ	1,319	0	1,319
ລວມຍອດ	27,689	17,339	10,350

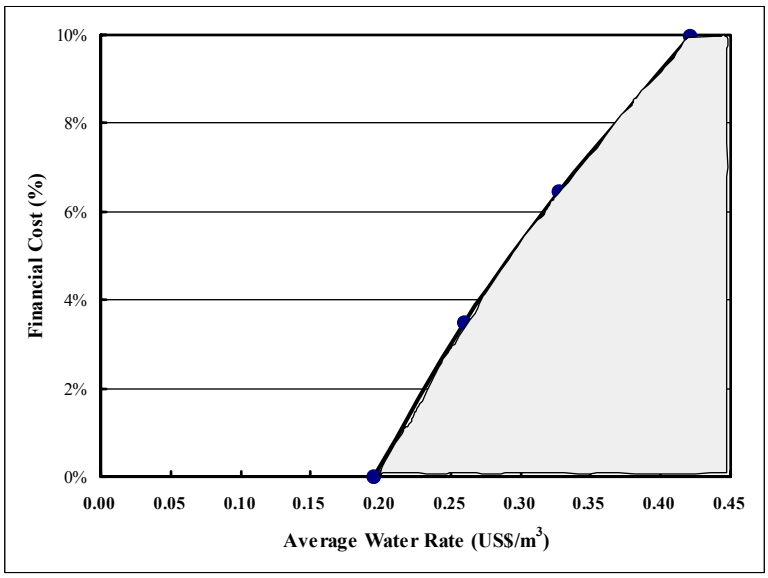
ເພື່ອເຮັດໃຫ້ໂຄງການບູລິມະສິດສຳເລັດສົມບູນພາຍໃນທ້າຍປີ 2007, ຄວນເລີ່ມການກໍ່ສ້າງໂຄງ ການພາຍໃນກາງປີ 2005, ຊຶ່ງຕ້ອງໄດ້ເອົາໃຈໃສ່ຕໍ່ຄວາມສຳຄັນຂອງໂຄງການດ້ວຍ. ວຽກງານ ດ້ານການກໍ່ສ້າງສຳລັບໂຄງການບູລິມະສິດຈະໃຊ້ເວລາຢ່າງໜ້ອຍທີ່ສຸດສອງປີເຄິ່ງ. ເພາະສະນັ້ນ ຈຶ່ງມີຄວາມຈຳເປັນຢ່າງຍິ່ງທີ່ຈະຕ້ອງເລີ່ມການປະມູນເພື່ອການສຳຫລວດແລະອອກແບບລະ ອຽດໃນທ້າຍປີ 2004 ພ້ອມດ້ວຍການຈັດສັນງົບປະມານ.

ການປະເມີນຜົນທາງດ້ານເສດຖະກິດໄດ້ຖືກດຳເນີນການ ໃນລັກສະນະທີ່ຄືກັບທີ່ໄດ້ເຮັດຢູ່ໃນ ແຜນການສັງລວມ. ດັດຊະນີຕ່າງໆທີ່ໃຊ້ໃນການປະເມີນຜົນຂອງໂຄງການຂັ້ນຕອນທີ 1 ສະແດງ ຢູ່ໃນຕາຕະລາງທາງລຸ່ມນີ້. ດ້ວຍການເຕີບໂຕທາງດ້ານເສດຖະກິດໃນອະນາຄົດ, ດັດຊະນີ ຂອງຜົນຕອບແທນທາງດ້ານເສດຖະກິດ EIRR ແມ່ນ 12.4%, ຂອງ ນປວ ແມ່ນ 0.68 ລ້ານໂດ ລາສະຫະລັດ, ຂອງ B/C ແມ່ນ1.03. ໃນເງື່ອນໄຂທາງສັງຄົມ-ເສດຖະກິດນີ້, ໂຄງການໜ້າຈະ ເປັນໄປໄດ້ຈາກມຸມມອງທາງດ້ານເສດຖະກິດ, ເປັນເພາະວ່າ ຢູ່ໃນ ສປປ ລາວ, EIRR ແມ່ນ ສູງກວ່າຄ່າສະແຫວງຫາໂອກາດຂອງທຶນ (12%).

ລາຍການ	EIRR (%)	ນປວ* (ລ້ານໂດລາ)	B/C*
ພາຍໃຕ້ເງື່ອນໄຂປະຈຸບັນ	8.1	- 5.84	0.77
ດ້ວຍເງື່ອນໄຂການເຕີບໂຕດ້ານເສດຖະກິດ	12.4	0.68	1.03

ໝາຍເຫດ: * ລົດ 12%

ສຳລັບໂຄງການຂັ້ນຕອນທີ 1, ການວິເຄາະດ້ານການເງິນໄດ້ຖືກດຳເນີນການໂດຍການໃຊ້ລາຍ ຮັບອີງຕາມອັດຕາຄ່ານ້ຳ ແລະ ຄ່າໃຊ້ຈ່າຍທາງດ້ານການເງິນທີ່ກ່ຽວພັນກັບຜົນຕອນແທນທາງ ດ້ານການເງິນ FIRR (ບົ່ງຊີ້ໃຫ້ເຫັນເຖິງການລົງທຶນທີ່ເກີດປະສິດທິຜົນຕ່ຳ). ບໍລິເວນທີ່ຄອບຄຸມຢູ່ ໃນເສັ້ນສະແດງບົ່ງຊີ້ໃຫ້ເຫັນເຖິງການລວມຕົວທາງດ້ານການເງິນທີ່ມີປະສິດທິຜົນຂອງຄ່າໃຊ້ຈ່າຍ ທາງດ້ານການເງິນ ແລະ ຄ່ານ້ຳປະປາ. ໂດຍຜ່ານການວິເຄາະນີ້, ກໍລະນີຕໍ່ໄປນີ້ແມ່ນໄດ້ຮັບການ ພິຈາລະນາວ່າເປັນເງື່ອນໄຂທີ່ສາມາດສັນນິຖານໄດ້ຊັດເຈນທີ່ສຸດ, ທີ່ໄດ້ຈາກມຸມມອງຂອງການ ປະຕິບັດງານ ທີ່ຜ່ານມາຂອງ ນປວ. ແຫລ່ງການ ເງິນໄດ້ມາແມ່ນມີຄ່າໃຊ້ຈ່າຍທາງ ການເງິນຢູ່ທີ່ 3.5% ຕໍ່ປີ ແລະ ອັດຕາ ຄ່ານ້ຳສະເລ່ຍເທົ່າກັບ 0.26 ໂດລາ ສະຫະລັດ/ມ^3, ຊຶ່ງກົງກັບ 5.2 ທຶບ ຂອງອັດຕາຄ່ານ້ຳປະຈຸບັນ. ນປວ ເຄີຍມີປະສົບການກ່ຽວກັບຄ່າໃຊ້ຈ່າຍ ດ້ານການເງິນນີ້ແລ້ວໃນ ໂຄງການຂະ ຫຍາຍໂຮງງານຈືນາຍໂມ້.



ເພື່ອເປັນການຊຸດເຊີຍປັດໄຈນຳເຂົ້າທັງໝົດສຳລັບໂຄງການຂັ້ນຕອນທີ 1, ຄາດໝາຍວ່າໂຄງການທີ່ມີຢູ່ນີ້ຈະຄຸ້ມຄອງລາຍຮັບ ແລະ ລາຍຈ່າຍດ້ວຍຄວາມລະມັດລະວັງຕະຫລອດອາຍຸການ ຂອງໂຄງການ. ເພື່ອທີ່ຈະບັນລຸຕາມນະໂຍບາຍຊຸດເຊີຍຄ່າໃຊ້ຈ່າຍ, ອັດຕາຄ່ານ້ຳແມ່ນອີງຕາມຄ່າສະເລ່ຍໄລຍະຍາວ (LRAC) ຊຶ່ງຖືກສະເໜີໄວ້ຕອນກາງປີເປົ້າໝາຍ. ຈາກນັ້ນ, ອັດຕາຄ່ານ້ຳເບື້ອງຕົ້ນຈະສູງຂຶ້ນຕາມໄລຍະເວລາທີ່ຍືດອອກໄປຫລາຍກວ່າຄ່າສະເລ່ຍໄລຍະຍາວ. ໃນທີ່ສຸດ, ການຄຸ້ມຄອງກໍ່ຈະບັນລຸເຖິງການຊຸດເຊີຍຄ່າໃຊ້ຈ່າຍທັງໝົດພາຍໃນກຳນົດສິ້ນສຸດ ອາຍຸການຂອງໂຄງການ. ອີງຕາມຜົນທີ່ໄດ້ຮັບ, ກະແສເງິນຂອງໂຄງການຈຶ່ງສາມາດຄອບຄຸມຈຳນວນຍອດເງິນກູ້ພາຍໃນອາຍຸການຂອງໂຄງການ, ຊຶ່ງໄດ້ຮັບການກວດສອບກັບສັດສ່ວນຄອບຄຸມໄລຍະບໍລິການກູ້ຢືມ (LLCR) ຈຳນວນ 1.016.

ຍັງມີຄວາມຍາກລຳບາກໃນການຄຸ້ມຄອງການປະຕິບັດໂຄງການ. ຢ່າງໃດກໍ່ດີ, ເພື່ອທີ່ຈະບັນລຸສູ່ອັດຕາຄ່ານ້ຳສະເລ່ຍທີ່ 0.26 ໂດລາສະຫະລັດ/ມ^3, ຊຶ່ງການຄຸ້ມຄອງຕ້ອງໄດ້ຄອຍຖ້າຈົນກວ່າຈະຮອດປີ 2020 ເພາະວ່າອັດຕາຄ່ານ້ຳນັ້ນ ຈະເລີ່ມຈາກອັດຕາປະຈຸບັນ. ດ້ວຍເຫດນີ້, ການຄຸ້ມຄອງຈຶ່ງມີການຂາດຈຳນວນຫລາຍໃນເຄິ່ງທຳອິດຂອງໄລຍະເວລາຂອງໂຄງການ. ໃນເຄິ່ງຫລັງມັນຕ້ອງໄດ້ຖົມຊຸມຈຳນວນທີ່ຂາດເຫລົ່ານີ້ດ້ວຍການໃຊ້ກຳໄລສຸດທິ. ເຖິງແມ່ນວ່າຄ່າ ນ້ຳສຳລັບຜູ້ບໍລິໂພກພາຍໃນຈະຖືກກຳນົດໄວ້ທີ່ 1.1% ຂອງລາຍໄດ້ຄອບຄົວຕອນຕົ້ນປີ, ຄ່ານ້ຳ ກໍ່ຍັງຄົງຢູ່ພຽງ 2.2% ເຖິງແມ່ນຈະຮອດປີ 2037 ກໍ່ຕາມ. ສັດສ່ວນນີ້ຈຶ່ງສາມາດສະໜອງຕໍ່ຜູ້ຮັບປະ ໂຫຍດຂອງຜູ້ຊົມໃຊ້ພາຍໃນ.

ສຳລັບເຫດຜົນທີ່ໃຫ້ລາຍລະອຽດໄວ້ທີ່ນີ້, ໂຄງການຂັ້ນຕອນທີ 1 ຈະສາມາດກຳນົດໃຫ້ເປັນໄປໄດ້. ຕະຫລອດຂັ້ນຕອນຂອງການວາງແຜນຂອງວຽກງານປັບປຸງລະບົບນ້ຳປະປາສຳລັບໂຄງການຂັ້ນຕອນທີ 1, ທີມຄົ້ນຄວ້າຂອງໄຈກ້າຕ້ອງໄດ້ໃຫ້ຄວາມສົນໃຈເພື່ອຮັບປະກັນວ່າວຽກງານປັບປຸງທີ່

ຖືກສະເໜີໄວ້ສາມາດປະຕິບັດ, ດຳເນີນການ ແລະ ບຳລຸງຮັກສາໄວ້ໄດ້ພາຍໃນລະດັບຂອງຄວາມ ຊ່ຽວຊານດ້ານເຕັກນິກ ແລະ ຄວາມອາດສາມາດໃນດ້ານວິສະວະກຳທີ່ຫາໄດ້ໃນວຽງຈັນ ແລະ ສ ປປ ລາວໃນປະຈຸບັນ. ດັ່ງນັ້ນ ຈຶ່ງຄາດໝາຍໄດ້ວ່າໂຄງການຂັ້ນຕອນທີ 1 ຈະສາມາດປະຕິບັດໄດ້ ພາຍໃນກຳນົດເວລາທີ່ຢູ່ຕໍ່ໜ້າ, ແລະ ໂຄງການຕ້ອງໄດ້ຖືກປະຕິບັດໂດຍ ທັນທີ ແລະ ໄດ້ຮັບການ ຄຸ້ມຄອງບົນພື້ນຖານຂອງຄວາມຍືນຍົງ.

4. ຂໍ້ສະເໜີແນະ:

ມຸມມອງດ້ານວິສະວະກຳ

(1) ການປະສານງານກັບ ການສຶກສາຂອງ AFD ໃນລະບົບຈ່າຍນ້ຳເພື່ອຮັກສາສະເຖຍລະ ພາບພ້ອມກັບຜົນໄດ້ຮັບຈາກການສຶກສາຂອງໄຈກ້າ.

(2) ການປະສານງານກັບໂຄງການສູນຝຶກອົບຮົມຂອງ AFD ຢູ່ໂຮງງານຜະລິດນ້ຳຈືນາຍໂມ້ ເພື່ອຈັບຈອງດິນທີ່ຈຳເປັນສຳລັບອ່າງເກັບນ້ຳເພີ່ມເຕີມ ແລະ ສະຖານີສູບສົ່ງນ້ຳ.

(3) ການພິຈາລະນາຢ່າງຮອບຄອບກ່ຽວກັບການປ້ອງກັນຕາຝັ່ງແມ່ນ້ຳຢູ່ບ່ອນກໍ່ສ້າງສະຖານີ ສູບນ້ຳໃໝ່ຂອງໂຮງງານຜະລິດນ້ຳເກົ້າລ້ຽວ.

(4) ການຫລຸດຜ່ອນນ້ຳເສຍ.

(5) ການຕິດຕາມກວດກາຄຸນນະພາບ ແລະ ປະລິມານນ້ຳ.

(6) ການປະຕິບັດງານ ແລະ ການບຳລຸງຮັກສາທີ່ພຽງພໍ.

(7) ການເປີດຮັບ ແລະ ການຝຶກອົບຮົມພະນັກງານເພີ່ມເຕີມທີ່ຈຳເປັນສຳລັບໂຄງການບູລິມະ ສິດ.

(8) ເລີ່ມການຈັດກຽມການຖືສິດຄອບຄອງທີ່ດິນສຳລັບໂຄງການຂັ້ນຕອນທີ 2 ຢູ່ທ່າງ່ອນ.

(9) ການສຶກສາຄວາມເປັນໄປໄດ້ ແລະ ການກວດຄືນແຜນການສັງລວມ ຈຳເປັນຕ້ອງເຮັດ ກ່ອນໂຄງການຂັ້ນຕອນທີ 2.

(10) ການປະສານງານກັບໂຄງການປັບປຸງທາງໂດຍກອງທຶນຊ່ວຍເຫລືອຍີ່ປຸ່ນ.

ມຸມມອງດ້ານການຈັດຕັ້ງ:

(1) ການຂະຫຍາຍຂອງຖານະຕຳແໜ່ງທີ່ເປັນເອກະລາດຂອງຫົວໜ້າອຳນວຍການຂອງ ນ ປວ.

(2) ການສົ່ງເສີມຫຸ້ນສ່ວນເອກະຊົນທົ່ວໄປ.

(3) ພິຈາລະນາຄືນບົດບາດຂອງໂຮງງານຜະລິດນ້ຳແກ້ວ.

(4) ການສົ່ງເສີມການປະຢັດນ້ຳ ແລະ ການຄຸ້ມຄອງຄວາມຕ້ອງການນ້ຳ.

ມຸມມອງດ້ານການເງິນ:

(1) ນປອ ຕ້ອງເຮັດໃຫ້ສະມາຊິກທັງໝົດໃນບໍລິສັດມີທັດສະນະຮ່ວມກັນໃນດ້ານການຊົດເຊີຍຄ່າໃຊ້ຈ່າຍ. ຈາກນັ້ນ, ສະມາຊິກທັງໝົດຕ້ອງມີຄວາມເຂົ້າໃຈທີ່ຖືກຕ້ອງກ່ຽວກັບການຊົດເຊີຍຄ່າໃຊ້ຈ່າຍ ແລະ ນຳໄປສູ່ການປະຕິບັດເປັນໜ້າທີ່ຂອງຕົນເພື່ອເຮັດໃຫ້ເປົ້າໝາຍໃນການຊົດເຊີຍຄ່າໃຊ້ຈ່າຍປາກົດເປັນຕົວຈິງ.

(2) ການຂຶ້ນອັດຕາຄ່ານ້ຳສຳລັບຜູ້ບໍລິໂພກນ້ຳທຸກຄົນ ແມ່ນເປັນຄວາມຈຳເປັນຢູ່ໃນຂັ້ນຕອນຂອງໂຄງການ. ສຳລັບການຕິດຕາມນະໂຍບາຍຂຶ້ນອັດຕາຄ່ານ້ຳ, ການກະຕຸ້ນທາງການເງິນ ແມ່ນສຳຄັນສຳລັບການຮັບປະກັນການມີສ່ວນຮ່ວມໃນໂຄງການຂັ້ນຕອນທີ 1 ຂອງຜູ້ປະກອບທຶນທັງໝົດ.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1. Introduction

The Study on Vientiane Water Supply Development Project which was requested by the Government of the Lao PDR was commenced in March 2003 and completed in January 2004 by the JICA, the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan.

The objectives of the Study are:

1. To prepare a long term master plan for the Vientiane water supply. The target year of the master plan is 2020; target year of facility planning is 2015.
2. To conduct a feasibility study on priority project(s) identified in the master plan
3. To transfer technology to the counterpart personnel in the course of the study.

The study is to cover the present and planned service areas of the “Master Plan: Vientiane Water Supply Development Project, November 1999” (here in after referred to as “NPVC Master Plan”).

2. Master Plan

Future water demand is projected for domestic and non-domestic purposes separately. For the domestic water demand, future water demand is calculated from village level populations, service ratios, the calculated served population and the per capita water consumption. Non-domestic water demand is projected from past trends and the industrial area development planned by the Vientiane Capital City. Table below shows summary of future water demand projection.

Summary of Water Demand Projection

	Unit	2000	2005	2010	2015	2020
Population	person	599,000	687,084	788,165	902,716	1,034,521
Served Population	person	215,522	275,567	370,269	466,981	564,648
Service Ratio	%	36.0%	40.1%	47.0%	51.7%	54.6%
Population in Service Area	person	297,575	380,342	499,737	586,710	662,441
Service Ratio in Service Area	%	72.4%	72.5%	74.1%	79.6%	85.2%
Total Number of Connections	nos.	39,305	50,081	66,662	83,940	101,842
Per Capita Consumption	lpcd	174	172	170	170	170
Total Water Demand	m3/day	67,862	85,177	109,957	137,885	168,783
UFW Ratio	%	33%	28%	25%	25%	25%
Day Average Water Demand	m3/day	101,286	118,302	146,609	183,847	225,044
Day Maximum Water Demand	m3/day	111,415	130,132	161,270	202,232	247,548

To meet the increasing future water demand, the following alternatives were compared and the best alternative plan was selected.

1. Expansion of the existing Chinaimo Treatment Plant,
2. Expansion of the existing Kaolieo Treatment Plant,
3. Construction of new Thangone Treatment Plant, and
4. Combination of the above three alternatives.

As a result of the comparative study, a plan of expansion of the existing Kaolieo Treatment Plant under the 1st Stage (by year 2007) and construction of new Thangone Treatment Plant under the 2nd Stage (by year 2012) has been selected as the best alternative.

1st Stage: Expansion of Existing Kaolieo Water Treatment Plant

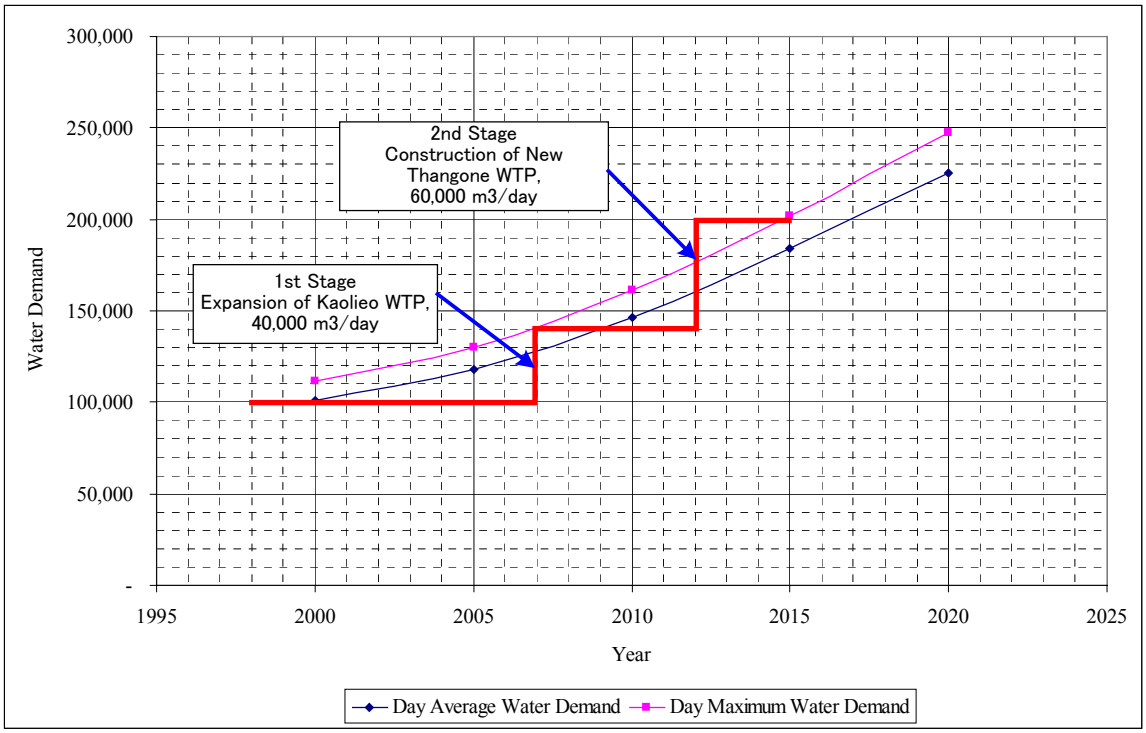
- Intake Facilities: Construction of new intake facilities from the Mekong River
- Treatment Plant: Expansion of 40,000 m3/day
- Clear Water Transmission Pipelines: Installation of 2.2 km of pipelines
- Booster Pumping Stations: Improvement of the Km6 BP Station

- Distribution Trunk Mains: Installation of 24.2 km of pipelines

2nd Stage: Construction of New Thangone Water Treatment Plant

- Intake Facilities: Construction of new intake facilities from the Nam Ngum River
- Treatment Plant: Construction to produce a capacity of 60,000 m3/day
- Clear Water Transmission: Installation of 10.6 km of pipelines
- Distribution Centre: Construction of a new distribution centre with capacity of 60,000 m3/day
- Booster Pumping Stations: Improvement of the Km12 BP Station
- Distribution Trunk Mains: Installation of 73.6 km of pipelines

The system expansion plan is shown in the figure below. The 1st Stage Project will be completed by 2007 and the 2nd Stage Project will be completed by 2012.



Preliminary cost estimates for the 1st and 2nd Stages are shown below.

Preliminary Cost Estimates for the Master Plan (x 1,000 US$)

Stage	Total Costs	Foreign Costs	Local Costs
1st Stage	35,732	22,549	12,823
2nd Stage	66,050	44,316	21,749

Among the projects examined, the following priority projects have been selected based on their urgency and importance for the improvement of the water supply. Project scale was carefully

examined considering the NPVC's financial capabilities and future tariff schedules. Selected priority projects are as shown below.

- Rehabilitation of the existing Kaolieo Treatment Plant, with a production capacity of 20,000 m3/day
- Improvement of the Chinaimo Treatment Plant, with a production capacity of 80,000 m3/day
    - Expansion of reservoirs (10,000 m3) including additional distribution pumping facilities
    - Installation of a transmission pipeline from the Chinaimo Treatment Plant to the existing transmission pipelines (separation of transmission and distribution system)
- Expansion of the Kaolieo Treatment Plant, 40,000 m3/day
- Improvement of the Km6 BP Station
- Installation of 2.2 km of transmission mains
- Installation of 15.2 km of distribution mains

Among the various benefits of water supply, the tangible benefits were selected for economic evaluation, and bounded into the following three components: (1) water source saving benefit for domestic water consumers, (2) public health improvement, and (3) water source saving benefit for non-domestic water consumers. The water source saving benefit accrues from the elimination of water procurement systems, in cases where water supply systems are introduced in the project areas. Future projected economic conditions by 2020, furthermore, domestic water consumers will improve their water procurement systems in proportion to the betterment of their living standards owing to the projected national economic growth. Thus, these conditions increase the unit benefit in the future.

The evaluation indices in the case with economic growth in the future were 12.8% of EIRR, US$2.96 million of NPV and 1.06 of B/C. The project could be viable from an economic point of view, because its EIRR exceeded the opportunity cost of capital.

Item	EIRR (%)	NPV* (US$ Million)	B/C*
Under Present Conditions	8.5	-10.9	0.77
With Economic Growth Conditions	12.8	3.0	1.06

Note: * Discounted at 12%.

Annual revenue accrues mainly from water sales, water meter installations and water meter rentals in the new project operation. Applying these revenues and costs estimated in market values, the financial analysis was conducted, and gave the relationship between the water rate and financial

costs as shown in the table below.

Case	Financial Cost		Average Water Rate	
	Interest Rate (%)	Remark	Water Cost (US$/m^3)	Ratio to Present Rate
Case 1	0.0%	Complete Subsidy	0.19	3.8 times
Case 2	3.0%	Chinaimo Expansion	0.25	5.0 times
Case 3	6.3%	International Loan	0.34	6.8 times
Case 4	9.9%	Private Bank Loan	0.45	9.0 times

According to the results of surveys, an average water charge for domestic water consumers ranges between 1.0% and 1.6% of the family income. Affordability-to-pay for water is considered as not more than 5% of family income, as declared and/or reported by the authorities.

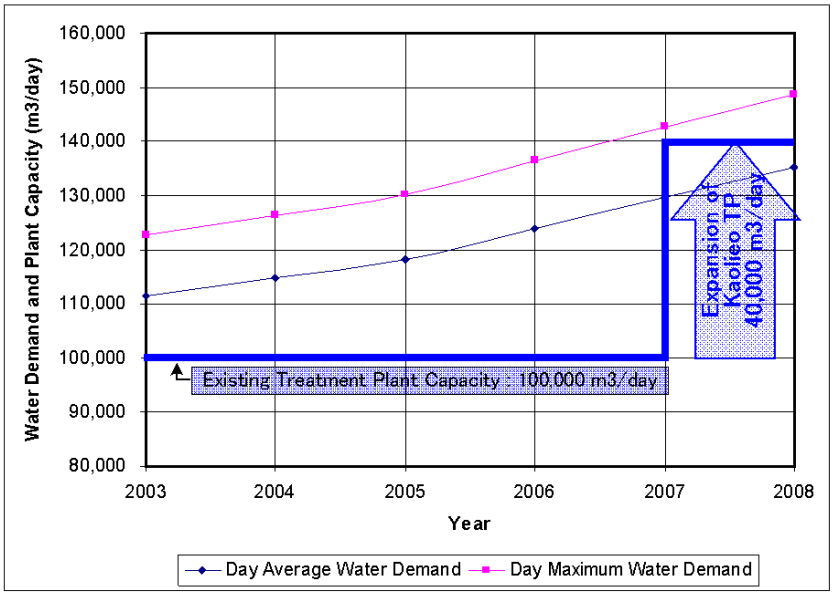
The ratio of water charge to family income in Case 1 was 4.0% which is within the affordable range of 3% to 5%, so it would be considered that Case 1 is fair for the people. In Case 2, although the rate was 5.4% which is slightly over the range, it would be affordable if the water tariff for domestic users is arranged through cross subsidisation to accept taking account of their affordability. In addition, the NPVC has already experienced the same financial cost of 3.0% in Chinaimo expansion project.

3. Feasibility Study

The target year of the feasibility study was set as 2007, the time of completion of the priority projects of the 1st stage of the project. The population, served population, service ratio, and future water demand were estimated and calculated, as shown below.

Population, Served Population, and Service Ratio

	Unit	2003	2004	2005	2006	2007
Capital City Population	People	651,850	669,467	687,084	707,300	727,516
Served Population	People	251,549	263,558	275,567	294,508	313,448
Service Ratio in Capital City	%	38.5%	39.3%	40.1%	41.5%	42.9%
Population in Service Area	People	347,235	363,789	380,342	404,221	428,100
Service Ratio in Service Area	%	72.4%	72.4%	72.5%	72.8%	73.1%
Total Net Water Demand	m3/day	78,251	81,714	85,177	90,133	95,089
UFW Ratio	%	30.0%	29.0%	28.0%	27.4%	26.8%
Daily Average Water Demand	m3/day	111,496	114,899	118,302	123,963	129,625
Daily Maximum Water Demand	m3/day	122,645	126,389	130,132	136,360	142,587



To meet the future daily maximum water demand in 2007, it was planned to expand the existing Kaolieo Treatment Plant to have an additional capacity of 40,000 m3/day, bringing the total supply capacity to 140,000 m3/day, upon completion of the priority projects. As shown in this figure, it is apparent that the existing supply capacity, 100,000 m3/day, is far smaller than the daily maximum water demand. To relieve or mitigate the water shortage situation in the very near future, it is strongly recommend to reduce the unaccounted-for water ratio (UFW), and initiate the promotion of water conservation and water demand management programmes.

The preliminary design for facilities included in the priority projects was conducted to estimate project cost. The facilities included in the priority projects were designed with careful technical

examinations. The project does not require any advanced technology for its operation and maintenance.

Scope of the priority project which was studied under the feasibility study is same as the scope of the projects identified in the previous master plan except for the pipelines.

During the preparation of the master plan, the lengths of the proposed pipelines were estimated from drawings supplied by the NPVC. Based on the results of the field survey during the feasibility study, considering the results of detailed filed investigation and referring to the on-going projects, the length of the proposed pipelines estimated during the mater plan was altered, as shown in table below. For a network analysis of the 1st Stage Project, the pipeline lengths obtained from the survey shown on the table were used. The distribution system was studied by AFD project and the minimum required distribution pipelines which were included in the 1st Stage Project is the minimum requirements for the pipeline to distribute water from the expanded Kaolieo Treatment Plant.

Pipeline Length for Minimum Required Distribution and Transmission Pipelines

Dia (mm)	Minimum Required Distribution Pipeline (km)	Transmission Pipeline (km)
150	4.57	-
250	3.24	-
400	4.65	-
450	-	1.88
600	1.62	-
700	0.50	0.72
Total	14.58	2.60

Attention must be devoted to managing the increasing demand for water, to achieve a sustainable long-term balance between water availability and water requirement in an equitable manner. Thus, water conservation and water demand management programmes should be given significance in the development of the water supply in Vientiane Capital City.

A comprehensive program for water demand management includes software and hardware components. The major measure for demand control can be further divided into; 1) water conservation measures, 2) water pricing measures, 3) information and education measures, and 4) legal measures.

The costs required for the priority projects were estimated as shown below.

Costs for the Priority Projects (x 1,000 US$)

Description	Total Costs	Foreign Costs	Local Costs
Construction	20,312	13,341	6,971
Consulting Services	1,422	934	488
Contingencies	4,637	3,064	1,537
Administration Cost	1,319	0	1,319
Total	27,689	17,339	10,350

In order to complete the priority projects by the end of 2007, the projects should commence in the middle of 2005, taking into account the magnitude of the projects. The construction work for the priority project will take at least two and half years. It is therefore necessary to start the detailed design and tendering works from the end of 2004 following the budgetary arrangement.

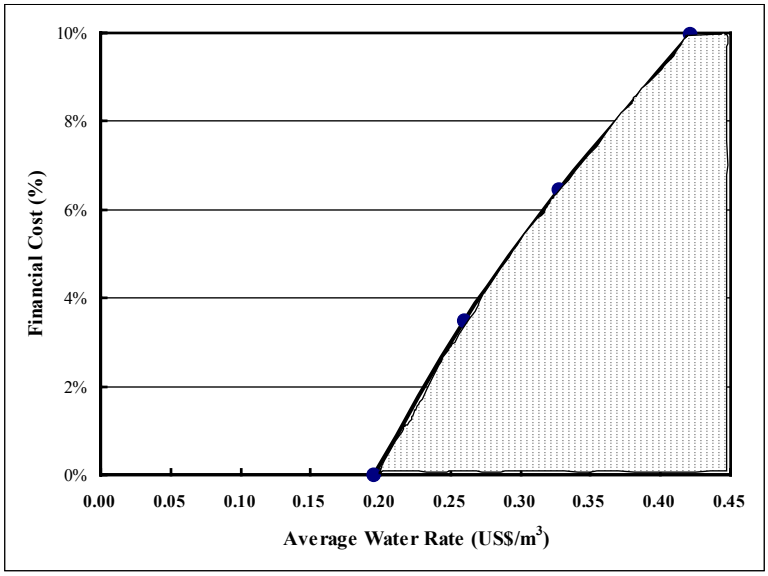
The economic evaluation was conducted in the same manner as done in the master plan. The evaluation indices of the 1st Stage Project are shown in the table below. With the economic growth in the future, the indices are 12.4% of EIRR, US$0.68 million of NPV and 1.03 of B/C. In this socio-economic condition, the project could be feasible from the economic point of view, because of higher EIRR than the economic opportunity cost of capital (12%) in Lao PDR.

Item	EIRR (%)	NPV* (US$ Million)	B/C*
Under Present Conditions	8.1	-5.84	0.77
With Economic Growth Conditions	12.4	0.68	1.03

Note: * Discounted at 12%.

For the 1st Stage Project, a financial analysis was conducted applying the revenue based on water tariff and financial cost related to FIRR (indicating a marginal efficiency of investment). The area shaded in the graph indicates the financially effective combination of financial cost and water charge. Through this analysis, the following case is considered as the most presumable condition, from the viewpoint of past performance of the NPVC. The financial source is procured at the financial cost of 3.5% per annum and water tariff of US$0.26/$m^3$ on average, corresponding to 5.2 times of the present water rate. The NPVC has already experienced this financial cost in Chinaimo Expansion Project.

To recover the all input for the 1st stage project, the project entity is expected to manage its revenues and costs with care for the project life. To attain the cost recovery policy, the water tariff based the Long Run Average Cost (LRAC) is introduced in the middle of the target year. Then, the initial tariff is raised over a prolonged period of time to more than the LRAC. Finally, the management attains to recover the all costs by the end of the project life. As a result, the project cash flow could cover the total amount of the loan within the project life, which was verified with the Loan Life Debt Service Coverage Ratio (LLCR) of 1.016.



Yet, there are some difficulties for the management of the project operation. To attain at the average water tariff of US$0.26/m^3, however, the management has to wait until 2020 because the water tariff starts from the present tariff. Thus, the management has lots of deficit in the first half of the project life. In the second half, then, it has to cover these deficits in terms of the net profits. The water charge for domestic consumers is set to 1.1% of the household income at the beginning year, the charge is still 2.2% only even in the year 2037. This ratio could satisfy the beneficiaries of domestic users.

For the reasons described here, the 1st stage projects can be assessed as feasible. Throughout the planning process of the water supply system improvement works for the 1st stage project, continuous attention was paid by the JICA Study Team to ensure that any improvement works to be proposed can be implemented, operated and maintained within the level of technical skills and engineering capacity currently available in Vientiane and in Lao PDR. It is therefore expected that the 1st stage project can be implemented within the time frame envisaged, and that the project, once it has been implemented, can be managed on a sustainable basis.

4. Recommendations

Engineering Aspects

(1) Coordination with AFD Study on distribution system to maintain consistency with the results of the JICA Study

(2) Coordination with the AFD Training Centre Project at Chinaimo Treatment Plant to reserve land space required for additional reservoir and pumping station

(3) Careful consideration of river bank protection at the new intake of Kaolieo Treatment Plant

(4) Reduction of UFW

(5) Monitoring water quality and quantity

(6) Adequate operation and maintenance

(7) Recruiting and training of additional staff required for the priority projects

(8) Feasibility Study and review of the master plan will be required before the 2nd Stage Project

(9) Coordination with road improvement project by the Japan's Grant Aid

Institutional Aspects

(1) Expansion of autonomous status of General Manager of the NPVC

(2) Promotion of Public Private Partnership

(3) Reconsider the role of a bottled water factory

(4) Promotion of Water Conservation and Water Demand Management

Financial Aspects

(1) The NPVC has to make all members in the company have a characteristic common of cost recovery. Then, all members have to have a correct understanding of cost recovery and to carry out their duties to realize the target of full cost recovery.

(2) Rising water tariff for every water consumer is indispensable in the process of the project. For pursuance of this tariff rising policy, financial incentives are essential to ensure participation in the 1st stage project of all stakeholders.

SUMMARY

1. INTRODUCTION

The development of a water supply system in Vientiane started with the construction of the Kaolieo Treatment Plant in 1964. The Kaolieo Treatment Plant was rehabilitated in 1983. The Chinaimo Treatment Plant was established in 1980 by the ADB and was expanded and rehabilitated from 1992 to 1996 by Japan's Grant Aid. Japan's assistance has provided not only facilities for the construction, expansion and rehabilitation works, but also for technical assistance through dispatching JICA experts, senior overseas volunteers and JICA overseas cooperation volunteers to Lao.

The status and condition of the water supply in Vientiane has been aggravated by an increasing water demand as a result of population growth, increased living standards, and the expansion of industrial and housing areas. The two existing treatment plants have been obliged to operate at an overloaded condition to meet increasing water demand. At the same time, the existing water supply facilities are decrepit, and the problem of high unaccounted-for water ratio becomes more serious every year. Low pressure and unstable supply are common in the service area.

Vientiane as capital city of Lao PDR, has set a target that the water service ratio in urban area should be increased by 80 % by 2020. To help achieve this, the Government of the Lao PDR (hereinafter referred to as GOL) requested the Government of Japan (hereinafter referred to as GOJ) to conduct "The Study on Vientiane Water Supply Development Project". In response to the request of the GOL, the GOJ decided to conduct the study, and JICA, the official agency responsible for the implementation of the technical cooperation programs of the GOJ, dispatched the Preparatory Study Team to the Lao PDR in August, 2002. At this time, the purpose of the study and the scope of work was agreed to and confirmed between the JICA and GOL.

In March 2003, a JICA Study Team of 10 study team members from Nihon Suido Consultants Co., Ltd., Tokyo, Japan was dispatched to the Lao PDR, and commenced this study after confirmation of the scope of work, schedule, methodology and undertakings of the GOL of the study through an inception meeting.

The objectives of the Study are:

1. To prepare a long term master plan for the Vientiane water supply. The target year of the master plan is 2020; target year of facility planning is 2015.
2. To conduct a feasibility study on priority project(s) identified in the master plan
3. To transfer technology to the counterpart personnel in the course of the study.

The study is to cover the present and planned service areas of the "Master Plan: Vientiane Water Supply Development Project, November 1999" (here in after referred to as "NPVC Master Plan").

The Study is conducted in three phases as follows:

Phase I: A Reconnaissance Survey
Phase II: The Preparation of a Master Plan
Phase III: A Feasibility Study on the Priority Project

The Phase I of the Study was conducted during the first field investigation in Lao PDR from March to April in 2003. Phase II of the Study was also conducted during the first field investigation in Lao PDR from May to July in 2003. During the Phase II, priority projects were identified and agreement was reached with Lao PDR side that the identified projects should be the subject of a subsequent feasibility study. Phase III was conducted during the second field investigation in Lao PDR from August to November in 2003 and the subsequent work from that phase was conducted in Japan from December 2003 to January 2004. The scope of work during Phase III centred on the feasibility study of the priority projects and included an overall evaluation and recommendations concerning the project implementation.

The Final Report comprises a total of five volumes. They are as follows:

Volume I: Executive Summary
Volume II: Main Report : Master Plan
Volume III: Main Report : Feasibility Study
Volume IV: Annex for Master Plan
Volume V: Annex for Feasibility Study

The Executive Summary contained in Volume I summarises the conclusions and recommendations of the Study as a whole. Volumes II and III are self-contained so as to facilitate access by those concerned with only individual parts of the overall study. Volume IV compiles supporting and back–up information with respect to Volume II, and Volume V compiles information used in the preparation of Volume III.

This report forms Volume I of the final report and summarises the conclusions and recommendations of the Study as a whole.

2. DEVELOPMENT PLAN OF VIENTIANE CAPITAL CITY

Vientiane Urban Development Master Plan (VUDMP) was formulated in 1991 with UNDP/UNCHS support and revised in 2000. The revised VUDMP by the Urban Research Institute, a division of the MCTPC was approved in 2002 by the Prime Minster, and the implementation of improvements to roads and drainage systems started. This was financed by the ADB. The implementing agency of the projects is the Vientiane Urban Development and Administration Authority (VUDAA) of the Vientiane Capital City Government.

This VUDMP covers the central part of the Vientiane Capital City and the area covered by the VUDMP is called as "Capital Municipality Zones". Although the VUDMP covers only the central part of the Capital City, "Special Development Zones", "Satellite Towns Zones" and "Long-Term Expansion Urban Zones" which are outside of the planning zone, are also discussed in the VUDMP report.

The VUDMP defines the policy for urban development and land use patterns for future development to achieve a well coordinated development. Although the development policy and land use plans are defined, specific target years or sources of funds for implementation are not described in the report.

The Capital Municipality Zones are categorized into 17 kinds of land use zones and areas where development will take place in the future and areas that should be reserved as green space or paddy fields are distinguished. For the areas outside of the Capital Municipality Zone, the development plan is described in the "National Infrastructure and Services" section of the VUDMP.

According to the Decree (No. 37/PM), the water supply sector development in the capital city, Vientiane, is defined as the first priority and the service ratio should be increased to 80% by 2020.

3. EXISTING CONDITIONS

3.1 Existing Conditions of Vientiane Water Supply System

The Vientiane Water Supply Company (Nam Papa Vientiane Capital City: NPVC) was reorganised from Lao Water Supply Company (Nam Papa Lao: NPL) under the provision of Decree (No.37/PM) on September 30, 1999. The NPL used to cover the entire country's water supply services. After

the reorganisation, the NPVC became one of a number of Nam Papa State-owned Enterprises (NPSEs), and covers Vientiane Capital City only. In terms of training for water engineers, the NPVC has trained all the NPSEs in the country.

The service area that is supplied by the existing Kaolieo and Chinaimo WTPs covers the central part of the capital city and the northern area of the capital city along Road No. 13 and Thangone Road. Thadeua WTP supplies water to the area along the Mekong River near the Friendship Bridge. The Thangone WTP covers a very limited area in Thangone. The NPVC service area is divided into seven zones and each zone is managed by a NPVC branch office.

The total number of connections is 43,444 and total metered water consumption is 2,416,152 m3/month (77,940 m3/day), as of March 2003.

The existing Kaolieo WTP is located in the west of the central part of the capital city along the Mekong River. The Kaolieo Treatment Plant, which has a capacity of 20,000 m3/day, was constructed in 1964 by Japan's Grant Aid Project and is the oldest treatment plant in Vientiane. In 1983, rehabilitation works were implemented also by Japan's Grant Aid. Deterioration of facilities and equipment have become significant problems for the stable operation of the plant since the last rehabilitation work was implemented about 20 years ago.

The Chinaimo WTP is located in the south of the central part of the capital city along the Mekong River. The Chinaimo Treatment Plant which had a capacity of 40,000 m3/day, was constructed in 1980, and financed by the ADB. In 1992 - 1996, rehabilitation and expansion works were implemented by Japan's Grant Aid and the total capacity was expanded to 80,000 m3/day. Compared with the Kaolieo WTP, the condition of facilities and equipment are better. However, stable water distribution and transmission has not been achieved since the plant only has transmission facilities and is not designed as a centre of distribution.

The total length of pipelines with a diameter greater than 40 mm is estimated to be about 460 km in length. Pipelines more than 300 mm in diameter are manufactured from Ductile Iron Pipe (DIP) and Steel Pipe (SP) and pipelines less than 300 mm in diameter are mainly PVC. Pipelines in the downtown area of the Vientiane Capital City were installed in the 1960s and 1980s at the time of the construction of the Kaolieo and Chinaimo WTPs respectively. Although the NPVC installed small diameter pipelines by itself, pipelines of large size diameters made from DIP and SP, were mainly installed in the 1990s by the Japan's Grant Aid project, and the projects financed by ADB.

Construction work to extend the water distribution network in 5 areas by AFD aid, commenced in March 2003 and the pipe materials are currently being delivered. A leakage reduction project is also underway according to an action plan which was prepared by AFD aid. Water meter investigations in each zone were also conducted by testing on site, as well as by calibration using a meter test bench in the workshop at the NPVC. According to the reports on the leak detection campaign and the reduction of unaccounted-for water by the NPVC, the losses in terms of volumes of unaccounted-for water represent about 30% of the total water supply.

Vientiane Water Supply System has 9 reservoirs with a total capacity of 17,460 m3 including 3 ground reservoirs and 6 elevated tanks. The total capacity of the reservoirs is calculated to be equivalent to 4.2 hours of the total production capacity of the Chinaimo and Kaolieo WTPs.

A network analysis of the existing system has been conducted using WaterCAD which runs under the AutoCAD environment, after examination of the existing transmission and distribution pipeline networks with a diameter greater than 100mm. Survey results of flow and pressure measurements have been also been taken into account for the calibration of the network model.

3.2 Financial Conditions of NPVC

The sales revenue of the NPVC comes from water sales, new connection fees, rental fees of heavy equipment and rental fees of water meters. In 2002, the sales revenues of the NPVC accounted for 19.8 billion kip. Of these sales revenues, 78% was accrued from water sales.

In 2002, the total expenditure of the NPVC was 21.6 billion kip. Expenditure is divided into two main categories: (a) 11.2 billion kip for purchasing of materials and equipment for water production (52% of the total), and (b) 10.4 billion kip for service and administration expenses supporting water supply services (48%). At the end of the fiscal year, the total expenditure was reduced through a closing adjustment of 2.4 billion kip. Accordingly, the net expenditure for the year 2002 was 19.2 billion kip.

Water sales in 2002 increased remarkably, 165% more than in 2000. This was because of an incremental increase of the average unit price of water from 269 kip/m^3 in 2000 to 547 kip/m^3 in 2002, in spite of the fact that the volume of water supplied in 2002 increased only 118% more than in 2000. For the same period, production costs increased 143%. Thus, the gross profit increased by 218% for these three years.

Item (unit : Billion kip)	2000	2001	2002	Increment (2000~02)
Gross Sales	12.0	15.8	19.8	165%
Production Cost	8.4	10.6	12.0	143%
Gross Profit	3.6	5.2	7.8	218%
Services and Administration Expenses	5.1	5.5	6.3	122%
Operating Profit	-1.5	-0.3	1.5	-
Net non-operating Earnings & Expenses	-0.8	-0.8	-0.7	-
Net Profit before Tax	-2.3	-1.1	0.8	-
Appropriation for Tax	0.1	0.1	-0.2	-
Net Profit after Tax	-2.4	-1.2	0.6	-

The incremental increase of services and administration expenses was 122% for the same period. As a result, the operating profit generated a surplus of 1.5 billion kip in 2002. Since the net non-operating earnings and expenses was -0.7 billion kip, the net profit before tax was 0.8 billion kip.

In 2002, the total assets were estimated at 39.0 billion kip. Fixed assets accounted for 22.6 billion kip or 58% of the total assets. Current assets accounted for 16.3 billion kip or 42% of the total. Of the total current assets, accounts receivable was 3.6 billion kip or 9%. This amount is equivalent to three months' water sales.

In 2002, the ratio of net profit to total capital was 1.9%, which was not small and was better than the Japanese index. The ratio of net expense to net sales was almost the same as the Japanese index in 2002, but larger in 2000 and 2001. The ratios in these years indicate unstable conditions for profitability.

	Item	Unit	2000	2001	2002	Japanese*1
1.	Ratio of Net Profit to Total Capital	%	-	-	1.9	0.7
2.	Ratio of Net Expense to Net Sale Amount	%	122	109	96	95
3.	Current Ratio	%	280	228	303	302
4.	Ratio of Fixed Assets to Long-term Capital	%	79	77	67	95
5.	Ratio of Deprecation of Fixed Assets	%	6.1	7.1	9.6	3.4
6.	Turnover of Account Receivable		2.7	3.2	3.7	7.9
7.	Number of Employees per Water Supplied	Persons/ $10^4 m^3$/day	44	41	40	12

Note: *1 Quoted from Japanese management indices of water supply services (more than 300,000 consumers) in 2001.

The current ratio of the NPVC was around 300%, which is a good condition for solvency and for short-term safety. The ratio of fixed assets to long-term capital was less than 100%, which is also a fair condition for long-term safety. The ratio of depreciation to fixed assets is usually 3% in every case for Japanese water supply systems. However, the ratio of the NPVC was almost 2 to 3 times larger than the Japanese standard.

In terms of the turnover of accounts receivable, the NPVC recorded a worsening index 2.7 to 3.7. These figures were considerably lower than the Japanese index of 7.9. This means that the NPVC takes more than 3 months to collect bills.

The number of staff at the water supply services seems to be quite large compared with the Japanese average. It ranged between 40 and 44 persons per 10,000 m^3 per day, which is around 4 times the Japanese average.

Unit water production costs during the past four years were larger than the average unit prices compared with the Japanese average. This was the reason why the NPVC recorded a final net deficit for the three years from 1999 to 2001. The new tariff system in 2002 turned the NPVC profitable in 2002, but the net profit was comparatively small. The new unit production cost in 2002 was 529 kip/m^3. In the same year, the average unit price was calculated at 547 kip/m^3. The unit price after tax was 521 kip/m^3, so it still resulted in a profit smaller than the unit production cost.

People in Vientiane are not always recognising that the cheaper water charges are the best solution

for their social life, according to the JICA household survey conducted in March 2003. They understand that a shortage of water supply leads to social confusion. During the dry season this year, there was a shortage of water supply and this led to social confusion. People are aware that a shortage of water can upset their social life. In general, they are substantially aware of the importance of maintaining adequate water supplies for their living circumstances.

4. MASTER PLAN

4.1 Future Population and Water Demand Forecast

The Master Plan for the Vientiane Water Supply Development Project is being prepared to solve existing problems which the NPVC and people in Vientiane presently encounter with the water supply system, and to increase the water supply capacity with an adequate transmission/distribution system. This will enable the NPVC to meet future water demands and enable the security of the sustainable development of Vientiane and to maintain hygienic living environments for the citizens of Vientiane.

The future population of Vientiane is forecast in three steps, 1) Capital City population forecast, 2) District level population forecast, and 3) Village level population forecast. Capital City population is forecast taking account of past trends, other population forecasts conducted by agencies/projects concerned, the average population increase in the whole the Lao PDR, and applying statistical curves and lines. After forecasting the total capital city population to 2020, district level populations are forecast considering past trends of population increases in the respective districts. The total district level population is forecasted so as to be equal to the forecasted capital city population. Population increasing ratios for each village are also examined and based on past trends. Future populations in each village are forecast so as to be equal to the forecasted district population in total.

One of the most important information for the planning of the future service area expansion is future land use and urban development plans. This information is fortunately included in the VUDMP. Planned industrial areas and reserved areas are taken into account to outline future water service areas. The priority areas for expansion of the service area are also studied, considering on-going projects such as the expansion of the distribution network by the AFD. Expansion of future service areas is finalised by consultation with the WASA and NPVC.

Future water demand is projected for domestic and non-domestic purposes separately. For the

domestic water demand, future water demand is calculated from village level populations, service ratios, the calculated served population and the per capita water consumption. Usually per capita water consumption would be expected to increase in future; per capita water consumption in Vientiane is expected to decrease from its current level of 174 lpcd to 170 lpcd by 2010. This is because about 20% of households have in-house leakages not repaired. This situation will be improved by adequate public relation activities managed by the NPVC. Also, there is expectation to be some influence on water usage by the tariff increase which is planned under this Master Plan. Non-domestic water demand is projected from past trends and the industrial area development planned by the Vientiane Capital City. In this Mater Plan, it is strongly recommended that the NPVC promotes water conservation activities and a reduction of UFW to avoid over-scaled project formation. Table below shows summary of future water demand projection.

Summary of Water Demand Projection

	Unit	2000	2005	2010	2015	2020
Population	person	599,000	687,084	788,165	902,716	1,034,521
Served Population	person	215,522	275,567	370,269	466,981	564,648
Service Ratio	%	36.0%	40.1%	47.0%	51.7%	54.6%
Population in Service Area	person	297,575	380,342	499,737	586,710	662,441
Service Ratio in Service Area	%	72.4%	72.5%	74.1%	79.6%	85.2%
Number of Domestic Connections	nos.	34,210	43,741	58,773	74,124	89,627
Number of Non-domestic Connections	nos.	5,095	6,340	7,889	9,817	12,215
Total Number of Connections	nos.	39,305	50,081	66,662	83,940	101,842
Served Population (Incremental)	person		60,046	94,702	96,712	97,667
Number of Domestic Connections (Incremental)	nos.		9,531	15,032	15,351	15,503
Per Capita Consumption	lpcd	174	172	170	170	170
Total Domestic Water Demand	m3/day	37,501	47,398	62,946	79,387	95,990
Non-Domestic Water Demand	m3/day	30,361	37,780	47,011	58,499	72,793
Total Water Demand	m3/day	67,862	85,177	109,957	137,885	168,783
UFW Ratio	%	33%	28%	25%	25%	25%
Day Average Water Demand	m3/day	101,286	118,302	146,609	183,847	225,044
Day Maximum Water Demand	m3/day	111,415	130,132	161,270	202,232	247,548

4.2 Water Supply Facility Development

To meet the increasing future water demand, the following alternatives were compared and the best alternative plan was selected.

1. Expansion of the existing Chinaimo Treatment Plant,
2. Expansion of the existing Kaolieo Treatment Plant,
3. Construction of new Thangone Treatment Plant, and
4. Combination of the above three alternatives.

To compare these alternatives, the study team prepared water supply facility plans including intake, treatment plants, clear water transmission pipelines, and distribution pipelines. Each alternative's construction costs, operation and maintenance costs have been calculated to compare each system as a whole. The social, environmental, technical, and economic aspects of each alternative had also been compared. Furthermore, the organization, management, financial condition, and human resource development areas have been carefully examined for the soundness of the future NPVC management.

As a result of the comparative study, a plan of expansion of the existing Kaolieo Treatment Plant under the 1st Stage (by year 2007) and construction of new Thangone Treatment Plant under the 2nd Stage (by year 2012) (Alternative K-1) has been selected as the best alternative. The components of alternative K-1 are as follows.

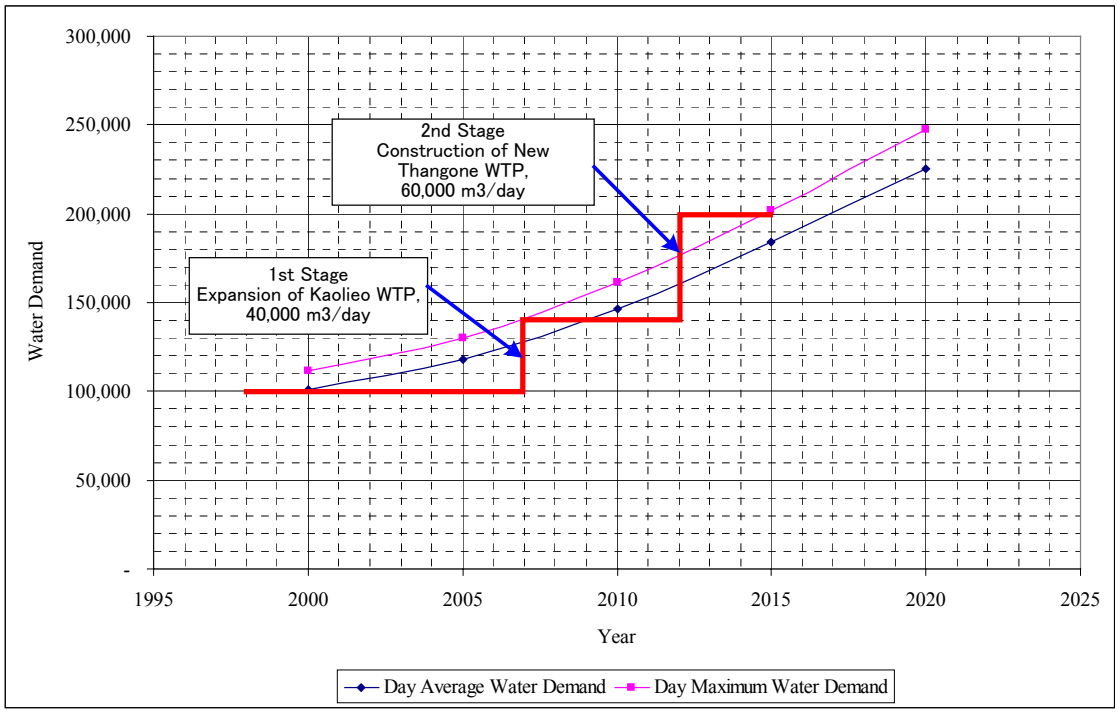
1st Stage: Expansion of Existing Kaolieo Water Treatment Plant

- Intake Facilities: Construction of new intake facilities from the Mekong River
- Treatment Plant: Expansion of 40,000 m3/day
- Clear Water Transmission Pipelines: Installation of 2.2 km of pipelines
- Booster Pumping Stations: Improvement of the Km6 BP Station
- Distribution Trunk Mains: Installation of 24.2 km of pipelines

2nd Stage: Construction of New Thangone Water Treatment Plant

- Intake Facilities: Construction of new intake facilities from the Nam Ngum River
- Treatment Plant: Construction to produce a capacity of 60,000 m3/day
- Clear Water Transmission: Installation of 10.6 km of pipelines
- Distribution Centre: Construction of a new distribution centre with capacity of 60,000 m3/day
- Booster Pumping Stations: Improvement of the Km12 BP Station
- Distribution Trunk Mains: Installation of 73.6 km of pipelines

The system expansion plan is shown in the figure below. The 1st Stage Project will be completed by 2007 and the 2nd Stage Project will be completed by 2012.



The scale of the 1st Stage Project was decided considering the adequate scale of the project. This was to avoid difficulties among international lending agencies in finding funding sources for the Lao PDR. After the completion of the 1st Stage Project, the daily maximum water demand will still not be satisfied, and the water shortage situation will continue until the completion of the 2nd Stage. Therefore, it is strongly recommended that the NPVC promotes water conservation activities through adequate public relations, and to reduce the UFW by intensive measures.

The scale of the 2nd Stage may be rather large for international or Lao PDR's own funding bodies, even though the economic and financial viability has been calculated as described in the Master Plan. Therefore, in order to adapt the 2nd Stage Project at an appropriate capital investment scale, efforts on water conservation and reduction of the UFW are indispensable by the NPVC.

After completion of the 1st Stage Project, a feasibility study will be required to implement the 2nd Stage. During the feasibility study for the 2nd Sage, the scale of the 2nd Stage will be reviewed. If the maximum water demand is reduced by the promotion of water conservation and the reduction of UFW is less than estimated by the study, the implementation of the 2nd Stage could be divided into two phases, each stage being a phased production capacity increase of 30,000 m3/day, or, alternatively, to be reduced to 50,000 m3/day from 60,000 m3/day. Such modifications of scale to

the 2nd Stage will reduce the financial impacts to the NPVC.

4.3 Preliminary Cost Estimates of the Master Plan

Preliminary cost estimates were conducted and the project costs for the 1st and 2nd Stages are shown below together with the planned implementation schedule.

(x 1,000 US$)

	Total	Foreign	Local
FIRST STAGE	**35,372**	**22,549**	**12,823**
1. Construction Cost	26,048	17,122	8,926
1.1 Treatment Plants	15,081	9,055	6,026
Expansion of Kaolieo T.P.	9,624	5,762	3,862
Rehabilitation of Kaolieo T.P.	3,023	1,951	1,072
Expansion of Reservoir in Chinaimo T.P.	2,434	1,342	1,092
1.2 Clear Water Transmission Pipelines	1,234	984	250
1.3 Distribution Center	0	0	0
1.4 Booster Pump Station	737	607	130
1.5 Distribution Trunk Mains	6,393	4,694	1,699
1.6 Secondary and Tirtially Distribution Mains	606	510	96
1.7 House Connection Installation	752	620	132
1.8 Unaccounted-for Water Reduction	1,245	652	593
2. Consulting Services	1,822	1,540	282
2.1 D/D and S/V for Stage 1 (2004 - 2007)	1,822	1,540	282
3. Contingencies	5,817	3,887	1,930
3.1 Physical Contingency	2,787	1,866	921
3.2 Price Contingency	3,030	2,021	1,009
4. Administration Cost	1,685	0	1,685

(x 1,000 US$)

	Total	Foreign	Local
SECOND STAGE	**66,065**	**44,316**	**21,749**
1. Construction Cost	41,563	28,801	12,762
1.1 Treatment Plants	13,427	8,693	4,734
Construction of Thangone T.P.	13,427	8,693	4,734
1.2 Clear Water Transmission Pipelines	7,521	6,198	1,323
1.3 Distribution Center	4,376	2,984	1,392
1.4 Booster Pump Station	366	294	72
1.5 Distribution Trunk Mains	11,156	7,280	3,876
1.6 Secondary and Tirtially Distribution Mains	1,202	1,011	191
1.7 House Connection Installation	1,874	1,544	330
1.8 Unaccounted-for Water Reduction	1,641	797	844
2. Consulting Services	3,505	2,954	551
2.1 Feasibility Study for Stage 2 (2008)	595	496	99
2.2 D/D and S/V for Stage 2 (2009 - 2012)	2,910	2,458	452
3. Contingencies	17,851	12,561	5,290
3.1 Physical Contingency	4,507	3,175	1,332
3.2 Price Contingency	13,344	9,386	3,958
4. Administration Cost	3,146	0	3,146
Total Project Costs	**101,437**	**66,865**	**34,572**

Implementation Schedule

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
M/P, F/S													
1st Stage													
Budgetary Arrangement													
Detailed Design													
Construction													
2nd Stage													
Feasiblitiy Study													
Budgetary Arrangement													
Detailed Design													
Construction													

4.4 Selection of the Priority Projects

Among the projects examined, the following priority projects have been selected based on their urgency and importance for the improvement of the water supply. Project scale was carefully examined considering the NPVC's financial capabilities and future tariff schedules. Selected priority projects are as shown below.

- Rehabilitation of the existing Kaolieo Treatment Plant, with a production capacity of 20,000 m3/day
- Improvement of the Chinaimo Treatment Plant, with a production capacity of 80,000 m3/day
    - Expansion of reservoirs (10,000 m3) including additional distribution pumping facilities
    - Installation of a transmission pipeline from the Chinaimo Treatment Plant to the existing transmission pipelines (separation of transmission and distribution system)
- Expansion of the Kaolieo Treatment Plant, 40,000 m3/day
- Improvement of the Km6 BP Station
- Installation of 2.2 km of transmission mains

The costs required for the priority projects are as shown table below.

(x 1,000 US$)

	Total	Foreign	Local
PRIORITY PROJECT	**18,246**	**11,391**	**6,854**
1. Construction Cost	17,052	10,646	6,406
1.1 Treatment Plants	15,081	9,055	6,026
Expansion of Kaolieo T.P.	9,624	5,762	3,862
Rehabilitation of Kaolieo T.P.	3,023	1,951	1,072
Expansion of Reservoir in Chinaimo T.P.	2,434	1,342	1,092
1.2 Clear Water Transmission Pipelines	1,234	984	250
1.3 Booster Pump Station	737	607	130
2. Consulting Services	1,194	745	448
2.1 D/D and S/V for Stage 1 (2004 - 2007)	1,194	745	448

In this Master Plan, priority projects have been selected from treatment plant facilities and clear water transmission pipelines. Other components such as distribution systems and house connections will be selected as priority projects under the study which is conducted by the AFD. The minimum requirements of distribution systems which will be necessary to distribute water from the expanded Kaolieo treatment plants are examined as below and these pipelines were agreed to be included in the priority project among agencies concerned.

Dia (mm)	Length (km)	Cost (1000 US$)
150	4.57	229
250	3.22	309
400	4.89	1,540
600	1.76	1,006
700	0.68	483
Total	15.12	3,567

The priority projects are further studied in the consecutive feasibility study. It should be noted that quantity, costs, and implementation schedule are reviewed and modified in the feasibility study.

4.5 Economic and Financial Evaluation of the Master Plan

(1) Economic Evaluation

Among the various benefits of water supply, the tangible benefits were selected for economic evaluation, and bounded into the following three components: (1) water source saving benefit for domestic water consumers, (2) public health improvement, and (3) water source saving benefit for non-domestic water consumers. The water source saving benefit accrues from the elimination of water procurement systems, in cases where water supply systems are introduced in the project areas. They were quantified into their respective components in the table below. Future projected

economic conditions by 2020, domestic water consumers will improve their water procurement systems in proportion to the betterment of their living standards owing to the projected national economic growth. Thus, these conditions increase the unit benefit in economic terms for the future.

Beneficiary		Benefit Component	Unit Benefit in Economic Terms at 2003 Constant Prices	
			Present	2020 Conditions
(1)	Residents	Water source saving benefit	US$0.41/m^3	US$0.71/m^3
(2)	Residents	Public health improvement benefit		
(3)	Non-residential Water Consumers	Water source saving benefit	US$0.21/m^3	US$0.21/m^3

Economic costs of construction, O&M and replacement of the master plan schemes were converted from the respective financial costs estimated at market prices, applying a conversion factor.

Item		Financial Cost (US$ Million)	Economic Cost (US$ Million)
Construction Cost*		98.6	79.4
O&M Cost (at matured stage)		2.1	1.4
Replacement Cost	2022	5.4	5.4
	2027	7.2	7.1

Note: * Total cost was estimated for components related to the proposed scheme.

The evaluation indices in the case with economic growth in the future were 12.8% of EIRR, US$2.96 million of NPV and 1.06 of B/C. The project could be viable from an economic point of view, because its EIRR exceeded the opportunity cost of capital.

Item	EIRR (%)	NPV* (US$ Million)	B/C*
Under Present Conditions	8.5	-10.9	0.77
With Economic Growth Conditions	12.8	3.0	1.06

Note: * Discounted at 12%.

(2) Financial Analysis

Annual revenue accrues mainly from water sales, water meter installations and water meter rentals in the new project operation. The revenue until the target year 2020 was estimated at 2003 constant prices in the table below. The revenue was based on the latest tariff of the NPVC.

(Unit: US$1000/year)

Item	2007	2010	2015	2020
Water Sales	465	576	1,296	1,423
Water Meter Installation	131	156	398	406
Water Meter Rental	3	14	53	99
Total	599	746	1,747	1,928

The investment cost of the new water supply schemes was estimated at US$98.6 million. These costs do not include supplementary works such as "UFW Reduction" in this analysis. The O&M costs were estimated at US$0.8 million/year in 2007 and US$2.1 in 2020. Replacement costs were taken into account, as mentioned in the economic evaluation.

Through the financial analysis based on the demand projection, and the costs mentioned above, the relationship between the water rate and financial cost was elucidated as follows.

Case	Financial Cost		Average Water Rate	
	Interest Rate (%)	Remark	Water Cost (US$/$m^3$)	Ratio to Present Rate
Case 1	0.0%	Complete Subsidy	0.19	3.8 times
Case 2	3.0%	Chinaimo Expansion	0.25	5.0 times
Case 3	6.3%	International Loan	0.34	6.8 times
Case 4	9.9%	Private Bank Loan	0.45	9.0 times

According to the surveys listed in the table below, an average water charge for domestic water consumers ranges between 1.0% and 1.6% of the family income. Affordability-to-pay for water is considered as not more than 5% of family income, as declared and/or reported by the authorities.

Survey/Report		Ratio of Water Charge to Household Income (Expenditure)
LECS2*, 1997/98, NSC		1.0%
Household Survey by JICA in March 2003	People Served by NPVC	1.6%
	People without Water Supply Service	1.4%
Prime Ministerial Decision (37/PM), Sept. 30, 1999	For low-income people	Not more than 3%
	In case of higher water rate	Not more than 5%
World Bank Report "Investing in Development", 1985		3% ~ 5%

Note: * "Households of Lao PDR, Lao Expenditure and Consumption Survey"

As shown in the table below, the ratio of water charge to family income in Case 1 was 4.0% which is within the affordable range of 3% to 5%, so it would be considered that Case 1 is fair for the people.

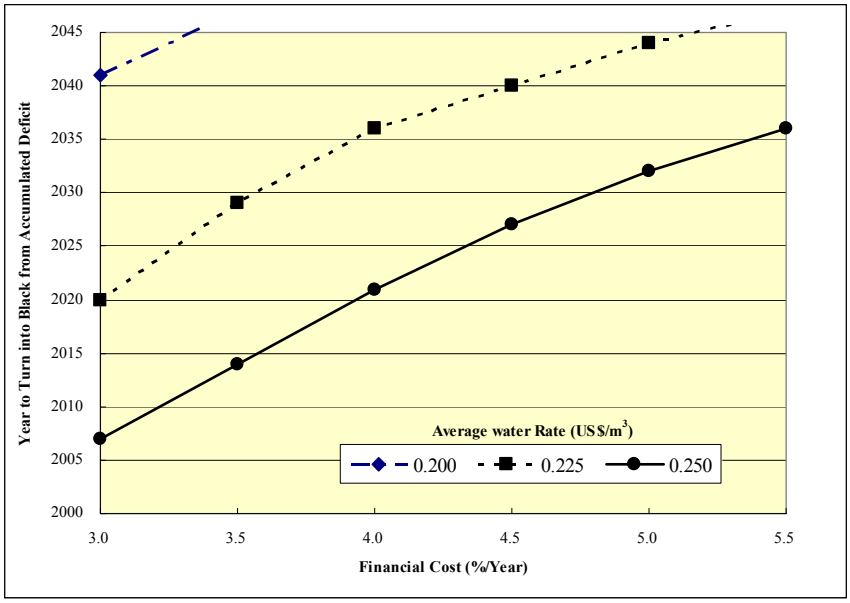
In Case 2, the rate was 5.4% which is over the range, so it would not be affordable. However, the water tariff could be made within the affordable range by means of cross subsidization taking affordability of domestic consumer into consideration.

Case	Water Unit Rate		Water Charge	Percentage of Water Charge to HH Income	Affordability*1
	(US$/m^3)	(Kip/m^3)	(Kip/month)	(%)	
Case 1	0.19	2,010	64,000	4.0	○
Case 2	0.25	2,680	86,000	5.4	△
Case 3	0.34	3,640	117,000	7.3	△
Case 4	0.45	4,820	154,900	9.7	×

Note: *1 Signs mean: ○ - fair, △ – hard, and × - impossible

(3) Financial Simulation

Through the simulation analysis, the relationship between the water cost and financial cost was depicted as shown in the figure on the right. For instance, if the average water rate was cut down to US$0.225/m^3 (10% down) and the financial cost went up to 4.5%/year (around 50% up), the year of solving accumulated deficit would be delayed to 2040 from 2007. In making a management plan for the project, the procurement of financial sources and the establishment of water rates are important issues.



4.6 Initial Environmental Examination

Although significant environmental impacts as a result of the implementation of the priority projects are not foreseen, possible environmental impacts have been listed and screened. A forthcoming environmental impact assessment is conducted during the feasibility study period.

4.7 Evaluation of the Master Plan and Recommendations

The prepared Master Plan has been evaluated from technical, socio-economic, and environmental aspects to help confirm the adequacy of the plan. Based on the identified issues of the existing conditions and development plans, the following recommendations are included in the Master Plan:

(1) Institutional, Organisational, and Legislative Aspects

- Expansion of an autonomous, and Legislative Aspects
- Promotion of Public Private Partnership
- Reconsideration of the roles of Drinking Water Factory

(2) Technical Aspects

- Coordination with AFD Study
- Reduction of UFW
- Monitoring water quality and quantity
- Promotion of water conservation
- Recruiting and training additional staff
- A Feasibility Study and Review of the Master Plan will be required

(3) Managerial Aspects

- Maintenance of good customer relations
- Strengthening of billing relating works

(4) NPVC Financial Aspects

- Improvement of the following issues: (a) expansion of equity instead of liability, (b) increase of water sales, (c) decrease of water production cost, (d) shortening water charge collection, and (e) cultivation of versatile workers.
- Procurement of financial sources with cheaper financial costs to supply water within consumers' affordability-to-pay.
- Setting up reasonable water tariffs based on the mutual understanding between water consumers and the water supplier.
- Finding rational water price for motivating water conservation.

(5) Improvement in Public/Customer Relations

5. FEASIBILITY STUDY

5.1 Framework of the Feasibility Study

The feasibility study is conducted focussing on the priority projects which were identified during the Master Plan. Taking into account the significance and urgency to solve problems which the NPVC and the people of Vientiane are encountering, the restoration work of the existing water supply system, the rehabilitation of the Kaolieo Treatment Plant and improvement of the Chinaimo Treatment Plant, and the expansion of the Kaolieo Treatment Plant and reforms to the transmission/distribution pipelines are selected as the priority projects. These projects are indispensable to improve the water supply conditions in Vientiane and are urgently required to meet increasing water demand. For the selection of the priority projects, the Lao PDR side and the JICA Study Team have mutually agreed on the projects and priorities and the scope of the priority projects are as follows.

- Rehabilitation of the existing Kaolieo Treatment Plant which has a production capacity of 20,000 m3/day
- Improvement of the Chinaimo Treatment Plant which has a production capacity of 80,000 m3/day. This includes:
    - Expansion of the reservoir (10,000 m3), including additional distribution pumping facilities
    - Installation of a new transmission pipeline from Chinaimo Treatment Plant to the existing transmission pipeline (separation of the transmission and distribution systems)
- Expansion of the Kaolieo Treatment Plant, to increase the capacity of 40,000 m3/day, so that the total capacity of the plant will become 60,000 m3/day
- Improvement of the Km6 BP Station
- Installation of 2.2 km of transmission mains
- Installation of 15.2 km of distribution mains

The target year of the feasibility study was set as 2007, the time of completion of the priority projects of the 1st stage of the project. The population, served population, and service ratio were estimated and calculated, as shown below.

Population, Served Population, and Service Ratio

	Unit	2003	2004	2005	2006	2007
Capital City Population	People	651,850	669,467	687,084	707,300	727,516
Served Population	People	251,549	263,558	275,567	294,508	313,448
Service Ratio in Capital City	%	38.5%	39.3%	40.1%	41.5%	42.9%
Population in Service Area	People	347,235	363,789	380,342	404,221	428,100
Served Population	People	251,549	263,558	275,567	294,508	313,448
Service Ratio in Service Area	%	72.4%	72.4%	72.5%	72.8%	73.1%

The service area in the target year 2007 will cover the existing service area and the expanded service area by the AFD distribution pipeline project.

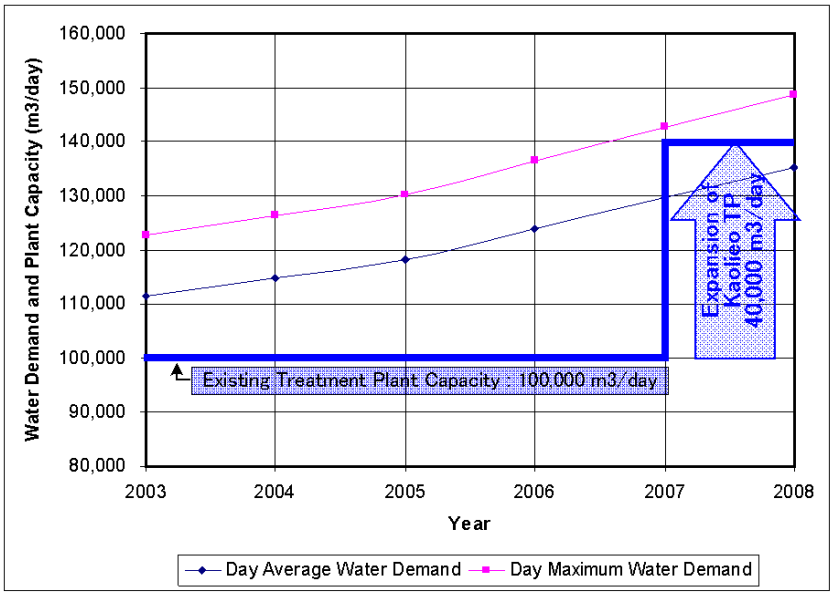
Based on the net water demand, the daily average water demand was calculated based on the estimated UFW ratio. The daily maximum water demand was calculated from the daily average water demand and the peak factor.

Day Average and Day Maximum Water Demand

	Unit	2003	2004	2005	2006	2007
Total Net Water Demand	m3/day	78,251	81,714	85,177	90,133	95,089
UFW Ratio	%	30.0%	29.0%	28.0%	27.4%	26.8%
Daily Average Water Demand	m3/day	111,496	114,899	118,302	123,963	129,625
Daily Maximum Water Demand	m3/day	122,645	126,389	130,132	136,360	142,587

Based on the forecast water demand, the priority projects were planned. To meet the future daily maximum water demand in 2007, it was planned to expand the existing Kaolieo Treatment Plant to have an additional capacity of 40,000 m3/day, bringing the total supply capacity to 140,000 m3/day, upon completion of the priority projects as shown in figure below.

Water Demand and Supply Capacity



As shown in this figure, it is apparent that the existing supply capacity, 100,000 m3/day, is far smaller than the daily maximum water demand. To relieve or mitigate the water shortage situation in the very near future, it is strongly recommend to reduce the unaccounted-for water ratio (UFW), and initiate the promotion of water conservation and water demand management programmes.

5.2 Preliminary Design of the Priority Projects

Rehabilitation of Kaolieo Treatment Plant

The Kaolieo Treatment Plant which was constructed in 1964 with a production capacity of 20,000 m3/day and rehabilitated in 1983. It is the oldest plant in Vientiane, therefore deterioration of facilities and equipment has become a significant problem for the stable operation of the plant. Operators are struggling against such deterioration without sufficient spare parts under overloaded conditions to meet an increasing water demand. Therefore, in order to secure water supply to the existing service area from the Kaolieo Treatment Plant, it has been judged that the rehabilitation works for the Kaolieo Treatment Plant is indispensable and is selected as one of the priority projects. The rehabilitation works of the existing Kaolieo Treatment Plant are as shown on table below.

Rehabilitation Work of the Existing Kaolieo Treatment Plant

Name of Facility	Name of Component		Specifications
Intake Facilities	Intake Pump	Replace	7.65 m3/min×19.5 m×37 Kw×3 Units
			Check and Sluice Valves with Motorized Operation
	Butterfly Valve	Replace	D500mm with Motorized Operation for Flow Control
	Crane	Replace	Electric Hoist Crane
	Maintenance Bridge	Repair	
	Bank Protection	Improve.	River Bed and River Bank Protection: L=45 m
Raw Water Transmission Pipe	Flow Meter & Control Panel	Replace	Ultrasonic Flow Meter at Maintenance Bridge
			Flow Control Panel
Mixing Well	Flash Mixer	Replace	Repairing the Structure and Valves if necessary
Flocculation & Sedimentation Basins	Flocculation Basin	Replace	D400mm of Inlet Valves
			D250mm of Sludge Drain Valves
			Up and Down Flow Baffle Walls
	Sedimentation Basin	Improve.	Substitute Outlet Launders for Gravel Filter
		Replace	D150mm of Drain Valves
		Improve.	Pressurized Cleaning Piping System
		Repair	Structural Wall's Clacks
Filtration Facilities	Filter Media	Replace	Effective Size=0.6mm, Depth of Sand=0.70m
	Underdrain System	Improve.	Precast Concrete Perforated Lateral System
	Operating Valves for Filtration	Replace	Inlet & Outlet Valves with Motorized Operating Stand
		Replace	Motorized Drain, Backwash & Surface Wash Valves
		Replace	Flow Controller
	Surface Wash System	Improve.	Surface Wash Equip. and Flow Meter & Control Valves
	Backwash Pump	Replace	27.1 m3/min×55 Kw×2 Units
Clear Water Reservoir		Repair	Repairing the Structure and Valves if necessary
Distribution Facilities	Distribution Pump	Replace	6.3 m3/min×67 m×110 Kw×4 Units
		Replace	Check and Sluice Valves with Motorized Valves
		Replace	Vacuum Pump and Incidental Accessaries
	Hoist Crane	Replace	Electric Hoist Crane
	Distribution Pipe	Improve.	D450mm×65 m
Chemical Feeding Facilities	Chemical Building	New	Located in the Expanded Administration Building
	Feeding Equipment & Solution Tank	New	Aluminium Sulfate in the Chemical Building
		New	Polymer in the Chemical Building
		Replace	Calcium Hypochlorite at the Clear Water Reservoir

Name of Facility	Name of Component		Specifications
Electrical Facilities	Power Receiving Facility	Replace	Using the Expanded Power Receiving and Transformer Equipment
	Power Supply Facility	Replace	Intake Pump Control Panel
		Replace	Distribution Pump Control Panel
		New	Operation of Filtration Control Panel
		New	Central Supervising Panel
	Emergency Generator Facility		Located in the Expanded Generator Room
			Generator Capacity for 1/3 Distribution Pump Capacity
	Instrumentation Facility	New	CRT Supervising Equipment
		Replace	Intake Level Meter
		Replace	Raw Water Flow Meter (Ultrasonic Type)
		New	Filtered Water Flow Meter (Oriffice Type)
		Replace	Head Loss Meter
		Replace	Clear Water Reservoir Level Meter
		Replace	Pressure Meter of Distribution Line
		Repair	Distribution Flow Meter(Ultrasonic Type)
Administration Building			Using the Expanded Administration Building
Laboratory			In Preparation for Expanded Administration Building
Landscaping and Others			Site Preparation, Embankment, Roads, Lighting, etc.
			Including Demolision and Relocation of the existing housings

Improvement of Chinaimo Treatment Plant

The Chinaimo Treatment Plant was originally designed for water to be transmitted to elevated tanks and reservoirs throughout the town. Therefore, the total capacity of the pumps in the Chinaimo Treatment Plant is 80,000 m3/day, the same volume as the capacity of the plant. This means that the plant is not able to distribute water which has hourly fluctuations. Accordingly, the capacity of reservoirs is about 3,000 m3, equivalent to less than 1 hour of plant production capacity.

Although the plant was designed only for transmitting water to the elevated tanks and reservoirs, distribution lines are branched from the transmission pipeline to distribute water directly to the town. By the mixture of the distribution and transmission systems, the distribution system now cannot meet hourly fluctuations and the transmission system becomes unstable depending on the quantity of the volume of the distributed water.

Given these conditions, it is considered that the separation of the transmission and distribution systems is indispensable to achieve a stable water supply. For this system separation, the major work items for the improvements to the existing Chinaimo Treatment Plant are summarised in table below.

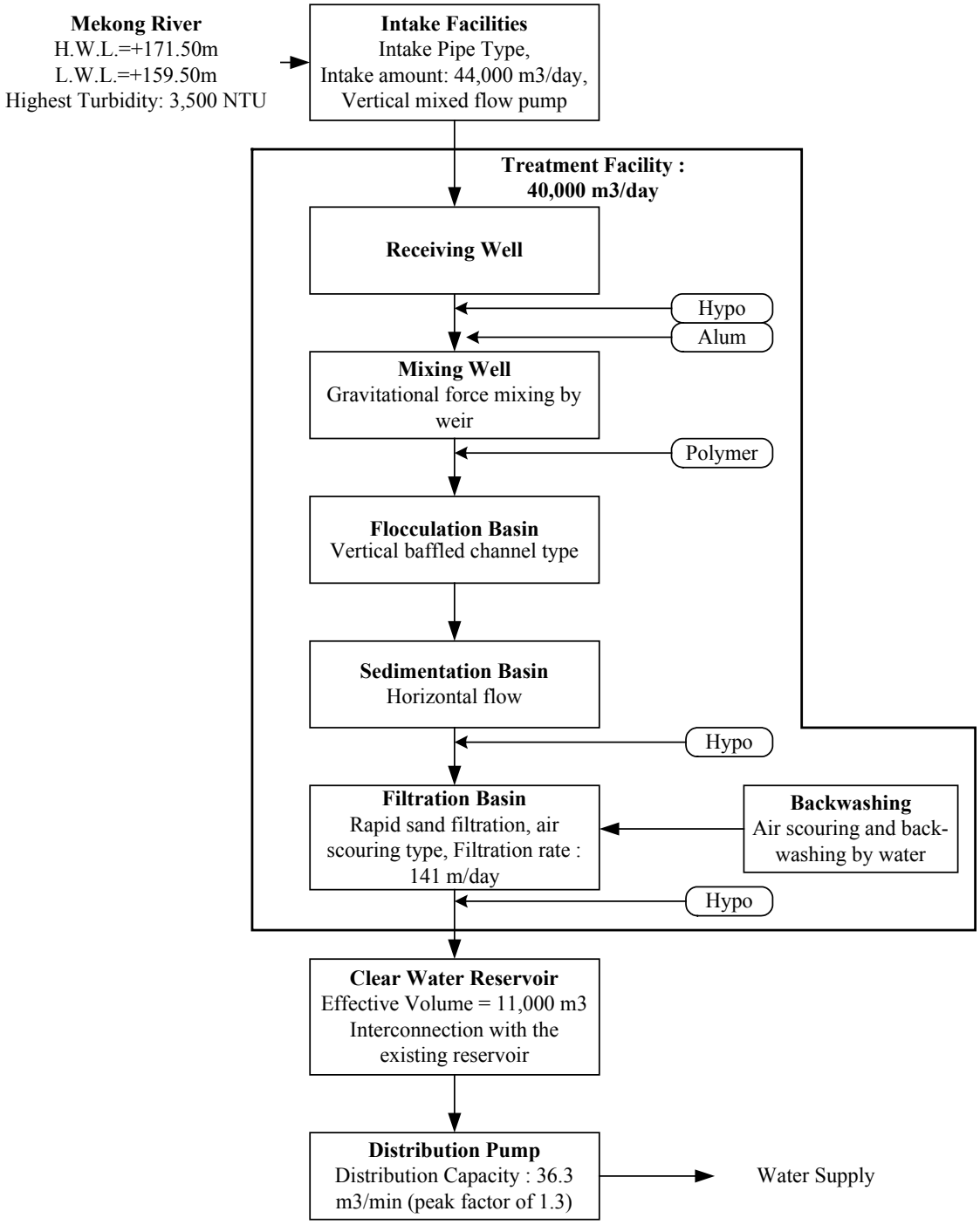
Improvement Work of the Existing Chinaimo Treatment Plant

Name of Facility	Name of Component	Specifications
Clear Water Reservoir	Clear Water Reservoir	V=10,000 m3, Detention Time=6 hr
	Operating Valves and Piping	D1,100mm Butterfly Valves with Manual Operating Stand
		D800mm Butterfly Valves with Manual Operating Stand
		D1,100mm Inlet Pipe×50 m
Distribution Pumping Facilities	Distribution Pump Building	Area=250 m2 Beside the Clear Water Reservoir
	Distribution Pump	12.1 m3/min×67 m×195 Kw×4 Units
		Check and Sluice Valves with Motorized Valves
		Vacuum Pump and Incidental Accessaries
	Hoist Crane	Electric
	Operating Distribution Pipe	D700mm×76 m and D1,000mm×25 m
	Operating Valves	D700mm and D1,000mm Butterfly Valve
Electrical Facilities	Power Receiving Facility	Branch Power Source from the Existing Power Receiving and Transformer Equipment
	Power Supply Facility	Low Voltage Power Receiving Panel
		Distribution Pump Control Panel
		Supplementary Power Supply Panel
	Emergency Generator Facility	Generator Room with Fuel Tank
		Generator Capacity for 1/3 Distribution Pump Capacity
	Instrumentation Facility	Replacement the Existing Monitoring Panel
		Replacement of Ultrasonic Flow Meter for Thaduea
Landscaping and Others		Site Preparation, Embankment, Roads, Lighting, etc.

Expansion of Kaolieo Treatment Plant

The first stage expansion of the Vientiane Water Supply Development Project will be 40,000 m3/day to meet the daily maximum water demand in 2007. The expansion of the Kaolieo Treatment Plant includes intake facilities, treatment facilities with chemical feeding facilities, distribution facilities, electrical facilities and other miscellaneous works. Figure below shows the flow diagram of the treatment process for the proposed expansion works.

Proposed Treatment Process for Extension of Kaolieo Treatment Plant



The results of the preliminary design of the Kaolieo Treatment Plant are summarised in the table below.

Expansion Works of the Existing Kaolieo Treatment Plant

Name of Facility	Name of Component	Specifications
Intake Facilities	Intake Structure	Construction of New Intake Pipe Type
	Bank Protection	River Bed and River Bank Protection: L=20 m
	Intake Pump	15.3 m3/min×18.5 m×70 Kw×3 Units
		Check & Sluice Valves with Motorized Operating Stand
	Inlet Pipes & Butterfly Valves	D1,000mm×3 Units with Manual Operating Stand
	Flashing Piping & Valves	D300mm with Manual Operating Stand
	Stop Valve for Discharge Main	D700mm Butterfly Valve with Manual Operating Stand
	Hoist Crane	Electric Crane with Associated Equipment
	Stop Log for Bottom Pipe	D1,000mm with Manual Operating Stand
Raw Water Transmission Pipe	Raw Water Transmission Main	D700mm×40 m
	Flow Meter & Flow Control Valve Chamber	Meter and Valve Chamber
		Ultrasonic Flow Meter
		Raw Water Flow Control Valve and Panel
Receiving Well & Mixing Well	Receiving Well	1 Basin, Detention Time=2.3 min
	Mixing Well	Gravity Type(Weir), 1 Basin, Detention Time=1.0 min
Flocculation & Sedimentation Basins	Flocculation Basin	Up and Flow Baffle Channel Type, 4 Basins
		Detention Time=23.7 min
		D300mm Sludge Valve with Manual Operating Stand
	Sedimentation Basin	Horizontal Flow Type with Outlet Launder, 4 Basin
		Detension Time=2.1 hr (Substantial D. Time=3.5 hr)
		D300mm Sludge Valve with Manual Operating Stand
		Pressurized Cleaning Piping System
Filtration Facilities	Filter Basin	Air-Scouring Type, Filter Area=49.35 m2/Basin
		6 Basin, Filtration Rate=148.6m/d
	Filter Media	Effective Size=1.0mm, Depth of Sand=1.0m
	Underdrain System	Pourous Concrete Type
	Rate of Backwashing and Air-scouring	Backwash Rate=0.40m3/min/m2,
		Air-scouring Rate=1.00m3/min/m2
	Oprerating Valves for Filtration	Inlet Gate with Motorized Operating Stand
		Motorized Outlet, Backwash & Air-scouring Valves
		Flow Controller (Volvoset)
	Backwash Pump & Air Blower	Backwash Pump:19.74 m3/min×30 Kw×2 Units
		Air Blower: 49.35 m3/min×45 Kw×2 Units
Measurement & Mixing Chamber	Flow Measurement Chamber	1 Basin, Detention Time=1.8 min
	Chlorine Mixing Chamber	Gravity Type (Weir), 1 Basin, Detention Time=0.7 min
Clear Water Reservoir	Clear Water Reservoir	V=10,000 m3 (11,000 m3), Detention Time=6 hr
	Operating Valves and Piping	D700mm Butterfly Valves with Manual Operating Stand
		D700mm Inlet Pipe & D600mm Connecting Pipe

Name of Facility	Name of Component	Specifications
Distribution Facilities	Distribution Pump Building	Area=300 m2 on the Clear Water Reservoir
	Distribution Pump	12.1 m3/min×67 m×195 Kw×4 Units
		Check and Sluice Valves with Motorized Valves
		Vacuum Pump and Incidental Accessaries
	Hoist Crane	Electric
	Flow Control Valve	Motorized Butterfly Valve
	Distribution Pipe	D700mm×80 m
Chemical Feeding Facilities	Chemical Building	Located in the Administration Building
	Feeding Equipment & Solution Tank	Aluminium Sulfate & Polymer in the Chemical Building
		Calcium Hypochlorite at the each Local Feeding Point
Electrical Facilities	Power Receiving Facility	Power Receiving and Transformer Equipment
	Power Supply Facility	Intake Pump Control Panel
		Distribution Pump Control Panel
		Operation of Filtration Control Panel
		Central Supervising Panel
	Emergency Generator Facility	Generator Room with Fuel Tank
		Generator Capacity for 1/3 Distribution Pump Capacity
	Instrumentation Facility	CRT Supervising Equipment Facility
		Intake Level Meter
		Raw Water Flow Meter (Ultrasonic Type)
		Filtered Water Flow Meter (Weir Type by Float)
		Filtered Head Loss Meter
		Clear Water Reservoir Level Meter
		Pressure Meter of Distribution Line
		Distribution Flow Meter (Ultrasonic Type)
Administration Building		A=200 m2×2F on the Clear Water Reservoir
Laboratory		Located in the Administration Building
		Water Quality Analysis Equipment and Reagent
Landscaping and Others		Site Preparation, Embankment, Roads, Lighting, etc.
		Including Demolition and Relocation of the existing housings

An additional water source will be required for the expansion of the existing Kaolieo Treatment Plant. The quantity of additional raw water required will be 44,000 m3/day, including 4,000 m3/day to cover the expected treatment losses which are unavoidable within the treatment process.

Based on the Water and Water Resources Law which was enforced in November 1996 by the Presidential Statement and Decree to Implement the Law on Water and Water Resources issued in October 2001 by the Prime Minister, the WASA, DHUP, MCTPC confirmed that the additional raw water source from the Mekong River would be secured by the MCTPC.

Improvement of Km 6 Booster Pumping Station

According to the network analysis, the improvement works for the Km6 Booster Pumping Station are outlined in table below. The transmission pumps for pumping the water directly to the Dongdok Reservoir, and the distribution pumps for distributing water to the northern area along the National Roads No.10 & No.13 will be installed for the booster pumping station at the existing site. An expansion of the pumping building will be necessary for the new transmission pumps. For the replacement of the distribution pumps, the existing pumping building can be utilised.

Improvement Works of Km6 Booster Pumping Station

Name of Facility	Name of Component	Specifications
Pump Facilities	Pumping Building	Area=35 m2×B1×2F
	Transmission Pumps	4.8 m3/min×50 m×57 Kw×2 Units
		Check and Sluice Valves with Motorized Valves
	Distribution Pumps	6.0 m3/min×50 m×72 Kw×3 Units
		Check and Sluice Valves with Motorized Valves
Electrical Facilities	Power Receiving Facility	Power Receiving and Transformer Equipment
	Power Supply Facility	Distribution Pump Control Panel
		Transmission Pump Control Panel
	Emergency Generator Facility	Generator Room with Fuel Tank
		Generator Capacity for 1/3 Dist. & Trans. Pump Capacity
	Instrumentation	Pressure Meter of Distribution and Transmission Line
		Supervising Panel
Landscaping and Others		Site Preparation, Lighting, etc.

Improvement of Transmission and Distribution System

During the preparation of the master plan, the lengths of the proposed pipelines were estimated from drawings supplied by the NPVC. Based on the results of the field survey during the feasibility study, considering the results of detailed filed investigation and referring to the on-going projects, the length of the proposed pipelines estimated during the mater plan was altered, as shown in table below. For a network analysis of the 1st Stage Project, the pipeline lengths obtained from the survey shown on the table were used. The distribution system was studied by AFD project and the minimum required distribution pipelines which were included in the 1st Stage Project is the minimum requirements for the pipeline to distribute water from the expanded Kaolieo Treatment Plant.

Pipeline Length for Minimum Required Distribution and Transmission Pipelines

Dia (mm)	Minimum Required Distribution Pipeline (km)	Transmission Pipeline (km)
150	4.57	-
250	3.24	-
400	4.65	-
450	-	1.88
600	1.62	-
700	0.50	0.72
Total	14.58	2.60

The results of the analysis confirm that the average residual pressure at each junction will be maintained at more than zero in the situation where the minimum required distribution mains were installed at the same time as the expansion of treatment plant capacity and the development of the transmission system.

It is, however, noted that to install only the minimum required distribution mains is not the appropriate development of the distribution network system in 2007. Essentially, the most appropriate development should follow the master plan. A detailed study on the distribution network system will be conducted by the AFD study.

5.3 Water Conservation and Water Demand Management

In the master plan, augmentation of the water supply by improvement of the infrastructure is planned, and the priority projects are selected. However, it is projected that even the consecutive implementation of the projects could not satisfy the increasing demand in Vientiane Capital City due to multiple factors and variables such as, the growing population, expansion of served areas, the time lag between construction and supply, and so forth. Therefore, the problem of water availability shall be solved by using an appropriate mix of supply- and demand- side measures.

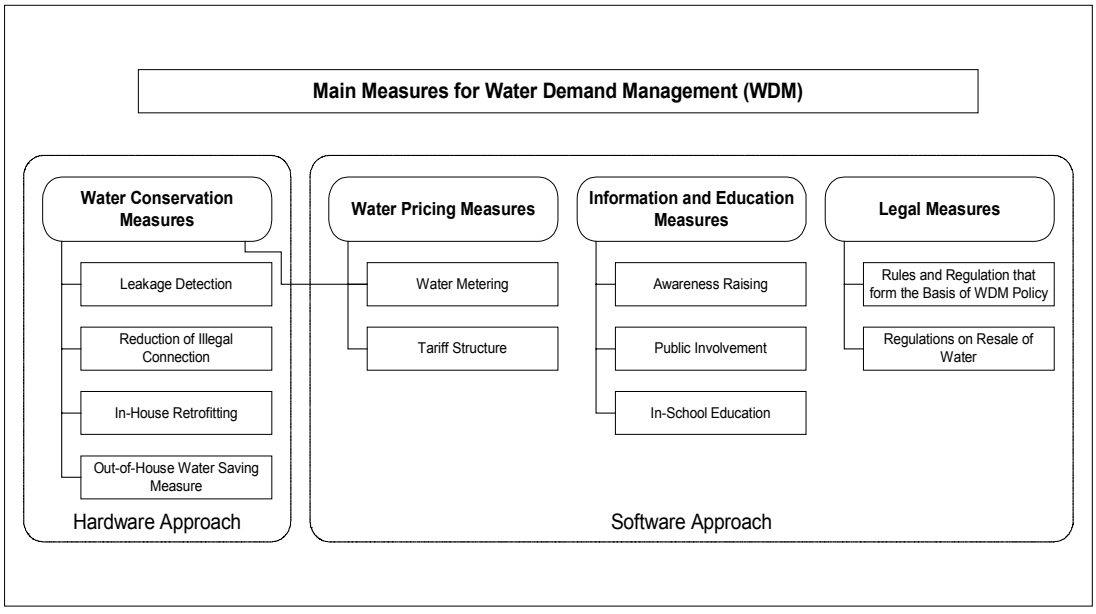
Attention must be devoted to managing the increasing demand for water, to achieve a sustainable long-term balance between water availability and water requirement in an equitable manner. Thus, water conservation and water demand management programmes should be given significance in the development of the water supply in Vientiane Capital City.

It has been demonstrated in many countries that saving water rather than the development of new water sources is a more economical option. A comprehensive water demand management

programme is therefore seen as the preferred alternative to meet the increasing water demand in Vientiane, and can be defined as a strategy to improve the efficiency and sustainable use of water resources, taking into economic, social, and environmental considerations.

A comprehensive program for water demand management includes software and hardware components. The major measure for demand control can be further divided into; 1) water conservation measures, 2) water pricing measures, 3) information and education measures, and 4) legal measures. These main measures involves several sub-measures or methods.

1. Water conservation measures includes; 1) leakage detection, 2) reduction of illegal connections, 3) in-house retrofitting, 4) out-of-house water saving measures.
2. Water pricing measures, which involve 1) water metering, 2) tariff structure.
3. Information and education measures, which includes 1) awareness raising, 2) public involvement, 3) in-school education.
4. Legal measures, which includes 1) rules and regulations that form the basis of the WDM policy, 2) regulations on the resale of water



The public water supply service will become viable and sustainable when mutual confidence and cooperation is increased between the service provider and consumers. This can be achieved by the service provider committing itself to an improvement in service quality, and consumers placing a higher value on the services provided and utilizing the service in a responsible manner.

Having no specific customer service and public relations department, the NPVC is hindered in the attempts to improve customer services and public relations. Improvements to customer service and public relations are indispensable to increase public awareness of water issues, and to obtain the cooperation of customers in the water supply service, in particular when some crucial actions such as pricing measures and the campaign for water conservation and water demand control are taken. Disclosure of information by the NPVC through the media, and the publication of annual report, discussing factors such as financial status and how the revenue collected is utilized, is another measure to increase the transparency of the service provider, thus increasing users' awareness and cooperation. Mitigation of users' dissatisfactions and claims would also contribute to convincing consumers of the intentions of the NPVC.

It is repeatedly emphasized, however, that the improvement of public relations, of which information flows are often one sided from the service provider to consumers, alone can not increase user awareness and responsibility for the water supply service, without the provision of improved services, such as a swift response and action by the service provider for claims and suggestions by consumers. It can be said that mutual communication between the service provider and consumers ensures a level of mutual confidence and cooperation as mentioned previously.

5.4 Preliminary Cost Estimates for the 1st Stage Project

Results of the preliminary cost estimates are shown on table below.

Project Costs for the 1st Stage (x 1,000US$)

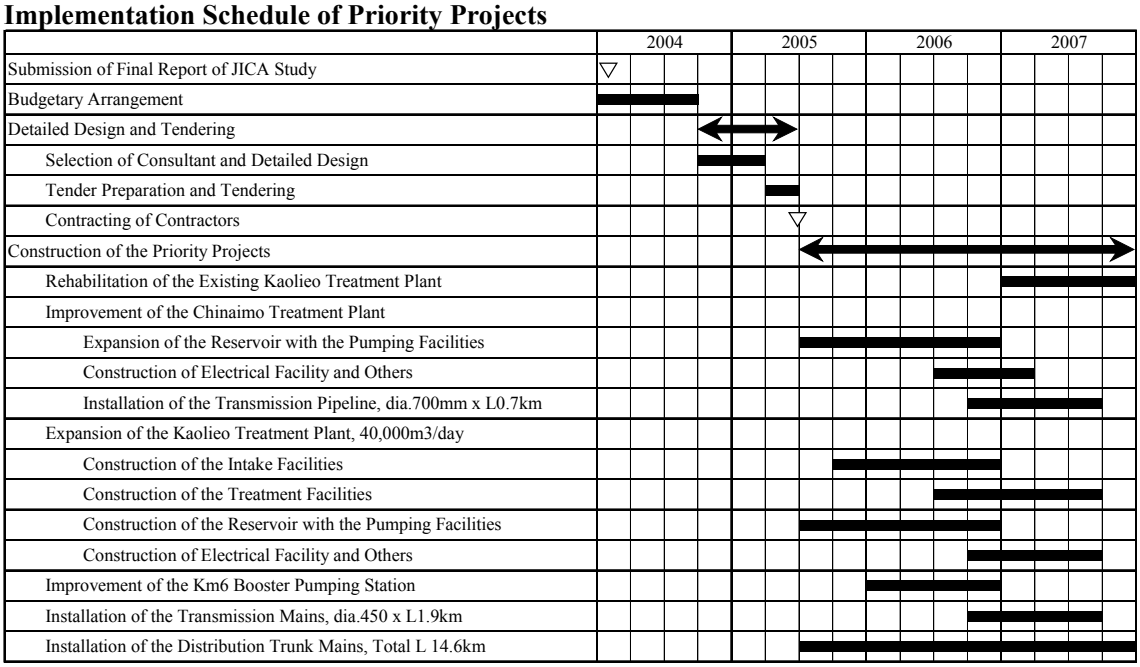
		Total	Foreign	Local
A. Priority Projects by JICA Study				
A1. Construction Cost		20,312	13,341	6,971
A1.1 Rehabilitation of Kaolieo T.P.		3,024	2,217	806
A1.2 Improvement of Chinaimo T.P.		2,433	1,428	1,004
Reservoir with Pumping Facilities		1,841	902	939
Electrical and Other Facilities		592	526	66
A1.3 Expansion of Kaolieo T.P.		9,625	5,723	3,902
Construction of Intake Facility		2,002	1,365	637
Construction of Treatment Facility		3,193	1,521	1,672
Construction of Distribution Facility		2,085	1,021	1,065
Electrical and Other Facilities		2,345	1,817	528
A1.4 Improvement of Km6 BP Station		736	634	102
A1.5 Installation of Transmission Mains		1,211	970	240
A1.6 Installation of Distribution Mains		3,285	2,369	916
A2. Consulting Services, D/D and S/V	7%	1,422	934	488
A3. Contingencies		4,637	3,064	1,573
A3.1 Physical Contingency = (1.+ 2.)×	(10)%	2,173	1,427	746
A3.2 Price Contingency = (1.+ 2. + 3.1)×rate$^{2004\sim}$	(3)%	2,463	1,637	827
A4. Administration Cost = (1.+ 2. +3.)×	5%	1,319	0	1,319
Total Project Costs for A = (1.+ 2. +3. +4.)		**27,689**	**17,339**	**10,350**
B. Other Projects				
B1. Construction Cost		5,711	4,107	1,604
B1.1 Installation of Distribution Mains		3,108	2,325	783
B1.2 Secondary & Tirtially Distribution Mains		606	510	96
B1.3 House Connection Installation		752	620	132
B1.4 Unaccounted-for Water Reduction		1,245	652	593
B2. Consulting Services, D/D and S/V	7%	400	287	112
B3. Contingencies		1,214	877	337
B3.1 Physical Contingency = (1.+ 2.)×	(10)%	611	439	172
B3.2 Price Contingency = (1.+ 2. + 3.1)×rate$^{2004\sim}$	(3)%	603	437	165
B4. Administration Cost = (1.+ 2. +3.)×	5%	366	0	366
Total Project Costs for B = (1.+ 2. +3. +4.)		**7,691**	**5,271**	**2,420**

5.5 Project Implementation Schedule

To satisfy the increasing water demand in the service area, the implementation of the priority projects should not be delayed from this proposed schedule, because the production capacity of 140,000 m3/day in 2007, after the completion of the 1st stage, will not meet the daily maximum water demand after 2007.

In order to complete the priority projects by the end of 2007, the projects should commence in the middle of 2005, taking into account the magnitude of the projects. The construction work for the priority project will take at least two and half years. It is therefore necessary to start the detailed design and tendering works from the end of 2004 following the budgetary arrangement.

Implementation Schedule of Priority Projects



5.6 Financial and Economic Analysis

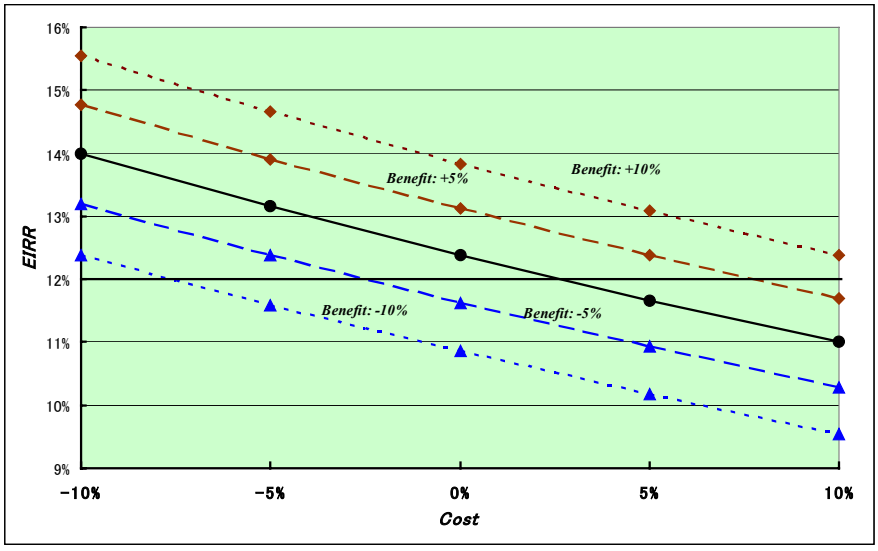
(1) Economic Evaluation

The evaluation indices of the 1st stage project are shown in the table below. Under the present socio-economic conditions, the indices were 8.1% for the EIRR, minus US$5.8million for NPV, and 0.77% for the B/C. Thus, the 1st stage project is deemed to be not feasible, because the EIRR is lower than the economic opportunity cost of capital (12%). With a projected increased economic growth in the future, however, the indices are calculated to be 12.4% for the EIRR, US$0.68 million for the NPV and 1.03% for the B/C. Given these different calculations, the project could then be feasible from an economic point of view.

Item	EIRR (%)	NPV* (US$ Million)	B/C*
Under Present Conditions	8.1	-5.84	0.77
With Economic Growth Conditions	12.4	0.68	1.03

Note: * Discounted at 12%.

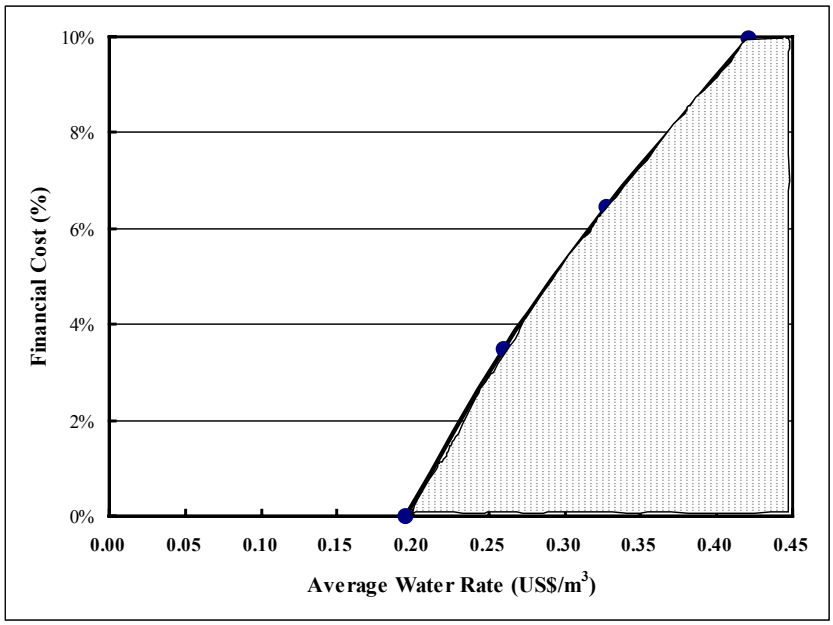
According to the sensitivity analysis, the allowance of the investment cost for project's feasibility was too small, as shown in the figure right. For instance, once the construction costs increases 5% more than the original estimate, the EIRR would be reduced to 11.7%, lower than 12%, the economic opportunity cost of the capital. At the implementation stage, thus, the investment and O&M costs should be estimated with prudence, taking particular account of cost over-runs.



(2) Financial Analysis

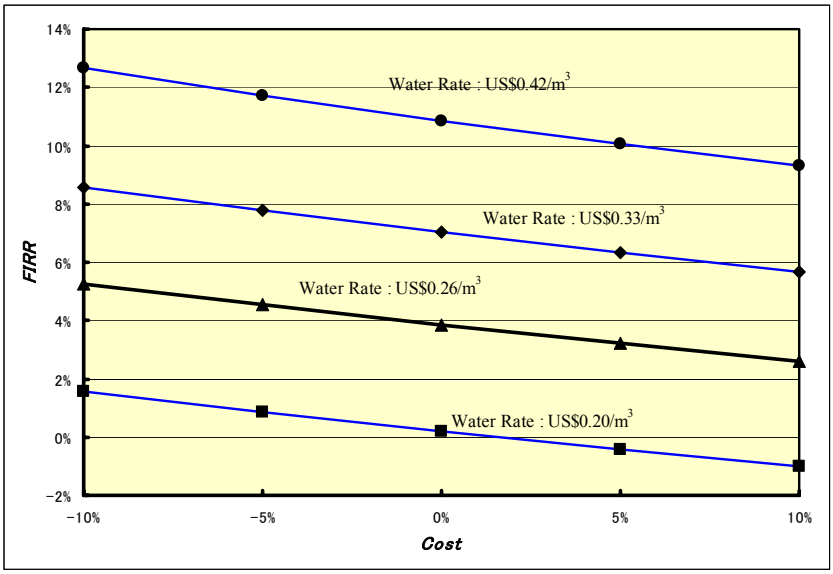
In the financial analysis, the evaluation indices of the 1st stage project were 0.12 of B/C and minus US$5.8 million of NPV, which were discounted at 12%. The FIRR was not calculated because the revenue from the beneficiaries is small compared with the investment and O&M costs. Based on this result of the financial costs and revenues, the relationship between water tariffs and the financial

costs were analysed and depicted to show the financially feasible positions in the graph below.



The area shaded in the graph indicates the effective combination of the financial costs and water charges. Through this analysis, the following case is considered as the most presumable condition from the viewpoint of the past performance of the NPVC. The financial source is to be procured at a financial cost of 3.5% per annum, and the water tariff is US$0.26/m^3 on average, corresponding to 5.2 times the present water rate. These financial costs were already applied in Chinaimo Expansion Project.

The FIRR indicates the marginal efficiency of the investment. In the case where water rates are US$0.26/m^3, the FIRR of the original cost estimate was 3.5%, as analysed above. Then, the project could have 3.5% of marginal efficiency for the investment, if it were managed in the most efficient conditions. In other words, the project could be viable from a financial point of view if the financial source providing an interest rate of less than 3.5% was procured for the execution of the project. According to the sensitivity analysis, however, if the cost increased to 10% more than the original estimate, the FIRR (marginal efficiency for investment) might be reduced to 2.2%, as shown in the figure at right. Thus, the investment cost would



directly influence the financial cost so all costs must be carefully reviewed at the design stage.

To recover the total input for the 1st stage project, the project entity is expected to manage its revenues and costs diligently throughout the project life. To attain a full cost recovery policy, the water tariff based on the Long Run Average Cost (LRAC) will be introduced at the beginning, or in the middle of the target year in case of approving of a raise of water tariff. Then, the initial tariff is to be raised over a prolonged period of time, relative to the LRAC. Finally, the management will strive to recover the total costs by the end of the project life. As a result, the projected cash flow of the project could cover the total amount of the loan within the project life, verified by the Loan Life Debt Service Coverage Ratio (LLCR) of 1.016.

There are some difficulties however for the management of the project operation. To attain the average water tariff of US$0.26/$m^3$ the management has to wait until 2020 because the water tariff originates from the present level because the tariff increases incrementally. Thus, the management has a large projected deficit for the first half of the project life. In the second half of the project then the NPVC has to cover these deficits by means of utilising the net profits. Finally, the debt service was covered by the end of the project life.

Regarding the water charge for domestic consumers, the ratio of the charge to household income is set to 1.1% of the household income at the beginning year. The ratio is 2.2% only even in the year 2037. This ratio could satisfy the beneficiaries of domestic users. The water tariff for non-domestic consumers could keep the same rate of two times higher than that of domestic consumers even in the year 2037.

Furthermore, the 1st stage project was analysed to find the necessary conditions for a financially sustainable management from the viewpoint of commercial financial viability. If the project was managed under sustainable financial conditions, the project would be able to stand alone. According to the results of the cash flow analysis, however, it would be very difficult to attain financially sustainable conditions within the project life. To reach these financially sustainable conditions, the management of the NPVC has to obtain 37% more revenue than that in the previous analysis result. The average water rate was calculated at US$0.37/$m^3$ at 2003 economic conditions, which was also 42% higher than the previous management case and 7.4 times more than the average water rate in 2003. Accordingly, as an immediate target, the management of the 1st stage project should aim for a policy of full cost recovery by the end of project life, instead of the financial sustainable management level.

5.7 Environmental Impact Assessment

The Initial Environmental Examination (IEE) and the Environmental Impact Assessment (EIA) were conducted as part of this study. Both the IEE and the EIA have been carefully evaluated for possible impacts on the environment which might be derived from the implementation of the priority projects. These evaluations indicated that the project can be implemented and maintained without adversely affecting the environment throughout the stages of construction and operation, with implementation of the recommended mitigation measures.

5.8 Project Evaluation

To secure sustainability of the water supply system as the sole source of water supply to people living in Vientiane, the JICA Study Team adopted the following as the basic engineering strategies for the planning and designing of the water supply infrastructure for the 1st Stage Project.

- Selection of an adequate intake facilities
- Use of a vertical mixed flow type intake pump
- Use of hydraulic energy for chemical mixing and flocculation, instead of adopting mechanical agitators and flocculators at water treatment works
- Adoption of horizontal flow sedimentation basins for expansion of the Kaolieo Treatment Plant
- Use of air scouring type filtration basin
- Rehabilitation of the existing Kaolieo Treatment Plant
- Separation of the treated water transmission mains from that of distribution mains
- Adequate technology level

The 1st Stage Project was planned and designed through careful technical examination and the project does not require any new, advanced technology for its operation and maintenance.

In the economic evaluation, the 1st stage project was evaluated through the use of evaluation indices. With the projected economic growth in the future, however, the indices became 12.4% for the EIRR, US$0.68 million for the NPV, and 1.03 for the B/C. In these changed socio-economic conditions therefore, the project could be feasible from an economic point of view. However, the allowance of the investment cost for the project's feasibility border line was too small. For instance, once the construction costs increases to 5% more than the original estimate, the EIRR would go down to 11.7%, lower than the 12% threshold. At the implementation stage thus, the investment and O&M

costs should be estimated with prudence, taking into account any cost over-runs.

In the financial analysis, the FIRR was not calculated because the revenue from the beneficiaries is small compared with the investment and O&M costs. Based on these financial cost and revenue results, the relationship between water tariffs and the financial costs were analysed, and a feasible financial position was assessed. The financial source is to be procured at a financial cost of 3.5% per annum and the water tariff will need to be US$0.26/m^3, on average. This financial cost was already applied in the Chinaimo Expansion Project.

To recover the total input for the 1st stage project, the project entity is expected to manage its revenues and costs with care for the life of the project. The water tariff is based on the Long Run Average Cost (LRAC), to be introduced at latest in the middle of the target year. Then, the initial tariff will be raised over a prolonged period of time relative to the LRAC. Finally, the management of the NPVC should attain recovery of the total costs by the end of the project life. The LLCR was calculated at 1.016, so the project cash flow could cover the total amount of the loan within the project life

In the financial analysis, the average water tariff was proposed as US$0.26/m^3 for the 1st stage project. This is almost five times more than the present average tariff. To mitigate the financial burden to water users then, the tariff structure was designed to start at the present water tariff level and to raise the water tariff in accordance with a projected increase of household income in order to attain the full cost recovery policy.

Regarding the water charge for domestic consumers, the ratio of the charge to household income is set to 1.1% of the household income at the beginning year. The ratio is 2.2% only even in the year 2037. This ratio could satisfy the beneficiaries of domestic users. The water tariff for non-domestic consumers could keep the same rate of two times higher than that of domestic consumers even in the year 2037.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

For the reasons outlined below, the proposed priority projects can be assessed as feasible.

Throughout the planning process of the water supply system improvement works for the 1st Stage

Project, continuous attention was paid by the JICA Study Team to ensure that any improvement works to be proposed can be implemented, operated and maintained within the level of technical skills and engineering capacity currently available in Vientiane and in Lao PDR. It is therefore expected that the priority projects can be implemented within the time frame envisaged, and that the project, once it has been implemented, can be managed on a sustainable basis.

The water resources available from the Mekong River required for the expansion of the exiting Kaolieo Treatment Plant has been confirmed as having the necessary quantity to meet the additional raw water requirement for the proposed Kaolieo Treatment Plant (44,000 m3/day including unavoidable losses within the plant).

The priority projects will increase the supply capacity of the NPVC water supply system from the present 100,000 m3/day to 140,000 m3/day. This drastic increase in supply capacity is expected to alleviate the chronic water shortage situation in Vientiane. The priority projects also includes the rehabilitation of the existing Kaolieo Treatment Plant to secure its function for several decades, and the improvement of the existing Chinaimo Treatment Plant to ensure stable water transmission and distribution to the whole service area including the Dongdok area where severe water shortages occurs. Additional transmission pipelines and distribution pipelines also will be installed under the priority project so as to distribute additional treated water from the expanded Kaolieo Treatment Plant.

6.2 Recommendations

Engineering Aspects

(1) Coordination with AFD Study

Unfortunately, because the procurement procedures of the AFD consultants to execute the study on the distribution system and household connections were delayed, the timing of the completion of the studies by the JICA and AFD are not coordinated. The AFD study concerning the distribution system will be continued until the middle of year, 2004. During the stages of the master plan and feasibility study by JICA, the JICA Study Team and the AFD consultant have exchanged information to maintain the consistency of these two studies. The feasibility study is to be completed by the time of submission of this report. The Lao PDR is recommended to coordinate with the AFD and AFD consultant about the AFD study conforming to the results of the JICA study.

(2) Coordination with the AFD Training Centre Project at Chinaimo Treatment Plant

Since the detailed design for the AFD Training Centre has not yet commenced, the NPVC could not confirm the exact location of the training centre in the Chinaimo Treatment plant premises. The Lao PDR is recommended to secure and reserve the land space required for the additional distribution reservoir which will be constructed under the 1st Stage Project at the Chinaimo Treatment plant.

(3) Careful Consideration of River Bank Protection at the Intake of Kaolieo Treatment Plant

The type of the river bank protection will be decided during the detailed design of the project. It should be discussed among the MCTPC and DCTPC which have responsibility for the river bank protection of the Mekong River. It also recommended to refer the results and recommendations of the river bank protection project which is under implementation by JICA. The river bank protection project will provide a good example of the river bank protection near the Kaolieo Treatment Plant.

(4) Reduction of UFW

Upon improvement of water supply pressure, underground invisible leakages will become above ground, visible leakages. This will be a chance to find and repair current underground leakages. If the leakage repair work is not implemented by the NPVC, the ratio of UFW will increase rapidly from the pressure increase in the system. To implement the necessary actions against increasing leakages, it is recommended to do a budgetary arrangement and staff assignment for the leakage repair work.

At the completion of the 1st Stage of the project in 2007, the total production capacity of the system will be 140,000 m3/day, the same as the daily maximum water demand in 2007. This means that from the time of completion of the 1st Stage, production capacity will be less than the water demand until 2012, when the 2nd Stage of the project will be completed. Reduction of UFW and water conservation promotion, which is discussed below, will be a key factor for the alleviation of water shortages up to 2012.

For the reduction of UFW, the JICA will carry out a cooperative project for capacity building of NPVC employees. As part of the cooperation, a Japanese expert in UFW reduction will be assigned to the NPVC, and will be prove to be of great assistance for the future of the NPVC UFW reduction activities.

To prevent leakage, pressure control in the distribution system is indispensable. To conduct pressure control, the NPVC should know the pressure distribution in the service areas. It is recommended to establish fixed pressure monitoring points at the same places as the water quality monitoring points as described below, and pressures should be measured periodically. Based on the pressure records from these fixed monitoring points, valve adjustment should be conducted to avoid extreme high pressure and to stabilize pressure distribution in the service area.

The definition of unaccounted-for water (UFW) is difference between total distributed water quantity and total metered water quantity at customers' connections. Therefore, water quantity equivalent to unpaid water bill, which is not paid by customer, is not included in the UFW. Needless to say, the unpaid water quantity should also be reduced as reduction of the UFW.

(5) Monitoring water quality and quantity

Water quality should be analyzed at the respective treatment plants to decide the adequate chemical dosage rates and to supply safe water to customers. Water quality monitoring is recommended not only at the treatment plant, but also at service connections periodically selected within the service area. The NPVC is recommended to select several tens of fixed point for monitoring residual chlorine and other necessary water quality indices. These results should be disclosed to customers so as to raise the awareness of the safety of the distributed water.

(6) Adequate Operation and Maintenance

The role of coordination or management by a management level higher than technicians or workers, such as engineer level or manger level is very important. Furthermore, maintenance work seems to be conducted in an allopathic manner. However, equipment usually requires periodical maintenance, such as lubrication, in order to prevent malfunction. The engineering or managerial level staff should prepare periodical maintenance schedules with the required frequency, such as daily, monthly, and yearly for the necessary maintenance work.

(7) Recruiting and training of additional staff

Additional staff for the expanded Kaolieo Treatment Plant and the expanded pipeline system will be required. It is recommended to start arrangements for recruiting additional staff and provide training for them. The training program is presented in the previous chapter.

(8) Feasibility Study and Review of the Master Plan will be required

Upon completion of the 1st Stage, a feasibility study will be required for the 2nd Stage for its

successful implementation. At the same time, a review of the master plan will also be required. The master plan is the long term plan, and the Vientiane water supply situation will change because of unforeseen factors. Therefore, the master plan should be reviewed at every turning point during the progress of the water supply development. After completion of the 1st Stage of the project, a feasibility study will be required to implement the 2nd Stage. During the feasibility study for the 2nd Sage, the scale of the 2nd Stage will be reviewed. If the situation is that the maximum water demand is reduced by the promotion of water conservation, and the reduction of UFW is greater than estimated by the study, the scale of the 2nd Stage should be reviewed during the feasibility study for the 2nd Stage.

(9) Coordination with Road Improvement Project by the Japan's Grant Aid

The project for the improvement of the road passing through the centre of the city including the Luang Prabang Road in front of the Wattai International Airport is an ongoing project by Japan's Grant Aid. The priority project includes the installation of distribution mains for about 1.6 km along the Luang Prabang Road. If the implementation of the pipeline installation is after the road construction, the new road constructed by the Japan's Grant Aid should be demolished and restored. The construction works for the road improvement will start from 2004 and it will take about 2 years. Therefore, depending on the timing of each construction, and the coordination between the road project and this project, there is a possibility that the two projects could be constructed concurrently.

Institutional Aspects

The NPVC is required to achieve the targeted performances, and the achievements of these performances are the responsibility of the General Manager as the senior manager of the enterprise. To achieve the set performances requires a certain amount of autonomous status for the General Manager. According to Article 11 (Regulation of Enterprise, 1999), the Administrative Council (AC) shall supervise the GM, but not directly join to manage the daily operations of the GM, except if the GM is a member of the AC. The supervision of the GM by the AC includes orders in general, and this is not deemed to be a suitable method of business operations.

Considered from a view point of an efficiency oriented corporate management, reforms will be necessary, to be taken in various managerial phases. It is considered that one of the measures, PPP is worth studying as a reform which could be adopted.

The mission of a water supply utility is to supply safe and potable water to the inhabitants of the community, and not low quality water which one cannot drink without boiling. The supply of water which one cannot drink without boiling is unsatisfactory, compared with the stated mission of

the water utility. A continuous effort and a large amount of investment will be necessary to improve such a situation. The production and sale of bottled water by the NPVC seems to weaken such an effort. It is considered that water quality is sufficient when it meets the guidelines of the WHO. It seems unnecessary to produce special quality water named Crystal, when the price is taken into account. It is considered that an effective alternative to bottled water is the improvement of the quality of tap water.

Water Conservation and Water Demand Management

In a situation of water shortages, the appropriateness and cost effectiveness of demand-side solutions must be considered and emphasized, along with supply-side augmentation options. Attention must be devoted to managing the increasing demand for water to achieve a sustainable long-term balance between water availability and water requirement in an equitable manner.

The proposed comprehensive program for water demand management includes four major measures with sub-measures as followed:

- Water conservation measures, which include 1) leakage detection, 2) reduction of illegal connections, 3) in-house retrofitting, 4) out-of-house water saving measures.
- Water pricing measures, which involve 1) water metering, 2) tariff structure.
- Information and education measures, which include 1) awareness raising, 2) public involvement, 3) in-school education.
- Legal measures, which include 1) rules and regulations that form the basis of WDM policy, 2) regulations on resale of water

Water pricing measures are one of the most effective measures for water demand control and water conservation, with the introduction of a progressive block tariff system, or increasing tariff system. Thus, it is recommended for the WASA/NPVC to formulate an appropriate tariff structure in an equitable manner which is sensitive to the needs of the poor, taking into consideration of any adverse effects. It is emphasized that the effectiveness of the measures is assured in combination with an extensive awareness raising campaign among consumers.

Awareness issues are important particularly when dealing with difficult decisions like the introduction of pricing measures (i.e. introduction of progressive tariff structure). As for any issue of public policy, the public is more likely to accept such a difficult decision if it is well aware of the commitment and efforts of the service provider to provide improved services in a cost effective

way. The specific needs and opportunities are identified, through the study, for an increase of public awareness in the following areas.

- The NPVC's commitment to the management, operation and maintenance of the public water supply service
- User-Pay-Principle in the management, operation and maintenance of public water supply service
- The NPVC's efforts to provide safe water (improved water quality)
- The understanding of water as a common and vital necessity of life, but a necessity with limited resources

Public education is certainly one of the most important instruments for achieving a successful campaign for water conservation and water demand management.

It is realized that some government institutions categorized as non-domestic users, distribute large quantities of water provided for staff accommodation in their residential areas, while accumulating large amounts of water bills and are well into arrears. It is also assumed that officers and staff in those government residential areas are not water-saving consciousness consumers since many government institutions have a policy to subsidize the employee's water bills. Thus, re-classification of domestic and non-domestic use in government organizations is an important reform, and water use in their residential areas and accommodation should be regarded as domestic use. These measures are to be followed by the introduction of an individual meter reading and billing system, whether or not those bills are subsidized by those government institutions. The regular procedures for non-payment of bills, such as disconnection, shall be taken for those residences if an unacceptable level of arrears are observed, which can also have the effect as pressure for the government organizations to pay the bills where they have a subsidizing policy.

Having no specific section for customer service and public relations, the NPVC is hindered in its attempts to increase users' awareness and cooperation in the public water supply service. The public water supply service will become viable and sustainable when mutual confidences and cooperation is increased between the service provider and consumers.

Improvement of customer service and public relations become are indispensable to increase the awareness and cooperation of users in the water supply service, in particular, when some crucial decisions are taken, such as the introduction of pricing measures and a campaign for water conservation and water demand management. Disclosure of information by media, and the

publication of annual reports, such as financial status and how the revenue collected is utilized, is another measure to increase the transparency of the service provider, thus increasing users' awareness and cooperation.

Financial Aspects

The NPVC has to make all members in the company have full cost recovery as a common characteristic. It will be hard for the NPVC to attain full cost recovery for the 1st stage project by the end of the project life. Therefore, all members of the NPVC have to have a correct understanding of the cost recovery process, and to carry out their duties to realize the target of full cost recovery. Every section of the NPVC needs to perform the recommended financial procedures extracted from the financial analysis for full cost recovery of the project.

Raising the water tariff for every water consumer is indispensable for the success of the 1st stage project. The tariff structure was designed to start at the present water tariff level and to then raise the water tariff in accordance with the projected increase in household income in order to attain the goals of the policy of full cost recovery. For pursuance of this policy, financial incentives are essential to ensure the participation in the 1st stage project of all stakeholders concerned in the project, and to understand each other.

Environmental Aspects

Even though the forecasted environmental impacts by the implementation or operation of the priority projects are very limited or only during the short period, it is recommended to implement mitigation measures which are descried in this report.

Project Implementation

The water shortage situation in Vientiane is in a state where it is expected that it will worsen every year. Therefore, it is strongly recommended to implement the priority projects as recommended in the Feasibility Study. The Lao PDR side is recommended to initiate budgetary arrangements to finance the project implementation.

For the implementation of the projects, it is recommended to establish a Project Implementation Unit (PIU), which will consist of representatives from the WASA, DHUP, MCTPC, NPVC and DCTPC.