ALEXANDRIA WATER GENERAL AUTHORITY

BASIS OF DESIGN REPORT
For
WATER TREATMENT PLANT PROJECTS
August 2001

MWH
MONTGOMERY WATSON HARZA

LIST OF FIGURES

LIST OF TABLES

Executive Summary

The Basis of Design Report (BODR) for the Water Treatment Plant Project has three sections which are summarized as follows.

Section 1- Introduction

Alexandria lies on the north coast of Egypt, on the west edge of the Nile Delta, with a population of about 4,000,000 permanent residents, which increases to about 5,000,000 during the summer months. The municipal water system for this area is owned and operated by the Alexandria Water General Authority (AWGA). The service area is very large and is bounded by the North Coast and extends from Abu Qir in the east, to Marsa Matruh to the west, and also extends south approximately 100 kilometers along the desert highway to Cairo.

This report focuses on the upgrades to seven Water Treatment Plants which are recommended in the High Priority Projects (HPP) Report related to plant process and mechanical upgrades. The plants are:

- Souif WTP
- Rond Point WTP
- Manshia WTP
- Maamoura WTP
- Nozha WTP
- Borg El Arab WTP
- Noubaria WTP

This Basis of Design Report provides the technical criteria to be used in the detailed design of the Water Treatment Plant Process and Mechanical Upgrades identified in HPP. The tasks identified in the HPP are:

- WTG-7- Chlorine facilities
- WTG-2,4- Chemical mixing, dosing, and flow/pressure measurement
- WT5-1- Nozha WTP rehabilitation and startup
- WTG-3- Filter control system upgrades

الملخص التنفيذي

يحتوي تقرير أسس التصميم الخاص بمشروع محطات التنقية علي ثلاثة أقسام و تتلخص في الأتي:-

القسم الأول : المقدمة

تقع مدينة الإسكندرية علي الساحل الشمالي للقطر المصري علي الطرف الغربي لدلتا نهر النيل و يبلغ التعداد السكاني حوالي أربعة ملايين و يزداد إلى خمسة ملايين أثناء أشهر الصيف ٠

و يمتلك مرفق مياه الإسكندرية منشآت الإمداد بمياه الشرب كما يقوم بإدارتها ٠ و تمتد منطقة الخدمة من ابي قير شرقا الي مرسي مطروح غربا علي الساحل الشمالي كما تمتد جنوبا حوالي ١٠٠ كيلومتر علي طريق الإسكندرية – القاهرة الصحراوي ٠

و يتم التركيز في هذا التقرير علي تطوير سبع محطات تنقية التي تم التوصية بها في تقرير المشروعات ذات الأولوية في ما يخص عملية التنقية و الأعمال الميكانيكية و هذه المحطات هي:

- محطة السيوف
- محطة وابور المياه
- محطة المنشية
- محطة المعمورة
- محطة النزهة
- محطة برج العرب
- محطة النوبارية

كما يقدم هذا التقرير المعايير الفنية التي ستستخدم في التصميم التفصيلي لعمليات التنقية و التطوير الميكانيكي المحددة في تقرير المشروعات ذات الأولوية و هي: -

- WTG-7 منشآت الكلور
- WTG-2,4 المزج الكيماوي و الجرعات و قياس التدفق و الضغوط
- WT5-1 تأهيل محطة النزهة و تشغيلها ٠
- WTG-3 تطوير نظام التحكم في المرشحات

3a

- WTG-9- Installation of turbidimeters and chlorine residual analyzers
- WTG-14- Computerized process monitoring
- WTG-10- Raw water intakes and canal outlet structure upgrades
- WTG-5- Emergency standby generators
- WTG-8- Process residuals handling system for Mahmoudia Canal WTPs
- WT1-2- New sanitary disposal system at Siouf

The project objectives can be summarized as:

- Improve chemical handling equipment for improved safety and efficiency of chemical usage.
- Provide flow measurement for improved process control
- Improve operation of filtering units
- Put Nozha WTP on line to enhance water supply
- Improve overall plant operation and control
- Improve raw water facilities
- Improve emergency standby power supply
- Improve handling and disposal of treatment process residuals

Section 2- Design Criteria

The design criteria will be used to establish the basis for the preparation of all engineering calculations and development of designs, drawings, and specifications and details pertaining to facilities.

The proposed improvements are intended to enhance and improve existing operations of the various water treatment plants. The current treatment processes and the plant capacities are not changed by the proposed improvements.

The design criteria have been developed for the various disciplines, including:

- WTG-9 تركيب أجهزة قياس العكاره و الكلور المتبقي
- WTG-14 تركيب أجهزة المتابعة الإلكترونية (بالكمبيوتر)
- WTG-10 تطوير مأخذ المياه و مخرج ترعة المحمودية
- WTG-5 توريد مولدات احتياطية للطوارئ
- WTG-8 تعديل نظام التخلص من المخلفات الصلبة لعملية التنقية من المحطات الواقعة علي ترعة المحمودية .
- WTG-12 التخلص من الصرف الصحي الناتج من محطة مياه السيوف

و يمكن تلخيص أهداف المشروع فيما يلي: -

- تحسين معدات تداول الكيماويات بهدف تحسين السلامة و الفاعلية
- توريد عدادات قياس التدفق لتحسين التحكم في عملية التنقية
- تحسين تشغيل وحدات المرشحات
- تشغيل محطة النزهة لتعزيز الإمداد بالمياه
- تحسين التشغيل الكلي و التحكم في المحطات
- تحسين منشآت المياه العكرة
- تحسين مصدر الكهرباء الاحتياطي للطوارئ
- تحسين التداول و التخلص من مخلفات عملية التنقية

القسم الثاني – معايير التصميم

ستستخدم معايير التصميم كأساس لتحضير الحسابات الهندسية و تطوير التصميمات و الرسومات و المواصفات و كذلك التفاصيل الخاصة بالمنشآت .

أن الغرض من التحسينات المقترحة هو تعظيم و تحسين عمليات التشغيل الحالية لكافة المحطات . و أن سعة المحطات و كذلك عمليات التنقية لن تتغير كنتيجة للتحسينات المقترحة .

و قد تم تطوير معايير التصميم للعناصر المختلفة و تشمل: -

- Civil
- Architectural
- Structural
- Mechanical
- Electrical
- Instrumentation

Standards, codes, specifications, and design guides from various United States organizations, in addition to applicable Egyptian standards, shall be used to establish the level of performance or quality required.

Section 3- Preliminary Design

The preliminary design section presents a list of project tasks for each of the Water Treatment Plants within the scope of this project. Also included are the project tasks to be completed for the Mahmoudia Pump Station and the Mahmoudia Canal.

A list of design drawings and a list of specifications are included in the BODR to indicate the work to be performed.

A preliminary Bill of Quantities is included in the BODR as Table 4 following Section 3.

- المدني
- المعماري
- الإنشائي
- الميكانيكي
- الكهربائي
- التشغيل الآلي

و سوف تستخدم المعايير القياسية و اللوائح و المواصفات و أسس التصميم من مختلف الهيئات بالولايات المتحدة الأمريكية بالإضافة إلى المعايير القياسية المصرية لتحديد مستوي الأداء أو الجودة المطلوبة ٠

القسم الثالث – التصميم الأولي

يقدم التصميم الأولي قائمة بمهام المشروع لكل محطة تنقية من خلال نطاق العمل في هذا المشروع ٠ كما يشتمل علي المهام المطلوب استكمالها لمحطة رفع المحمودية و ترعة المحمودية ٠

كما يشتمل تقرير أسس التصميم علي قائمة بالرسومات التصميمية و قائمة بالمواصفات لكي تبين الأعمال المطلوب تنفيذها ٠

و كذلك يشتمل التقرير علي قائمة بالكميات في الجدول رقم ٤ الذي يلي القسم الثالث ٠

Section 1 – Introduction

1.1. BACKGROUND

Alexandria lies on the north coast of Egypt, on the west edge of the Nile Delta – see Figure 1. It has a population of about 4,000,000 permanent residents, which increases to about 5,000,000 during the summer months. The municipal water system for this area is owned and operated by the Alexandria Water General Authority (AWGA). The service area is very large and is bounded by the North Coast and extends from Abu Qir in the east, to Marsa Maruth to the west, and also extends south approximately 100 kilometers along the desert highway to Cairo.

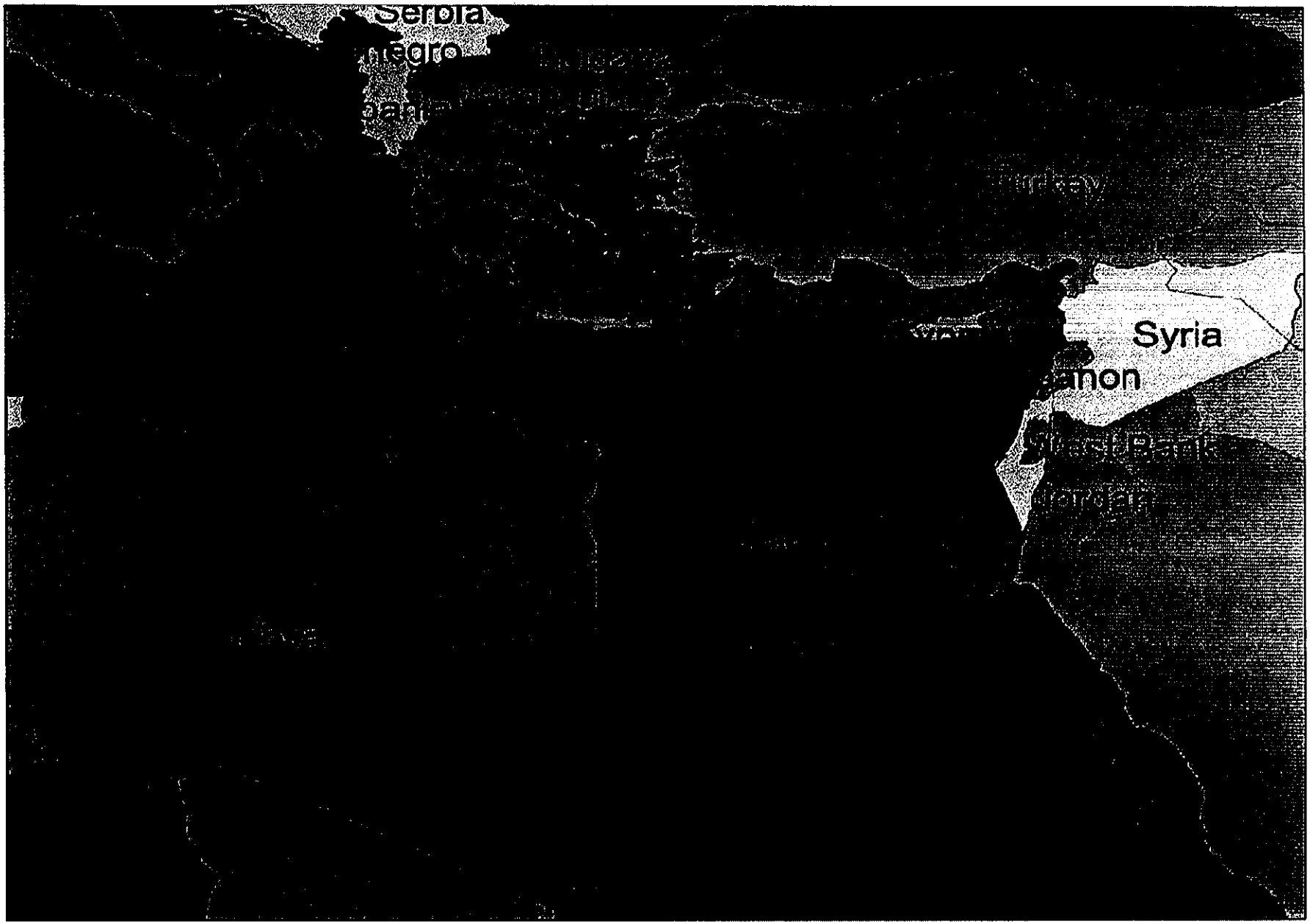
The source water for the water system originates from the Nile River and is conveyed through two major canal systems known as the Mahmoudia Canal and the Noubaria Canal. The Drinking Water Canal is a major branch of the Mahmoudia Canal. These canals supply water to eight water treatment plants (WTPs) which produce drinking water for the AWGA municipal water system - see Figure 2. As of July 2001, six of the eight WTPs were in continuous operation.

The water treatment plants produce water that generally meets Egyptian and World Health Organization (WHO) drinking water quality standards most of the time. Some of the WTPs are over 80 years old and some process equipment does not work, for which spare parts have become unavailable. This has compromised the ability of the WTPs to perform at the highest level and efficiency. The High Priority Projects (HPP) Report dated June 2000 recommended upgrades to priority treatment processes and mechanical equipment at the WTPs. These upgrades are intended to improve the safety, efficiency, and reliability of the water treatment plants.

This report focuses on the upgrades to the WTPs which are recommended in the HPP Report in Section HPP-3 Water Treatment Plant Process and Mechanical Upgrades.

Montgomery Watson Harza, in association with CH2M Hill International, CH2M Hill Middle East, AAW, and PA Government Services, was retained by USAID to provide the professional services required to develop specific tasks and projects identified and scoped in the HPP Report.

This Basis of Design Report provides the technical criteria to be used in the detailed design of the Water Treatment Plant Process and Mechanical Upgrades identified in HPP-3. The tasks identified in HPP-3 are summarized in the following table.



Location Map of Alexandria
Figure 1

4-2

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Summary of Tasks for HPP-3
Water Treatment Plant Process and Mechanical Upgrades
Included in This Report

Task	Description
WTG-7	Central chlorine storage and feed facilities
WTG-2,4	Chemical mixing, dosing, and flow/pressure measurement improvements
WT5-1	Nozha WTP rehabilitation and startup
WTG-3	Filter control system upgrades
WTG-9	Installation of on-line turbidimeters and chlorine residual analyzers
WTG-14	Computerized process monitoring at Siouf, Rond Point, and Manshia
WTG-10	Raw water intakes and canal outlet structure upgrades
WTG-5	Install emergency standby generators
WTG-8	Process residuals handling system for Mahmoudia Canal WTPs
WT1-2	New sanitary disposal system at Siouf

1.2. ORGANIZATION OF REPORT

This Basis of Design Report is organized into three sections. A brief summary of each section is provided below.

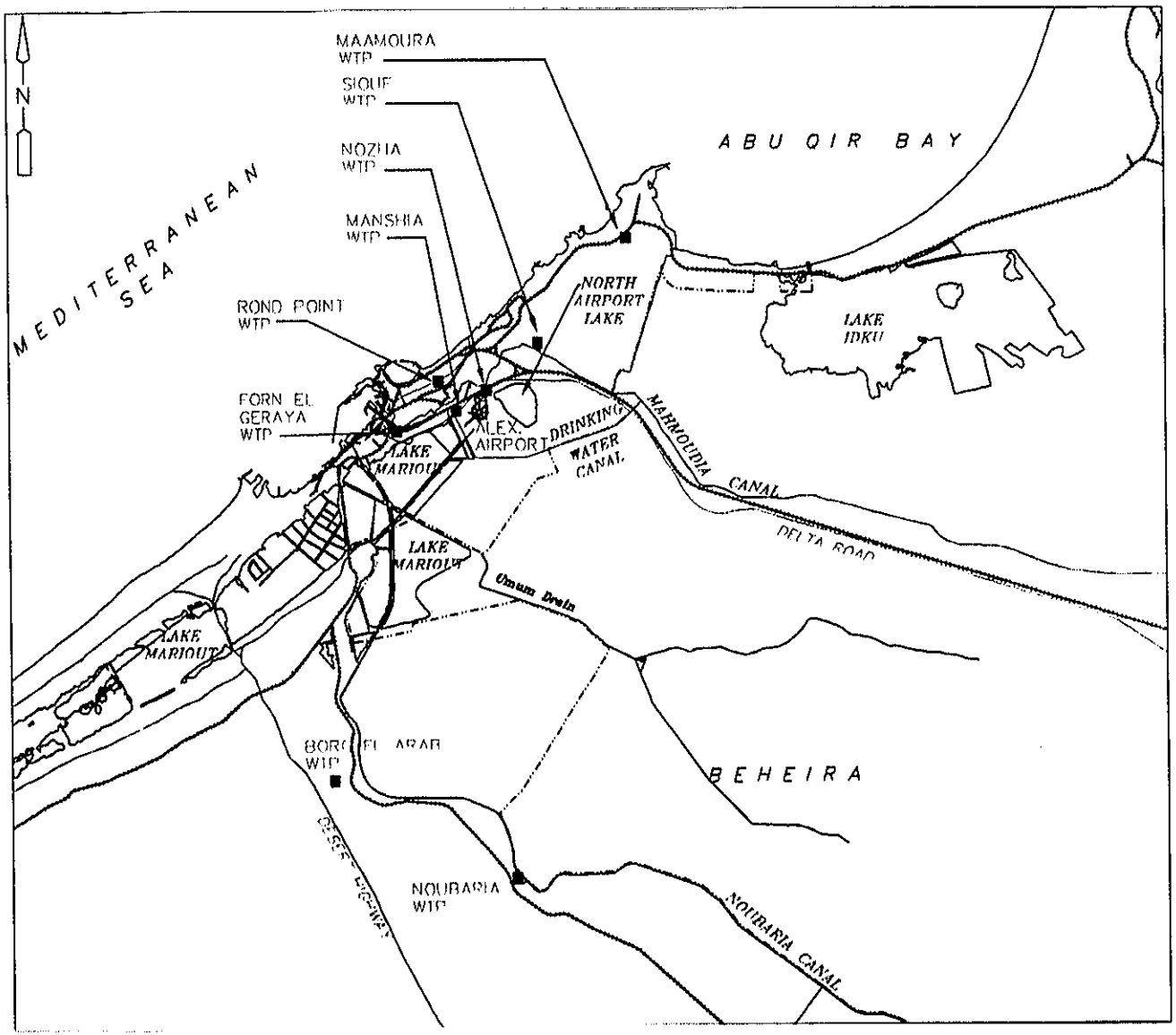
Section 1 – Introduction. Presents general background information for AWGA's municipal water system and a description of AWGA's existing water treatment plants. Also presented is a description of the work associated with HPP-3 Water Treatment Plant Process and Mechanical Upgrades.

Section 2 – Design Criteria. Presents design criteria for work associated with HPP-3, which are based on the recommendations presented in the HPP Report. Design criteria are presented for each design discipline including civil, architectural, structural, mechanical, electrical, and instrumentation. Design criteria will be applied to the tasks identified in HPP-3 and will be used to perform final design.

Section 3 – Preliminary Design. Presents preliminary information for the final design. This section includes a list of tasks to be performed at each WTP. Also presented is a preliminary list of technical specifications, list of drawings, and bill of quantities.

1.3. LOCATION OF WORK

The AWGA municipal water system includes eight WTPs which withdraw water from the Mahmoudia, Drinking Water, and Noubaria Canal systems – see Figure 2. Two of the eight WTPs are not in continuous operation. The Nozha WTP was never placed into continuous operation and the Forn El Geraya WTP has been out of service since November 1998. It should be noted that the Forn El Geraya WTP is not within the scope of work for this project. The table below presents a list of the WTPs with raw water source and rated treatment capacities.



Location Map of Alexandria

Figure 2

5a

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AWGA Water System WTPs

Treatment Plant	Existing Supply Canal	Design Capacity (m^3/day)	Comments
Siouf	Mahmoudia	970,000	
Rond Point	Drinking Water	630,000	Capacity is based on settling capacity.
Manshia	Drinking Water	380,000	Plant has operated at 550,000 m^3/day
Maamoura	Mahmoudia	240,000	
Nozha	Mahmoudia	180,000	Not in operation
Borg El Arab	Noubaria	326,000	Plant is currently overloaded.
Noubaria	Noubaria	260,000	Plant under expansion; in 3 years the capacity will reach 500,000 m^3/day

1.4. DESCRIPTION OF EXISTING FACILITES

1.4.1. Siouf WTP

The Siouf WTP has the largest treatment capacity of all the WTPs. The plant has been expanded several times to meet growing system demands. The raw water pumping stations and treatment units are generally located on the north side of the site and treated water reservoirs and pumping stations are generally located on the south side (closest to the Mahmoudia Canal). Two open channel canals supply raw water by gravity from intakes located on the Mahmoudia Canal to the raw water pumping stations. Several types of treatment units are used at the Siouf WTP and include Italba pretreatment units, Pulsator sludge blanket clarifiers, and Italba, Degremont, and Patterson filters. Several storage buildings and workshops, staff apartments and administration buildings are located on the plant site. There is limited space on the plant site for new construction; therefore, WTP expansion requirements were met by a combination of constructing new water treatment structures, upgrading existing structures and demolishing older structures.

1.4.2. Rond Point WTP

The Rond Point WTP has the second largest treatment capacity and is the oldest AWGA WTP, originally constructed in 1904. This plant has also been expanded several times to meet growing system demands and, as a result, treatment units are scattered across a congested site area without a proper physical arrangement of treatment units. Therefore, it is difficult for plant operators to achieve the accurate hydraulic flow splits across parallel treatment

units and to apply proper chemical dosages. The existing pretreatment units at the Rond Point WTP include a standard Italba pretreatment unit, several Pulsator sludge blanket clarifiers and older combination flocculation/sedimentation basins. Two Italba filter buildings and one Degremont filter building are presently in operation; three other filter buildings have been out of service for more than ten years. New raw water and treated water pump stations and a treated water storage reservoir are being constructed on the southwest corner of the site and will be brought online within one year.

1.4.3. Manshia WTP

The Manshia WTP is routinely operated well above the rated treatment capacity of 380,000 m^3/day, with summertime flows exceeding 550,000 m^3/day. The plant process train consists of three pairs of Pulsator sludge blanket clarifiers and three filter types (Italba, Czech and Degremont filters). In addition, three raw water pumping stations, three treated water pumping stations and four treated water storage reservoirs are located on the plant site.

1.4.4. Maamoura WTP

The Maamoura WTP typically operates at less than 50 percent of its rated capacity of 240,000 m^3/day. The plant process train consists of two 120,000 m^3/day Italba pretreatment units and three Italba filter buildings. Two of the three filter buildings were designed with five filters and the third one with six filters. Raw water is pumped to Maamoura from a pumping station located on the Mahmoudia Canal at Siouf; no additional raw water pumping is provided at the plant site. Three treated water reservoirs and two treated water pumping stations are presently in operation at the site.

1.4.5. Nozha WTP

The Nozha WTP has not been placed into continuous operation since it was constructed in 1993. This was mainly due to concern about the quality of raw water supply and more recently, insufficient flows in the Mahmoudia Canal near the Nozha WTP intake structure during the peak summer demand period. The plant process train consists of a single standard Italba pretreatment unit with three parallel trains, followed by an Italba filter building with ten sand filters. One raw water pumping station, one treated water pumping station and four treated water storage reservoirs. The treated water reservoirs are located underneath the pretreatment and filter units.

1.4.6. Borg El Arab WTP

The Borg El Arab WTP is located on the Mariout Canal, 2 km downstream from its takeoff on the Noubaria Canal at KM 96. It was constructed and is owned by the Ministry of Housing Utilities and Urban Communities (MHUUC), but is operated by AWGA. All existing treatment and pumping facilities are located on the north side of the plant site, while a major storage facility and staff housing are located on the south side. A large tract of open

land is available on the south side for future expansion projects. The existing plant process trains include a standard Italba pretreatment unit followed by 12 Italba filters; and four Bemag circular clariflocculators followed by 12 Bemag filters. Two raw water pumping stations, two treated water pumping stations, five storage reservoirs and associated chemical and electrical buildings are located on the north of the plant site.

Under MHUUC tender, a new intake, one raw water pumping station, one standard Italba pretreatment train, 12 additional Italba filters, one treated water pumping station and related chemical and electrical buildings will be constructed on the north side of the plant site, adjacent to the existing Italba units. The MHUUC tender reportedly does not specify Italba systems or any other specific system. However, AWGA is encouraging the use of their standard Italba design.

1.4.7. Noubaria WTP

The Noubaria WTP is located at KM 81 on the Noubaria Canal. All existing treatment and pumping facilities are located on the east side, a major storage and staff housing are located in the middle of the site, and space is reserved for future plant expansions on the west side. The three existing plant process trains include two Italba pretreatment unit followed by twenty Italba filters; and two Bemag clariflocculators followed by six Bemag filters with total capacity 260,000 m^3/day. An additional Italba treatment train is currently under construction and will increase the plant capacity to 500,000 m^3/day. Two raw water pumping stations, two treated water pumping stations and four reservoirs are also located on the site.

1.5. PROPOSED IMPROVEMENTS

The HPP-3 task recommends several process related upgrades for each of the water treatment plants. These improvements are scheduled for completion by 2004. The proposed improvements for each of the WTPs are listed in this section.

1.5.1. Siouf WTP

- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Install raw water flow meters
- Install automatic flow pacing for the alum and chlorine (pre- and post-chlorination)
- Rehabilitate the Patterson filters. Upgrading of filter control systems will include:
  - Valves
  - Pneumatic actuators
  - Flow meters and transmitters
  - Level elements and transmitters
  - Instrument air skids (compressors, recievers, dryers, piping, valves, and gauges)
  - Filter control desks and associated electrical and instrumentation components

- Install an automatic filter control system for three Italba filter control buildings
- Upgrade the existing process residuals holding tank and pump station for eventual discharge to AGOSD system
- Construct a new centralized chlorine storage and feed facility
- Replace the synchronizing controls for one pair of generators
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Install a plant-wide data acquisition and monitoring system, which will be installed in a control building to be constructed by AWGA
- Install level indicators in reservoir
- Install pressure sensor on every discharge lines
- Provide new sanitary sewerage system

1.5.2. Rond Point WTP

- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Upgrade two Pulsator weir mixers
- Installing raw water flow meters
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Install an automatic filter control system for three filter control buildings. Upgrading of filter control systems will include:
  - Flow meters and transmitters
  - Level elements and transmitters
  - Instrument air skids (compressors, recievers, dryers, piping, valves, and gauges)
  - Filter control desks and associated electrical and instrumentation components
- Upgrade the existing process residuals holding tank and pump station for eventual discharge to AGOSD system
- Construct a new centralized chlorine storage and feed facility
- Install a plant-wide data acquisition and monitoring system, which will be installed in a control building to be constructed by AWGA
- Install level indicators in reservoir
- Install pressure sensor on every discharge line

1.5.3. Manshia WTP

- Install mechanically cleaned intake screens
- Upgrade the existing hydraulic weir mixers
- Install raw water flow meters
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)
- Construct a new centralized chlorine storage and feed facility

- Rehabilitate the Czech filters. Upgrading of filter control systems will include:
  - Valves
  - Pneumatic actuators
  - Flow meters and transmitters
  - Level elements and transmitters
  - Instrument air skids (compressors, recievers, dryers, piping, valves, and gauges)
  - Filter control desks and associated electrical and instrumentation components
- Install a plant-wide data acquisition and monitoring system, which will be installed in a control building(room in old building) to be prepare by AWGA
- Install level indicators in reservoir
- Install pressure sensor on every discharge line
- Replace two existing generators with 3.3 KV, 1200 KW units

1.5.4. Maamoura WTP

- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Install raw water flow meters
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Construct a new centralized chlorine storage and feed facility
- Relocate two existing alum tanks to make room for the new chlorine building

1.5.5. Nozha WTP

- Repair mechanical equipment and electrical systems to startup plant
- Construct a new intake with mechanically cleaned screens
- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Install raw water flow meters
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Rehabilitate the existing chlorine storage facility
- Construct a new process residuals holding tank and pump station to discharge sludge flow to the Alexandria General Organization for Sanitary Drainage (AGOSD) sewerage system

1.5.6. Borg El Arab WTP

- Install mechanically cleaned intake screens
- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Install raw water flow meters
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)

- Rehabilitate the existing chlorine storage building
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Construct a new central chlorine bulk storage facility which will provide chlorine storage for all AWGA WTP

1.5.7. Noubaria WTP

- Install mechanically cleaned intake screens
- Replace Italba mechanical flash mixers with hydraulic weir mixing
- Install raw water flow meters
- Install automatic flow pacing for alum and chlorine (pre- and post-chlorination)
- Install turbidimeter in every filter bank
- Install chlorine residual analyzer in every treated pump building
- Construct a new centralized chlorine storage and feed facility

1.5.8. Mahmoudia Pump Station

- Provide new 380 KV 1200 KW fixed standby generator

1.5.9. Mahmoudia Canal

- Upgrade Mahmoudia Canal Outlet Structure by replacing gates, installing new pumps, and rehabilitate the existinf structure
- Conduct a sanitary survey of approxiimately 8 kilometers of the Mahmoudia Canal

Section 2 – Design Criteria

2.1. INTRODUCTION

This section presents technical design criteria to be used for the design of upgrades identified in task HPP-3 Water Treatment Plant Process and Mechanical Upgrades. The design criteria shall establish the basis for the preparation of all engineering calculations and development of designs, drawings, and specifications and details pertaining to facilities. Standards, codes, specifications, and design guides from various United States organizations, in addition to applicable Egyptian standards, shall be used to establish the level of performance or quality required.

Design criteria are categorized into design disciplines which include civil, architectural, structural, mechanical, electrical, and instrumentation disciplines. These criteria shall be adhered to during the final design of the project.

2.2. CIVIL – DESIGN CRITERIA

There is a limited scope of work that involves the civil discipline. The project tasks that involve civil work are primarily associated with site preparation for new chlorination facilities and yard piping for chemical feed lines, water supply lines, construction of new and rehabilitation of existing intake structures, and new sanitary sewer lines.

Refer to structural design criteria for listing of applicable codes.

2.2.1. Gravity Sewers

All gravity sewer lines shall be designed to provide adequate slope to maintain a flow velocity of 0.8 meters per second.

2.2.2. Design Codes and Standards

The design and specification of all work shall comply with United States standards and with applicable Egyptian codes when required. The standards from the following organizations shall be adhered to:

- Ten States Standards
- American Society of Civil Engineers (ASCE)
- American Water Works Association (AWWA)
- Water Environment Federation (WEF)
- Other recommended standards may be used where required to serve as guidelines for design, fabrication, and construction when not in conflict with the listed standards

2.3. ARCHITECTURAL – DESIGN CRITERIA

Architectural design criteria pertain to the new construction or upgrade of chlorination facilities. Since AWGA is responsible for providing the control room and building for the Computerized Process Monitoring and Control System in task WTG-14, design criteria are not provided for these facilities. The following design criteria are provided for the Central Chlorine Storage and Feed Facilities in task WTG-7.

2.3.1. Bulk Chlorine Storage Facility (at Borg El Arab WTP)

- A suitable storage area with ventilation system (fans)
- Crane for transporting drums
- Windows with fixed glass panes
- Two leaf iron doors with adequate height for passage of crane and wide enough to allow the passage of a truck
- Openings to fit exhaust fans in case of chlorine leakage
- Chemical and acid resistant finishing materials for floors, walls and ceilings
- Absorbtion tower outside building
- Outside room for manger and computer

2.3.2. Central Chlorination Facility (at each WTP)

Chlorine Storage Room

- A suitable area for the accommodation of chlorine drums with chlorine piping channels
- Crane for transporting drums
- Windows with fixed glass panes
- Two leaf iron doors with height at that of crane which allow the passage of a truck
- Openings to fit exhaust fans in case of chlorine leakage
- Chemical and acid resistant finishing materials for floors, walls and ceilings
- Install absorbtion tower outside building

Equipment Apparatus Room(s)

- Suitable area for required equipment, including evaporators and chlorinators (generally two rooms)
- Windows with movable leaves
- Openings for wiring and ventilation systems to be considered

Neutralization Equipment Room

- Located adjacent to drum storage room
- Exhaust fans to be fixed in party wall
- Windows with fixed glass panes
- Chemical and acid resistant finishing materials for floors, walls and ceilings
- Building to be provided with an outdoor emergency eye wash basin and shower in the event of exposure to harmful chemicals

- Absorbtion tower

2.4. STRUCTURAL – DESIGN CRITERIA

There are numerous structural components associated with the tasks identified in HPP-3. Structural design criteria are presented in this section for those tasks which require structural design. These tasks are primarily related to the following project items.

- New raw water intake structures (Manshia, Nozha)
- Rehabilitation of the existing raw water intake structures (Noubaria, Borg El Arab)
- Construct new bulk storage chlorine facility at Borg El Arab
- Construct new central chlorination storage and feed facilities at the water treatment plants (Siouf, Rond Point, Manshia, Maamoura, Noubaria)
- Rehabilitate existing chlorination buildings (Borg El Arab, Nozha)
- Retrofit the inlet structures for flash mix units to hydraulic weir mixing
- New process residuals tank at Nozha and Siouf. At Rond Point modify the old fuel tanks to serve this purpose. Some rehabilitation of the fuel tanks will be necessary.
- Process residuals pump building for process residuals tanks

2.4.1. General

The SAP 2000 Program will be used in the structural analysis where required. The design of sections will be carried out using the computer program SCALE. According to the HPP report, it is expected to have all the foundations on piles which will be decided after completion of the soil investigation report.

2.4.2. Design Codes and Standards

The design and specification of all work shall comply with United States standards, with applicable local Egyptian codes when required (especially for wind load and specifying seismic zone) and with the codes and industry standards. The following sections include references to codes, specifications, and industrial standards that are applicable, and the organizations that are responsible for them. The latest editions of these documents, as of bid date, shall apply. The Contractor shall be responsible for conforming to all applicable Egyptian standards, regulations, and codes and shall ensure that the design and selection is fully suitable for local conditions. The Contractor shall factor in climatic and environmental conditions at the specific sites. The standards from the following organizations shall be adhered to:

- American Society of Civil Engineers (ASCE)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- American Welding Society (AWS)

- American Water Works Association (AWWA)
- Steel Joist Institute (SJI)
- Uniform Building Code (UBC)
- Steel Structure Painting Council (SSPC)
- Cast Iron Soil Pipe Institute (CISPI)
- National Clay Pipe Institute (NCPI)
- Portland Cement Association (PCA)
- National Association of Corrosion Engineers (NACE)
- Egyptian code for loading in structural works and construction M.D. 45/1993 (ECP).
- Egyptian code for design and construction of reinforced concrete M.D. 464/1989 Last Edition (E.C.C.)
- Egyptian code of practice for steel construction and bridges M.D. 451/1985 Last Edition (E.C.S.)
- Normal Portland Cement 373/1984 Last Edition.
- Sulphate Resistance Cement 583/1986 Last Edition.
- Concrete Aggregate from National Resources 1109/1971 Last Edition.
- Steel bars for reinforcement and its modification 262/1974.
- Method of Concrete Testing 1658/1988.
- Other recommended standards shall be used where required to serve as guidelines for the design, fabrication, and construction when not in conflict with the above standards.

2.4.3. Design Loading

The following classes of loads shall be considered in the structural design of the project. The best engineering judgement shall be applied to ensure that the loads and their combinations reflect, as near as possible, the anticipated loading for each structure due to its intended use.

Dead Loads

Dead loads shall include the weight of all structural framing and all construction materials permanently incorporated in the building and supported by the framing including built-in partitions and permanent equipment. Dead loads shall be calculated from the unit weights in accordance with BS 648. The design weight of reinforced concrete shall be not less than 25 kN/m3.

Imposed Loads

Imposed loads include loads due to intended use and occupancy of an area, personnel, moveable equipment and partitions and vehicle loading. Imposed loadings shall be in accordance with ANSI or the ECP for loads.

Vehicle loads, wheel spacing and load distribution on buried structures, under roads or other locations affected by vehicle loads, shall be based on the anticipated transportable loads within this area or on loads brought into the area.

Earth and Liquid Loads

Design soil parameters and ground water level (minimum and maximum) shall be determined and agreed based on the results of the ground investigation. Lateral earth pressure from earthfill behind below grade walls or other retaining walls shall be evaluated and take into consideration the pressure enhancement due to seismic activity. For below grade walls, pressure "at rest" due to earthfill shall be considered. For retaining walls, the appropriate engineering judgement shall be applied to determine if sufficient movement of the wall is anticipated, and therefore active pressure conditions can be considered.

Lateral earth pressures resulting from construction loading, compaction equipment, soil heaps, construction traffic, lifting and erection equipment and stock piling shall also be considered. Additionally, the possible effects of over-compaction of backfill and of unpropped basement walls shall be considered.

All below grade structures shall be designed as water-excluding. The effect of saturation or partial saturation of lateral earth pressure subject to seismic activity shall be considered.

The effect of uniform surcharge at ground level shall also be considered.

Wind Loads

Wind loading shall be in accordance with ECP for loads 45/1993.

Thermal Loads

The structural frames shall be designed for the loads and movements produced by an increase or decrease in temperature of 30°C relative to the temperature of the frame when erected. For structures subject to heat development generated by running equipment, additional and/or differential temperatures shall be established and considered.

Seismic Loads

All structures shall be designed to resist earthquake ground motions. Assessment of design seismic loads shall be in accordance with the ECP. In accordance with ECP for loads, the site is located on Seismic Risk Zone III.

2.4.4. Materials

Material, fabrication, and erection requirements for structural materials including, but not limited to, concrete, masonry, structural metals, handrailing, grating, and metal decking are indicated in the appropriate technical specifications included with the Tender Document.

2.4.5. Concrete

The concrete cube strength must not be less than 30 N/mm^2 after 28 days for reinforced concrete and 25 N/cm^2 for plain concrete. Concrete design shall be

based on an assumed 28 day design reinforced compressive strength of 30 N/mm^2.

2.4.6. Reinforcement

Reinforcing steel shall be high tensile deformed bars with minimum yield strength not less than 360 N/mm^2 for main reinforcement and mild steel for stirrups with minimum yield strength not less than 250 N/mm^2.

2.4.7. Structural Design Requirements

The following design requirements shall be applicable to the design of the structures in addition to the requirements of the design codes and standards specified herein. In case of conflicting requirements, the requirements resulting in the largest factor of safety shall be applicable.

Reinforced Concrete Design

The design of reinforced concrete shall be in accordance with the recommendations of American codes or Egyptian codes, whichever is more stringent. The ACI Code is based on the 'Limit State Design' philosophy, under which the purpose of design is to achieve acceptable probabilities that a structure shall not become unfit for its intended use during its expected life. Thus the structure shall not reach a 'limit state'.

The following Limit States shall be considered:

Ultimate Limit State

At ultimate limit state, the structure shall be able to withstand (with an adequate factor of safety) the following:

1. Collapse
2. Buckling
3. Seismic events according to local codes

Serviceability Limit State

At serviceability limit state, the appearance and efficiency of any part of the structure shall not be adversely affected by the following:

1. Deflection
2. Cracking
3. Overturning
4. Durability – In terms of the proposed life of the structure and exposure conditions
5. Lighting – Protection against lighting
6. Vibration – Discomfort or alarm to users or structural damage

In practice the foregoing shall be achieved by applying partial factors of safety both to the working loads and to the materials ultimate strength.

Thus, **Design load** $F = Y_f - F_k$

Where: Y_f = Partial load factor

F_k = Characteristic load

and **Design Strength** $f = f_k/Y_m$

where: Y_m = Partial material factor
f_k = Characteristic material strength

2.4.8. Task Specific Design Criteria

The following descriptions provide specific design criteria for project tasks that involve structural design.

New Central Chlorination Facilities

- The structure system for the buildings will be reinforced concrete frames to be able to support both the roof and the crane loads from the crane beams. Transverse beams will be used to divide the slabs and to control the deflections.
- The imposed load on each floor will be considered according to the American National Standard Institute (ANSI) or the ECP for Loads MD 45/1993.
- The foundation will be designed according to the recommendations of the soils report.
- The effect of the seismic loads will be considered. The Alexandria area is classified as in Zone (3) according to the Egyptian Code of Loadings. The analysis of the expected seismic forces will be carried out considering the Egyptian Code. The Uniform Building Code will be used where the Egyptian Code is not applicable.
- Bias of absorbtion tower according to specification of manufacturer

Rehabilitate Existing Chlorination Facilities

An initial assessment of the existing chlorination facilities at the Borg El Arab and Nozha WTPs reveals that the available area within each facility may not be sufficient to provide central chlorine storage and feed facilities per task WTG-7. During the final design phase, each facility must be evaluated to determine if existing buildings can be used or will require expansion.

New Sludge Tank

New sludge tanks are proposed at the Siouf, and Nozha Water Treatment Plants, with upgrade of existing tanks at Rond Point. The design of the tank will follow the ACI standards and Egyptian Codes to suit the required capacity and dimensions according to mechanical requirements. Tank design shall secure tank to avoid floatation in the event the tank is empty and high groundwater conditions exist. New sludge pump building according to mechanical requirements.

New Intakes

New raw water intake structures with mechanically cleaned screens will be installed at the Manshia and Nozha WTPs. The design will be based on the Dutch design used at the Siouf WTP intake structure. The dimension of each intake will be based on the mechanical requirements. The design of sections for the intake elements will be carried out considering the ACI Code.

Rehabilitation of the Existing Intakes

The existing raw water intake structures at the Noubaria and Borg El Arab WTPs will be rehabilitated to include mechanically cleaned screens. The rehabilitation of the existing intakes will include the erection of new steel structures to allow for providing a crane to be used for lifting the new screens.

Modifications of the Flash Mixers

- The modification of the inlet structure to flash mixers will include the construction of a hydraulic weir mixing process. This may require the concrete side walls of the inlet structure to be raised, and will also involve the construction of weir gates. The following issues shall be considered for each flash mixer that will be modified:
- Utilize as-built drawings and actual field measurements and evaluations for each flash mixer to be modified. It is possible that as-built drawings may not be accurate, therefore, it is important to confirm as-built drawings with field measurements.
- Check the strength of the existing concrete to be modified either through Schmidt Hammer or by taking a core from the concrete element.
- Design a concrete repair system that will allow the construction of new weir gates.
- Consider additives and paintings for both the new and old concrete.

2.5. MECHANICAL – DESIGN CRITERIA

The following descriptions present mechanical design criteria for project tasks.

2.5.1. Chlorine Bulk Storage Facility

- The chlorine bulk storage facility at the Borg El Arab WTP shall be designed to provide adequate protection of 782 chlorine one-ton cylinders; 336 cylinders will be stored to meet current WTP demands. An additional 446 cylinders will be stored in the future to meet future chlorine demands for the WTPs.
- The design criteria for the bulk storage building is that it shall provide approximately 20 days of bulk storage to meet the current average day chlorine demands for the combined WTPs, assuming that all plants are operated at 75 percent of the rated capacities.
- The building shall be provided with a monorail system to allow simultaneous loading and off loading of the chlorine containers.
- A control room shall also be constructed for housing a computer workstation (for inventory control) and monitoring of chlorine leak alarms.
- A concrete neutralization tank filled with calcium oxide (lime) solution shall be constructed inside the building to neutralize the contents of one chlorine cylinder in the event of a cylinder leak. The monorail system shall also be used to move the leaking cylinder to the neutralization tank. The building layout shall be provided with two truck loading areas to allow simultaneous loading and off-loading of chlorine cylinders.

2.5.2. New Chlorine Storage and Feed Facilities

- The chlorine building is sized to provide 5 days of off-line storage to meet average day chlorine demand, one day of on-line storage to meet peak day demand and empty cylinder storage to meet 80% of off-line storage requirements. The chlorinators and storage rooms are separated from each other.
- The on-line cylinders shall be separated from the off-line ones.
- The on-line cylinders and the chlorinators areas shall be provided with contaminated air extraction system with extraction fans and air ducts.
- The contaminated air shall be discharged to a wet scrubber where the chlorine gas will be absorbed by caustic soda solution. Dry absorbing media can be utilized in the scrubber tower as an option considering that this media will be imported.
- All of the building areas shall be ventilated using wall type fans. When a leak is detected, the ventilation fans will stop and the extraction fans and scrapping system will start and an alarm will annunciate that there is chlorine leak.
- Also a concrete neutralization tank filled with calcium oxide (lime) solution shall be constructed at the off-line cylinders area to neutralize the contents of one ton container in event of a cylinder leak.
- A monorail system shall be provided for loading and off-loading of the containers from trucks and for moving containers from off-line to on-line storage areas within the building.
- The number of chlorinators is determined based on the number of prechlorine and post chlorine application points and the number of existing treatment process units. The prechlorinators will automatically pace feed rates with raw water flow meter signals. The post chlorinators will automatically pace feed rates using the summation of flow signals for individual fitters in the filter building where the chlorine dose is being applied.

2.5.3. Rehabilitation of the Existing Chorine Storage and Feed Facilities

- The rehabilitation will involve removal and replacement of the existing equipment (eg. chlorinators, evaporators, booster pumps, piping, control board and appurtenances). Provide a scrubber tower and air extraction system.
- Also the work shall include providing of ventilation equipment for the storage and equipment rooms.
- The building shall also be provided with chlorine gas detectors and an annunciation and alarm system.

2.5.4. Chemical Mixing, Dosing and Flow Measurement

- The existing mechanical flash mixers for Italba units will be replaced with hydraulic weir flash mixing systems. Alum solution troughs and weir gates shall be provided.
-
- The side walls of the distribution chamber will be raised to provide sufficient free board. Final design shall confirm that the hydraulic profile

of the treatment plant will not be adversely affected by modifying the distribution chamber.

- In addition to providing mixing, the weir gates will serve to isolate each rapid mixing chamber for maintenance purposes.
- An alum solution distribution trough with V-notches will be positioned approximately 30-cm above the weir crest to provide sufficient free-fall for the chemical solution for effective mixing.
- The alum solution will be fed through a chemical injector to be located near the solution trough. The motive water for the ejector will be plant water.
- The injector will assure complete mixing of alum solution with the dilution water immediately prior to the application point.
- The treated water pumping mains which are presently without flow measuring shall be equipped with flow meters. These flow meters shall be equipped with ultrasonic or pitot tube flow meters.
- Uninterruptable power supply units (UPS) will be provided, as appropriate, to keep meters operating during power outages and to protect them from power surges.
- Specially sized corporation stops are installed upstream of all the existing ultrasonic flow meters to allow the insertion of flow calibration pitometer rods to provide primary calibration of the ultrasonic meter.
- One or more local control panels will be provided for the alum feed pumping system at each WTP to control the feed rate in proportion to the raw water flow rate, as measured by the new flow meters.
- The pump feed rate shall be controlled by either automatic adjusting of the pump stroke or by using of variable speed controllers.
- Electrical duct banks or conduit will be constructed to route electrical and signal wires and conduits between the flow meters locations and the chemical feed buildings and between the raw water flow meters and the new central chlorine storage and feed buildings.
- The existing weirs and baffled chambers mixing systems for Pulsator units needs assessment of the hydraulic gradeline through each unit to determine if the existing system weir provides an adequate free fall for flash mixing or whether the weir crest will need to be raised. A new mixing strategy may be considered if practicable.
- The alum metering pumps shall be replaced with new ones to be controlled automatically in proportion to the raw water flow in the inlet pipes to the mixing chambers.
- Prechlorinators shall also be controlled automatically in proportion to the raw water flow in the inlet pipes to the mixing chambers.
- Post chlorinators shall be controlled automatically in proportion to the flow from the filter bank.

2.5.5. Flow Measurement Equipment

- Measurement and recording of raw water flows to individual flash mixing units will be done using insert-type pitot tube with integral flow transmitters. The pitot tubes will have multiple pressure-sensing ports distributed across the pipe profile.

- The tubes will be located in pipelines having at least straight part of 10 to 20 times pipe diameter up stream and 5 times the pipe diameter downstream of the meter, wherever possible to minimize flow disturbances and provide accurate flow measurement. Meter vaults will be provided for meters installed in pipelines below grade.
- Insert type pitot tubes with integral flow transmitters will also be installed in the filter outlet piping of individual filters and in-line of the existing non functioning electromagnetic flow meters and shall be used to flow pace post-chlorine doses. In cases where individual filter flow meters do not exist, a single flow meter will be installed on the piping between the filter bank and the storage reservoir.

2.5.6. On-line Turbidity Analyzers

- One turbidimeter shall be installed for each filter battery at the end of the filtered water channel before the channel exists the filter building.
- The sample shall be pumped using a small submersible pump to a wall or floor mounted turbidimeter. A data logger will be provided with each turbidimeter for storing turbidity readings at preset time intervals.
- One mobile turbidimeter will also be provided for each WTP to measure the turbidity from individual filters. This will require the installation of sample taps to allow the connection of a turbidimeter for each filter.

2.5.7. On-line Chlorine Residual Analyzers

- On-line chlorine residual analyzers will be installed in each treated water pump station in each WTP. A sample tap will be installed in the discharge pipe header with sample piping routed to the wall or floor-mounted chlorine analyzer. Multiple sample lines will be routed to the analyzer so that it will be possible to take chlorine residual measurements under all normal header valving arrangements.

2.5.8. Raw Water Intakes Upgrades

- All the intakes either to be newly constructed or to be upgraded will be provided with a mechanically cleaned system.
- The screens shall be of the mobile grabber type for intake structures which have plenty of screen channels or in the case where two or more intakes structures are close to each other. If the intake structures are far from each other individual mechanical climber screens shall be provided for each screen channel. For the intakes to be upgraded, the vertical bar screens shall be removed and new bars shall be installed with clear spacing of 20 mm between bars and to be inclined to the horizontal with 70° - 75°. The new structures shall be provided with rebate upstream and downstream of the screen for locating of stop logs to be used for maintenance purposes. Baffles with floats shall be installed in front of the intake structure to avoid ingress of floating matters to the intake bay. The maximum velocity through each screen shall be 0.6 m/s at the design peak flow and at the lowest operating water depth in the canal.

2.5.9. Process Residuals Handling System for Siouf, Rond Point and Nozha

- Sludge from the sedimentation basins shall be collected in new equalization tanks. The system will include sludge equalization tanks and pumping stations at each site.
- The storage capacity of the sludge tank will be based on one day of storage at the rated plant capacity to provide flexibility in the daily operation of the sludge pumping station, so that discharge to the AGOSD sewage system can be timed to coincide with or be separate from peak flow rates in the system. Final design of the pump station will be dependent on a future agreement between AWGA and AGOSD on the acceptance of the discharge of process residuals to the sanitary sewer system.
- Clarified waste backwash water from the filters will be discharged to the Mahmoudia Canal after settling, in the same manner as the current practice for all process residuals. Solids from backwash water will be discharged to the sludge equalization tank and ultimately be conveyed to the AGOSD system.

2.5.10. Emergency Stand-by Generators

- The adequacy of stand-by power for most AWGA WTPs was determined based on the ability of existing diesel generators to operate a sufficient number of pumps to supply at least 60% of the average plant rated capacity. A more stringent criterion of 75% of plant rated capacity was established for the Noubaria and Borg El Arab WTPs because these plants supply water to areas that cannot be supplied by other plants in the event of a power failure.
- Existing generators which should be decommissioned because of their age and poor condition, will be replaced with new generators, where indicated in the HPP.
- The medium-voltage generators sets at Siouf WTP should be equipped with synchronizer units so that the generators can be operated in parallel to provide additional power for starting pump motors.
- Based on the scope of work defined in the HPP, the following is a summary of equipment to be provided:

  1. Siouf WTP: Replace the synchronizing controls for one pair of generators. The plant will have the ability to operate five pumps per pair of generators, or ten pumps total, which achieves the 60% pumping capacity criterion.(in old pump building)
  2. Manshia WTP: Replace the two existing SKL generators with two 1200 kW – 3.3 KV generators.
  3. Mahmoudia Pump Station: Replace the two existing Mirless generators with one 1200 KW-380 V generator.

Level of Reservoir

Pressure Censor

2.6. ELECTRICAL – DESIGN CRITERIA

2.6.1. General

This section covers the design criteria which shall be used for all electrical work related to this project. This section covers the requirements for electrical materials, plant facilities, and equipment necessary to design, install, and rehabilitate existing electrical equipment. All new electrical systems and equipment shall be designed and sized based on the final electrical load study. All equipment, materials and installation shall be suitable for the ambient temperature and the atmospheric conditions.

2.6.2. Design Codes and Standards

The design and specification of all work shall comply with United States standards, with applicable local Egyptian codes when required and with the codes and industry standards. The following sections include references to codes, specifications, and industrial standards that are applicable, and the organizations that are responsible for them. The latest editions of these documents shall apply. The Contractor shall be responsible for conforming to all applicable Egyptian standards, regulations, and codes and shall ensure that the design and selection is fully suitable for local conditions. The Contractor shall factor in climatic and environmental conditions at the specific sites. The standards from the following organizations shall be adhered to:

- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE)
- Illuminating Engineering Society (IES)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Electrical Safety Code (NESC)
- National Fire Protection Association (NFPA)
- Underwriters' Laboratories (UL)
- Association of Edison Illuminating Companies (AEIC)
- Insulated Cable Engineers Association (ICEA)
- Recommended and recognized standards from other organizations shall be used where required to serve as guidelines for the design, fabrication, and construction when not in conflict with the standards referenced herein.
- The codes and industry standards used for design, fabrication, and construction shall be adhered.

2.6.3. Calculations

Calculations for all aspects of the electrical design shall support all design equipment selections and ratings. The calculations shall include at a minimum: load and short circuit studies, coordination studies, average lighting level calculations, power cable sizing (including voltage drop), new buildings, and areas modified as required. The load and short circuit studies shall include the new connected and existing operating loads and maximum short

circuit levels at all distribution panels, motor control centers, switchboards and switchgear.

2.6.4. Design Criteria for Electrical Components

The following descriptions provide design criteria for electrical components associated with the project tasks.

Electric Motors

- The following design parameters shall be considered:
- Environment
- Voltage utilization and phases
- Frequency
- Horse power and starting requirements and limitations
- Motor type (synchronous, induction, etc.) and construction
- Power factor
- Speed and direction of rotation
- Insulation
- Temperature limitations of winding insulation and enclosures
- Duty cycle time
- Accessory devices
- Enclosure
- Bearing construction, rating life of rolling elements, and external lube oil system.
- Cooling requirements
- Ambient noise level and noise level for motor and driven equipment
- Frame size
- Termination provisions for power, earthing, and accessories
- Installation, testing, and maintenance requirements
- Special features (shaft grounding, temperature and vibration monitoring, etc.)

Diesel Generating Sets

- The following design parameters shall be considered:
- Environment (ambient temperature, sea level, humidity, etc.)
- Voltage and number of phases, frequency and speed
- Load characteristics (starting current of motors, power factor, etc.)
- Operation requirement (stand-by, emergency, or prime power)
- Enclosure
- Noise level and vibration isolation
- Frame size
- Electrical connection (cabling, protection, loading, power factor, grounding/earthing requirements, parallel operation and insulation)
- Installation, handling, testing and maintenance requirements
- Safety
- Cooling and ventilation
- Fuel system
- Sensitivity of governor and voltage regulator

and jackets which have nonpropagating and self-extinguishing characteristics.

- *Medium Voltage Power Cable.* Power cables with 8 kV class insulation and power cables with 15 kV class insulation shall supply all3.3kV, 6.6 kV and 10.5 kV service and may be routed in tray, conduits, or direct buried.
- *Low Voltage Power Cable 600 Volts.* Power cable with 600 V class insulation shall supply power to loads at voltage levels of 380 volts AC and below, and 250 volts DC and below. Cables may be routed in trays, conduits, or direct buried.
- *Control Cable 600 Volts.* Control cable with 600 V class insulation shall be used for control, metering, and relaying.
- *Instrument Cable 600 Volts.* Instrument cable shall be used for instrument circuits that require shielding to avoid induced currents and voltages. The type of cable used shall be determined by individual circuit requirements and individual equipment manufacturer's recommendations.

Lighting and Fixture Cable. Lighting and fixture cable 600 V insulation shall be used as follows:

- Circuit runs totally enclosed in conduit, XLPE insulation for use in all areas.
- Circuit runs for roadway or outdoor area lighting enclosed in polyethylene tube, PVC insulation for direct burial.
- Fixture wire, silicone rubber insulation, braided glass jacket.

Protective Relaying

The selection and application of protective relays shall be based on the requirements described below. These relays protect equipment in the power supply system, and the electrical loads powered from these systems. These general requirements apply to all protective relay applications.

The protective relaying scheme will be designed to remove and alarm any of the following abnormal conditions:

- Overcurrent
- Undervoltage or overvoltage
- Frequency variations overtemperature
- Open circuits unbalanced current
- Abnormal direction of power flow

Secondary current produced by current transformers shall be in the 5 ampere range, and voltage signals produced by potential transformers shall be in the 220 volt range. Each medium voltage switchgear bus shall be provided with undervoltage relays which shall trip load feeder circuit breakers when bus voltage drops to a preset level.

Switchgear Feeder Breaker. Each switchgear feeder breaker shall be protected by a time overcurrent relay and a time overcurrent earth detection relay.

Tests and Settings

The following minimum tests and check shall be made prior to energizing electrical equipment:

- Mechanical inspection of all medium voltage circuit breakers, low voltage circuit-breakers, disconnect switches, motor starters, control equipment, etc., for proper operation.
- Grounding system
- 380 volt motor control centers
- Wiring
- Check all wire and cable terminations for tightness
- Check motor nameplates for correct phase and voltage. Check bearings for proper lubrication. Check motor shaft rotation.
- Overpotential, high potential, insulation resistance, and shield continuity tests for medium voltage.
- Mechanical inspection. of medium voltage circuit breakers and motor controllers to assure proper operation.
- Testing of 11 kV ,6.6kVand 3.3 kV switch gear, 380 volt switch gear, 380 volt motor control centers, and all other tests.

Power and Control Wiring

- Design Conditions. In general, conductors shall be insulated in accordance with NEMA on the basis of a normal maximum conductor temperature of 90°C and a short-circuit temperature of 250°C. In areas with higher ambient temperatures, larger conductors shall be used or higher temperature rated insulation shall be selected. Conductor size and capacity shall be coordinated with circuit protective devices. Cable feeders from 10.5 kV and 6.6 kVand 3.3kV power equipment shall be sized so that a short-circuit fault at the terminals of the load shall not result in damage to the cable prior to normal operation of fault interrupting devices.
- Cables for 11 kV and 6.6 kV service shall be shielded with the shield earthed at both ends.
- Instrument cable shall be shielded to minimize electrical noise.

Conductors

Design Basis. Electrical conductors shall be selected with an insulation level applicable to the system voltage for which they are used and capacities suitable for the load being served. Conductors shall be tinned copper.

Cable Capacities. The maximum capacities for any cable shall depend upon the worst case in which the cable will be routed (tray, conduit, duct, or direct buried). In addition to capacity, special requirements such as voltage drop, fault current availability and environment shall be taken into consideration in sizing of cable.

Insulation. Cable insulation shall be as follows:

- *Flame Retardance.* To minimize the damage that can be caused by a cable fire, cables installed in electrical cable tray systems shall have insulations

380 and 220 Volt Power Panels. Power panels shall be completed with a main breaker and thermal-magnetic circuit breakers sized to protect supply cable and individual loads. Power panels shall be provided with a minimum of 25% installed spare breakers.

Earthing (Grounding)

The WTP earthing system shall be extended where required and shall be an interconnected network of tinned copper conductor and copper-clad earth rods. The system shall be provided to protect plant personnel and equipment from the hazards which can occur during power system faults. New earthing systems shall be required at new buildings, new electrical rooms and building addition areas. All new earthing system shall be interconnected with any existing earthing systems available.

Design Basis. The WTP earthing grid shall be designed for adequate capacity to dissipate heat from earth current under the most severe conditions in areas of high earth fault current concentrations, with grid spacing such that safe voltage gradients are maintained. Tinned conductors to be installed below grade shall be spaced in a grid pattern as required. Each junction of the grid shall be bonded together by an exothermal welding process.

In the WTP area, earthing stingers shall be brought through the ground floor and connected to the building steel and selected equipment. The earthing system shall be extended, by way of stingers and conductor installed in conduit, to the remaining plant equipment. Equipment connections to earth shall conform to the following general guidelines:

- Electronic panels and equipment, where required, shall be earthed utilizing an insulated earth wire connected in accordance with the manufacturer's recommendations. In some situations, a separate small grid and earth electrode, isolated from the main earth, shall be required. Where practical, electronics earth loops shall be avoided.
- Motor supply circuits to 380 volt motors, which utilize three-conductor cable with an earthing conductor in the interstices, shall utilize this conductor for the motor earth. For 380 volt motor supply circuits which utilize three single-conductor cables, the earthing conductor shall be a separate conductor.

Materials. Earthing materials shall be as described in the following:

- Earthing electrodes shall be copper-clad. Earthing electrode length and diameter shall be determined by soil resistivity and subsurface mechanical properties. Where the required earthing electrode length exceeds standard lengths, standard sections shall be exothermally welded together using a guide clamp.
- Cable shall be soft-drawn copper or copper-clad steel.
- Clamps, connectors, and other hardware used with the earthing system shall be made of copper.
- Earthing wires installed in conduit shall be soft-drawn stranded copper and green colored 1.0 kV PVC insulation.

Lighting

The lighting system shall provide personnel with illumination for the WTPs under normal conditions, means of egress under emergency conditions, and emergency lighting to perform manual operations during a power outage of the normal power source. The permanent lighting system shall be used for construction lighting in areas where early installation is feasible. Temporary construction lighting shall be utilized in all other areas. The power supply for the lighting system shall be from 220/380 volt, 3-phase, 4-wire lighting panel boards. Emergency lighting shall be provided with self-contained battery units. Power used to supply outdoor roadway emergency and area lighting fixtures shall be at 220 volts.

Light Sources. The lighting system shall be designed in accordance with the Illuminating Engineering Society (IES) to provide illumination levels recommended by ANSI/IES RP-7, 1983, Industrial Lighting.

Fluorescent, high-pressure sodium, and incandescent lamps shall be used in the lighting systems. Generally, fluorescent lamps shall be used in finished indoor, low ceiling enclosed areas; high-pressure sodium lamps shall be used in high bay, and outdoor areas; and incandescent lamps shall be used for emergency lighting. All lamps shall be of manufacture so that replacement parts are readily available.

The following table presents illuminance levels for various areas in the WTPs.

General Illuminance Levels for Areas

Interior Location	**Lux**
Control Room/Area {Main and Auxiliary Control Panels)	300
Control Room Operator's Station	750
Control Room Emergency Lighting	200
Chlorine Store	300
Toilets	300
Closets	200
Stairways	150
Corridors	100
Storage rooms	100

Lighting Control. Electric power to luminaries shall be switched with wall mounted light switches in areas where the light can be "off" when the area is not occupied. Wall mounted switches shall be provided at the entrance to office, storage, battery, and equipment rooms. Electric power to luminaries located outdoors shall be switched with photoelectric controllers, where appropriate.

Luminaire Supports. In areas below operating floors and areas that are congested with piping, raceway, and overhead equipment, the luminaries shall be supported from suspended continuous row prefabricated metal channels. In other areas of the WTPs, luminaries shall be supported by rigid steel conduit

pendants where they cannot be mounted directly on the underside of decks, on structural steel, or in finished ceilings.

Sockets. Single phase plug sockets for general use shall be single duplex, and weatherproof (as required for the various installations), European "Schuko" type, two pole, 3 wire, with ground rated at 16 amperes and 250 volts. Socket outlets located outdoors shall have weatherproof covers. The socket outlets shall be spaced to provide access to almost any point in the buildings with a 15 meter extension cord. In hazardous locations, socket outlets shall be suitable for the hazardous area requirements. Switches used throughout the plant shall be sized for the switched load and rated 250 volts AC with enclosures suitable for the location in which they are installed.

Raceway and Conduit

- The design and specifications for the raceway and conduit systems used in supporting and protecting electrical cable shall be in accordance with the provisions of NEC. All conduit systems shall be sized as per the NEC requirements.
- Individual raceway systems shall be established for the following services:
  1. 6.6 kV and higher power cables
  2. 380 volt power and control cables
  3. Special noise-sensitive circuits or instrumentation cables
- Lighting branch circuits, telephone circuits, and intercommunication circuits run indoors shall be routed in conduit. Lighting circuits shall be routed in exposed indoor areas and PVC jacketed for outdoor exposed areas.
- PVC coated rigid galvanized steel conduit shall be used for all exposed conduit. Rigid galvanized steel conduit shall be used for instrument cables when conduit is encased in concrete.
- All conduit not located in finished areas shall be routed in exposed runs parallel or perpendicular to dominant surfaces with right-angle turns made of symmetrical bends or fittings. Conduit installed in finished areas, such as the office administration and control areas, shall be concealed. Conduit shall be routed at least 150 mm from the insulated surfaces of hot water, steam pipes, and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cables shall be used.
- Pull and junction boxes shall be sized in accordance with the NEC as to minimum size.

Retrofitting Existing Power Distribution Equipment

Work to be performed as indicated on existing Switchgear, Motor Control Centers, etc., including installation of new circuit breakers, motor starters and the addition of new vertical sections; etc. shall comply with the following:

- Coordination with Plant Authority, Power Company and Engineer regarding any required power shutdown to perform all scheduled tasks.
- All new equipment to be installed on existing equipment shall be obtained from the original manufacturer and shall equal in every way match the as-built installation, when possible.

2.6.5. Site Specific Design Criteria

The following information is presented for each WTP to provide specific design criteria for project tasks that involve electrical design.

Siouf WTP

- For the new central chlorine storage facility, the power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, ventilation.
- Improve the operation of existing medium voltage generator system by replacing a non-operational synchronizer panel, verta trick switch and all terminal connections, so that the generators can operate in parallel.
- Ultimate disposal of the WTP process residuals. The work shall include a sludge pump station, all required electrical equipment including the main service from the nearest LV switchgear, cabling, and any other equipment to put the pump station in good operating conditions. Coordinate with Sabbath factory, adjacent to the plant.

Rond Point WTP

- For the new central chlorine storage facility, the power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, ventilation. The facility shall be fed from the existed low voltage switchboard inside Filter House No. 2.
- Ultimate disposal of the WTP process residuals. The work shall include a sludge pump station, all required electrical equipment including the main service from the nearest LV switchgear, cabling, and any other equipment to put the pump station in good operating conditions.

Manshia WTP

- For the new central chlorine storage facility, the power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, ventilation.
- Replacement of the intake facilities with new intake structure and mechanically cleaned screens as indicated on the mechanical section. The work shall include all the required electrical equipment including the main service from the nearest LV switchgear, cabling, road crossing conduits and any other equipment to put the screens in good operating conditions.
- Install two new emergency stand by generators at 3.3 kV, 1200 kW each to replace existing generators. The work shall include medium voltage cable 3.3 kV, new concrete cable trench, rehabilitate the existed cable trench.

Maamoura WTP

- New centrally-located indoor chlorine storage. The power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, and ventilation.

Nozha WTP

- Rehabilitation of the existing centralized indoor chlorine storage. The power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, and ventilation.

- Replacement of the intake facilities with new intake structure and mechanically cleaned screens as indicated on the mechanical section. The work shall include all the required electrical equipment including the main service from the nearest LV switchgear, cabling, road crossing conduits and any other equipment to put the screens in good operating conditions.
- Ultimate disposal of the WTP process residuals. The work shall include a sludge pump station, all required electrical equipment including the main service from the nearest LV switchgear, cabling, and any other equipment to put the pump station in good operating conditions.

Borg El Arab WTP

- New bulk chlorine storage facility. The power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, and ventilation.
- Evaluate operation of the existing crane inside chlorine storage building. Check printed circuit/card and the inside of the electrical and control cabinet of the crane.
- Rehabilitation of the existing intake facilities including the installation of new mechanically cleaned screening facilities as indicated on the mechanical section. The works include all the required electrical equipment including the main service from the nearest LV switchgear, cabling, road crossing conduits and any other equipment to put the screens in good operating conditions.

Noubaria WTP

- For the new central chlorine storage facility, the power system shall include the main service, distribution panels, lighting, emergency lighting, receptacles, switches, ventilation. The facility shall be fed from the new low voltage switchboard installed beside Italba 2 clarifiers. New circuit breaker to be installed inside the switchboard.
- Rehabilitation of the existing intake facilities including the installation of new mechanically cleaned screening facilities as indicated on the mechanical section. The works include all the required electrical equipment including the main service from the nearest LV switchgear, cabling, road crossing conduits and any other equipment to put the screens in good operating conditions. New mechanical screens shall be fed from transformer No. 5, 1500 kVA, 11/0.380 kV, 50 Hz to a low voltage panel installed inside the transformers room.
-

Mahmoudia Pump Station

- Improve plant reliability at the pump station with respect to power outage. Replace the two existing 600 kW - 380 V, Mirles generators with one new 600 kW - 380 V generator. Replace low voltage switchgear with a new one. The new switchgear shall include:
- One incoming feeder from the new generator.
- Two outgoing feeders for the manual transfer switches.
- Utilize existing cable if practicable.

2.7. INSTRUMENTATION – DESIGN CRITERIA

This section covers the design criteria which shall be used for all Process Control and Instrumentation work related to this project.

2.7.1. Design Codes and Standards

The design and specification of all work shall comply with United States standards, with applicable local Egyptian codes when required and with the codes and industry standards. The following sections include references to codes, specifications, and industrial standards that are applicable, and the organizations that are responsible for them. The latest editions of these documents shall apply. The Contractor shall be responsible for conforming to all applicable Egyptian standards, regulations, and codes and shall ensure that the design and selection is fully suitable for local conditions. The Contractor shall factor in climatic and environmental conditions at the specific sites. The standards from the following organizations shall be adhered to:

- American National Standards Institute (ANSI)
- American Petroleum Institute (API)
- American Society of Mechanical Engineers (ASME)
- Instrument Society of America (ISA)
- American Society of Testing and Materials (ASTM).
- National Electrical Safety Code (NESC)
- National Electrical Code (NEC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association. (NFPA)
- Scientific Apparatus Makers Association (SAMA)
- Recommended and recognized standards from other organizations shall be used where required to serve as guidelines for the design, fabrication, and construction when not in conflict with the standards referenced herein.
- The codes and industry standards used for design, fabrication, and construction shall be followed.

2.7.2. General Requirements

The General Requirements specified below shall be followed. Refer to electrical design criteria and specifications for all equipment ratings and cable requirements.

Each item of hardware and software delivered or developed shall be able to accurately process date/time data (including, but not limited to calculation, comparing, sequencing and interfacing with existing equipment) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000.

Ambient Conditions

All field-mounted instruments and control devices shall be designed to withstand ambient temperature ranges from 0 deg. C to 50 C, and relative humidities up to 95 percent noncondensing throughout the temperature range.

Power Supplies

Input voltage is 220 volt, 50 Hz, single phase (+/- 10%). Provide fused output protection. All power supplies are to be furnished by equipment manufacturer. All instruments and control devices shall be designed to operate on power supplies as follows:

Electric

- 24 volt dc for two-wire transmitters.
- 220 volt ac, 50 hertz, single-phase for four-wire transmitters, power supplies and other devices.
- All Power Supplies required shall be furnished by the equipment manufacturer.

Standard Ranges of Analog Signals

The ranges of analog signals shall normally be as follows:

1. Electric	4 to 20 mA dc
2. Pneumatic	0.2 to 1.0 bar

Signal ranges other than the above shall not be used.

Contact ratings

The ratings of all instrument contacts used for alarms and interlocks shall be: IEC 158-1 and 337-1 and as follows:

Voltage Rating	**Rated Thermal Current**
volts	amperes
600 ac	10
300 dc	10

Instruments

Design criteria for instruments shall be as specified herein. All instruments shall be provided in accordance with the technical requirements including Instrumentation data sheets.

Flow Meters. Provide pitot type flowmeters.

Static Pressure and Differential Pressure Transmitters. Sensing elements for static pressure and differential pressure transmitters shall be of either the resonant wire or capacitance type.

Level transmitters. Sensing elements for level transmitters shall be of the following types:

1. Static head devices for vessels exposed to atmospheric pressure. (Level transmitters of this type are the same as static pressure transmitters.)
2. Differential pressure type with constant head chamber for high-pressure and temperature applications where installation of float cage becomes impractical. (Level transmitters of this type are the same as static pressure transmitters.)
3. Ultrasonic and admittance probe type for specialized applications.

Electronic Switching Devices. Signal monitor type of switching device will provide high-low contact closures by monitoring the output signals (4 to 20 mA DC) from transmitters and signal converters.

Local Indicators. All analog process transmitters shall be provided with a local indicator mounted for convenient access. Local indicator scales shall be calibrated for appropriate parameter (mg/l, NTU), 0 to 100 percent of scale.

Panel-Mounted Devices. Panel-mounted devices shall be NEMA 4X.

Process Indicators. Panel indicators shall be used for indication of process parameters.

Signal Wiring

- All signal shields must have only one ground point, which will be located at the source of the signal, unless otherwise recommended by the instrument manufacturer.
- For all termination refer to electrical design criteria.

2.7.3. Site Specific Design Criteria

The following information is presented for each WTP to provide specific design criteria for project tasks that involve instrumentation and control design.

Siouf WTP

- Upgrade Italba Flash mixers
- Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system(Alum, pre and post chlorine)
- Upgrade filter controls for Italba Filter Buildings.
- Rehabilitate the Patterson filter and its control system
- Install on line turbidimeters and chlorine residual analyzers.
- Provide new plant wide computerized process monitoring and control system.
- Level Reservoir and pressure censors

Rond Point WTP

- Upgrade Italba Flash mixers.
-

- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system(Alum, pre and post chlorine).
- Upgrade filter controls (flow meters) for filter buildings. Provide spare parts for all operational filters.
- Install on-line turbidimeters and chlorine residual analyzers.
- Provide new plant wide computerized process monitoring and control system.
- Level Reservoir and pressure censors

Manshia WTP

- Upgrade weir mixers
- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system. (Alum, pre and post chlorine)

- Upgrade filter controls for Italba filter buildings. Provide spare parts for all filter buildings
- Rehabilitate the Czch filter and its control system.
- Install on-line turbidimeters and chlorine residual analyzers.
- Provide new plant wide computerized process monitoring and control system.
- Level Reservoir and pressure censors

Nozha WTP

- Upgrade Italba Flash mixers.
- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system. (Alum, pre and post chlorine)
- Install on-line turbidimeters and chlorine residual analyzers.
- Spare parts for control system for Italba filter building.
- Treated water flow meters.

Maamoura WTP

- Upgrade Italba Flash mixers.
- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system. (Alum, pre and post chlorine)
- Install on-line turbidimeters and chlorine residual analyzers.
- Spare parts for control system for all filter buildings.

Borg El Arab WTP

- Upgrade Italba Flash mixers
- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system. (Alum, pre and post chlorine)
- Install on-line turbidimeters and chlorine residual analyzers.
- Spare part for filter control system.

Noubaria WTP

- Upgrade Italba Flash mixers
- Install new raw water flow meters, alum feed pumps and automatic flow pacing control system. (Alum, pre and post chlorine)

- Install on-line turbidimeters and chlorine residual analyzers.
- Spare parts for filter control system.

Section 3 – Preliminary Design

This section presents preliminary information to be used as a basis for the final design for the project. This section presents a list of tasks for each of the WTPs within the scope of this project. A preliminary list of technical specifications, list of drawings, and bill of quantities is also provided as a guideline for final design. This information was compiled based on the available information at the time. Note that this information may change during the course of the final design.

All drawings will be prepared to fit A1 size sheets. For review purposes, A3 size drawings will be prepared.

The following tables are presented in this section for the following items:

	Description
Table 1	Summary of Project Tasks
Table 2	Preliminary List of Technical Specifications
Table 3	Preliminary List of Drawings
Table 4	Preliminary Bill of Quantities

Table 1
Proposed WTP Improvements
Work Elements

Task	HPP No.	Project Description
Siouf WTP		
SI-1	WTG-2,4(M)	Upgrade Flash Mixers PM1, PM2, and PM3.
SI-2	WTG-2,4(F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.
SI-3	WTG-3 WTG-3(SP)	Upgrade filter controls for Italba Filter Buildings FI1, FI2, and FI3; provide spare parts for all operating filter buildings. (FP4, FP5, and FD6 filters)
SI-4	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
SI-5	WTG-8	Upgrade Sludge Storage Tanks TS1 and TS2 and Pump Station SP1 with discharge to AGOSD sewerage system; divert filter washwater to Mahmoudia Canal.
SI-6	WTG-7(N)	Construct new Central Chlorine Building CB4.
SI-7	WTG-14	Provide new plant-wide computerized process monitoring and control system.
SI-8	WTG-5	Install emergency standby generator. (synchronizer for existing).
SI-9	WT1-2	Provide new sanitary sewerage system.
Rond Point WTP		
RP-1	WTG-2,4(M)	Upgrade Flash Mixers PM1.
RP-2	WTG-2,4 (F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.
RP-3	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
RP-4	WTG-3 WTG-3(SP)	Upgrade filter controls (flow meters) for Italba Filter Buildings F1, F2 (and F3). Provide spare parts for all operational filters.
RP-5	WTG-8	Upgrade or replace Sludge Storage Tanks TS1, TS2 and TS3 and Sludge Pump Station SP1 and SP2 (CT3 and CT4 add pilot dewatering).
RP-6	WTG-7(N)	Construct new Central Chlorine Building CB2.
RP-7	WTG-14	Provide new plant-wide computerized process monitoring and control system.
Manshia WTP		
MN-1	WTG-10	Upgrade Intakes I1, I2 and I3 with new 1,200,000 m3/d intake and mechanical screens on pile foundation.
MN-2	WTG-2,4(M)	Upgrade Weir Mixers PM1, PM2, and PM3.
MN-3	WTG-2,4(F/CF)	Install new raw water flow meters.
MN-4	WTG-3 WTG-3(SP)	Upgrade filter controls for Czech Filter Building FC1 and FC2; provide spare parts for all filter buildings. (install new filter effluent flow meters in all filters except for Degremont filters. Install meters in vaults on filter bank piping to reservoirs for chlorine flow pacing for Degremont.
MN-5	WTG-9	Install new on-line turbidimeters and chlorine residual analyzers. (on each filter bank)
MN-6	WTG-7(N)	Construct new Central Chlorine Building CB4 on pile foundation. (Change location to S4 storage area).
MN-7	WTG-14	Provide new plant-wide computerized process monitoring and control system B12.
MN-8	WTG-5	Replace two existing generators with 3.3 KV, 1200 KW units.
Nozha WTP		
NZ-1	WTG-10	Replace Intake I1 with new intake (330,000 m3/d) with mechanical screens on pile foundation.
NZ-2	WTG-2,4(M)	Upgrade Flash Mixer PM1.
NZ-3	WTG-2,4(F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.
NZ-4	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
NZ-5	WTG-3(SP)	Provide spare parts for control system for Italba filter building.
NZ-6	WTG-8	Construct new sludge holding tank and pump station on pile foundation Spand TS.
NZ-7	WTG-7(R)	Rehabilitate existing Central Chlorine Building CB1.
NZ-8	WT5-1	Plant Startup
Maamoura WTP		
MA-1	WTG-2,4(M)	Upgrade Italba Flash Mixers PM1, PM2, and PM3.
MA-2	WTG-2,4(F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.
MA-3	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
MA-4	WTG-3(SP)	Provide spare parts for control system for all filter buildings.
MA-5	WTG-7(N)	Construct new Central Chlorine Building CB4 on pile foundation.
Borg El Arab WTP		
BA-1	WTG-10	(Upgrade) Replace Intake I1 with new 500,000 m3/d intake with mechanical screens on pile foundations.
BA-2	WTG-2,4(M)	Upgrade Flash Mixers PM1 (and PM2).
BA-3	WTG-2,4(F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.

Task	HPP No.	Project Description
BA-4	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
BA-5	WTG-3(SP)	Provide spare parts for filter control system for Italba Filter Buildings FI2 (and FI3) and Bemag Filter Building FB1.
BA-6	WTG-7(R)	Rehabilitate existing Central Chlorine Buildings CB3 and CB4 to a centralized chlorine storage , handling and feed facility.
BA-7	WTG-7(B)	Construct new Bulk Chlorine Storage Facility CB5.
Noubaria WTP		
NO-1	WTG-10	Upgrade Intakes I1 and I2 with new mechanical screens on pile foundation.
NO-2	WTG-2,4(M)	Upgrade Flash Mixers PM1, PM2, and PM3.
NO-3	WTG-2,4(F/CF)	Install new raw water flow meters, alum feed pumps (as needed) and automatic flow pacing control system.
NO-4	WTG-9	Install on-line turbidimeters and chlorine residual analyzers.
NO-5	WTG-3(SP)	Provide spare parts for filter control system for all filter buildings.
NO-6	WTG-7(N)	Construct new Central Chlorine Building CB6.
Mahmoudia Pump Station		
MPS-1	WTG-5	Provide new 380 KV, 1200 KW fixed standby generator at Mahmoudia Pumping Station.
Mahmoudia Canal		
MC-1	WTG-10	Upgrade Mahmoudia Canal Outlet Structure by replacing gates, installing new pumps and rehabilitate the existing structure.
MC-2	WTG-10	Conduct a sanitary survey of approximately 8 kilometers of the MC which are scheduled for cleaning and rehabilitation.

NOTES:

SI	Siouf WTP
RP	Rond Point WTP
MN	Manshia WTP
NZ	Nozha WTP
MA	Maamoura WTP
BA	Borg El Arab WTP
NO	Noubaria WTP
MPS	Mahmoudia Pump Station
MC	Mahmoudia Canal

WTG-7: Central Chlorine Storage and Feed Facilities
All WTPs
- WTG-7(N) Centrally Located Chlorine Storage- New.
- WTG-7(R) Centrally Located Chlorine Storage- Rehabilitated.
- WTG-7(B) Bulk Chlorine Storage- Borg El Arab.
- WTG-7 scope of work includes a one (1) year service contract with a qualified vendor for the first year of operation.

WTG-2,4: Chemical Mixing, Dosing and Flow Measurement
All WTPs
- WTG-2,4(M) Mixing.
- WTG-2,4(F/CF) Flow measurement and chemical feed.
- WTG-2,4 scope of work includes a one (1) year service contract with a qualified vendor for the first year of operation.

WT1-5: Nozha WTP Rehabilitation and Startup
Nozha WTP

WTG-3: Filter Control System Upgrades
Siouf WTP
Rond Point WTP
Manshia WTP
All WTPS- spare parts
- WTG-3(SP) Spare parts for filters
- WTG-3 scope of work includes a one (1) year service contract with a qualified vendor for the first year of operation.

WTG-9: On-Line Turbidity and Chlorine Residual Analyzers
All WTPs

WTG-9 scope of work includes a one (1) year service contract with a qualified vendor for the first year of operation.

WTG-14: Computerized Process Monitoring and Control
Siouf WTP
Rond Point WTP
Manshia WTP

WTG-14 scope of work includes a one (1) year service contract with a qualified vendor for the first year of operation.

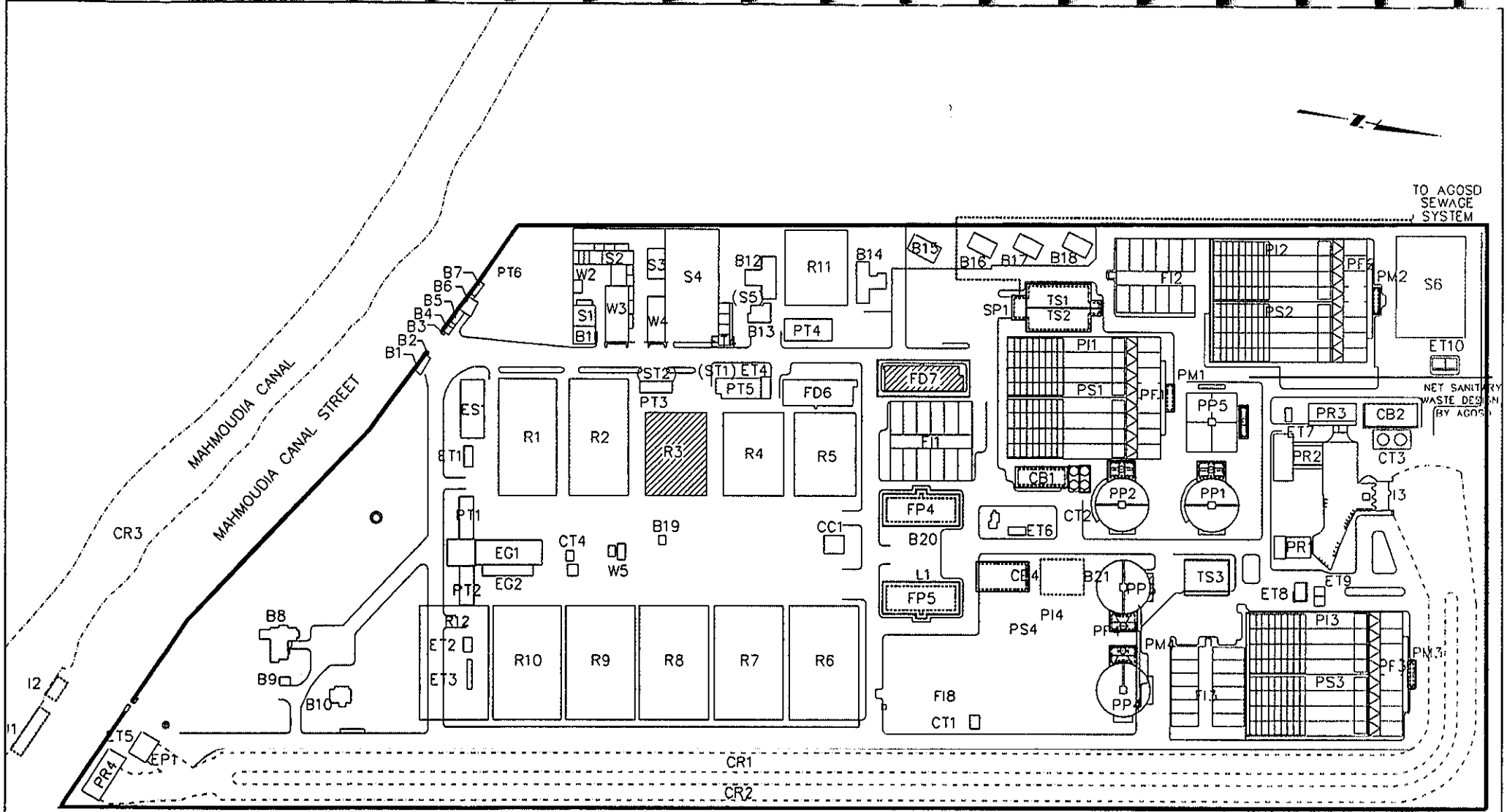
WTG-10: Raw Water Intake and Canal Outlet Control Structure Upgrades And Sanitary Survey Mahmoudia Canal (MC)
Manshia WTP
Nozha WTP
Borg El Arab WTP
Noubaria WTP
Mahmoudia Canal

WTG-10(N) Replace intake facilities
WTG-10 (R) Rehabilitate existing intake structure
WTG-10(MC) Modify existing MC Outlet Structure
WTG-10(SS) Sanitary Survey of MC

WTG-5: Emergency Standby Generators
Siouf WTP
Noubaria WTP
Mahmoudia PS

WTG-8: Process Residuals Handling System for Mahmoudia Canal WTPs
Siouf WTP
Rond Point WTP
Nozha WTP

WT1-2: Diversion of Sanitary Waste at Siouf WTP
Siouf WTP



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MWH
MONTGOMERY WATSON HARZA

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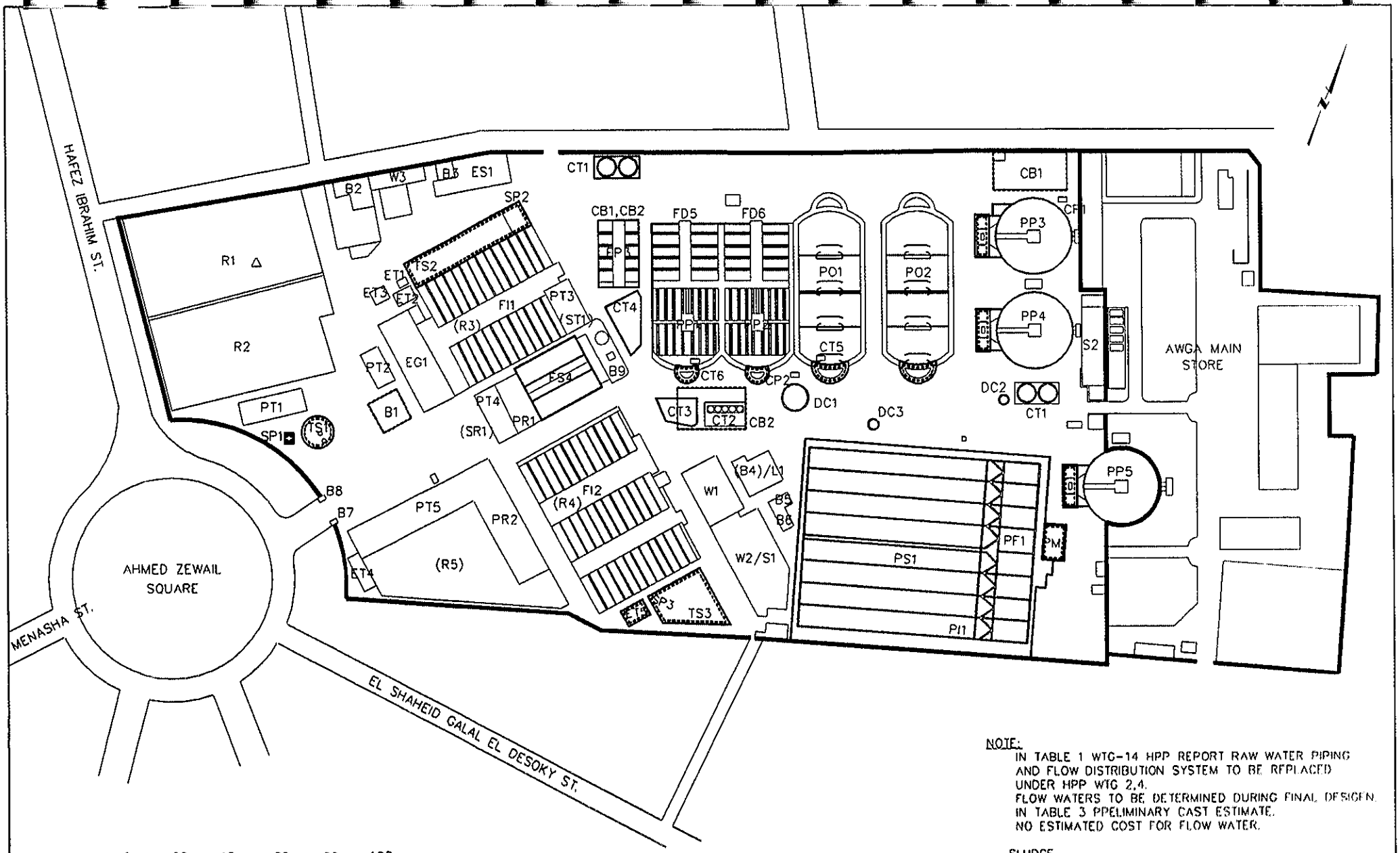
Alexandria Water General Authority
Egypt Utilities Modernization Activities
USAID Grant No. 263-0270.00
Contract No. 263-C-00-01-00016-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

SIOUF WTP

SHEET 1



NOTE:
IN TABLE 1 WTC-14 HPP REPORT RAW WATER PIPING AND FLOW DISTRIBUTION SYSTEM TO BE REPLACED UNDER HPP WTC 2.4.
FLOW WATERS TO BE DETERMINED DURING FINAL DESIGN IN TABLE 3 PPELIMINARY CAST ESTIMATE.
NO ESTIMATED COST FOR FLOW WATER.

- SLUDGE

——— PROPOSED

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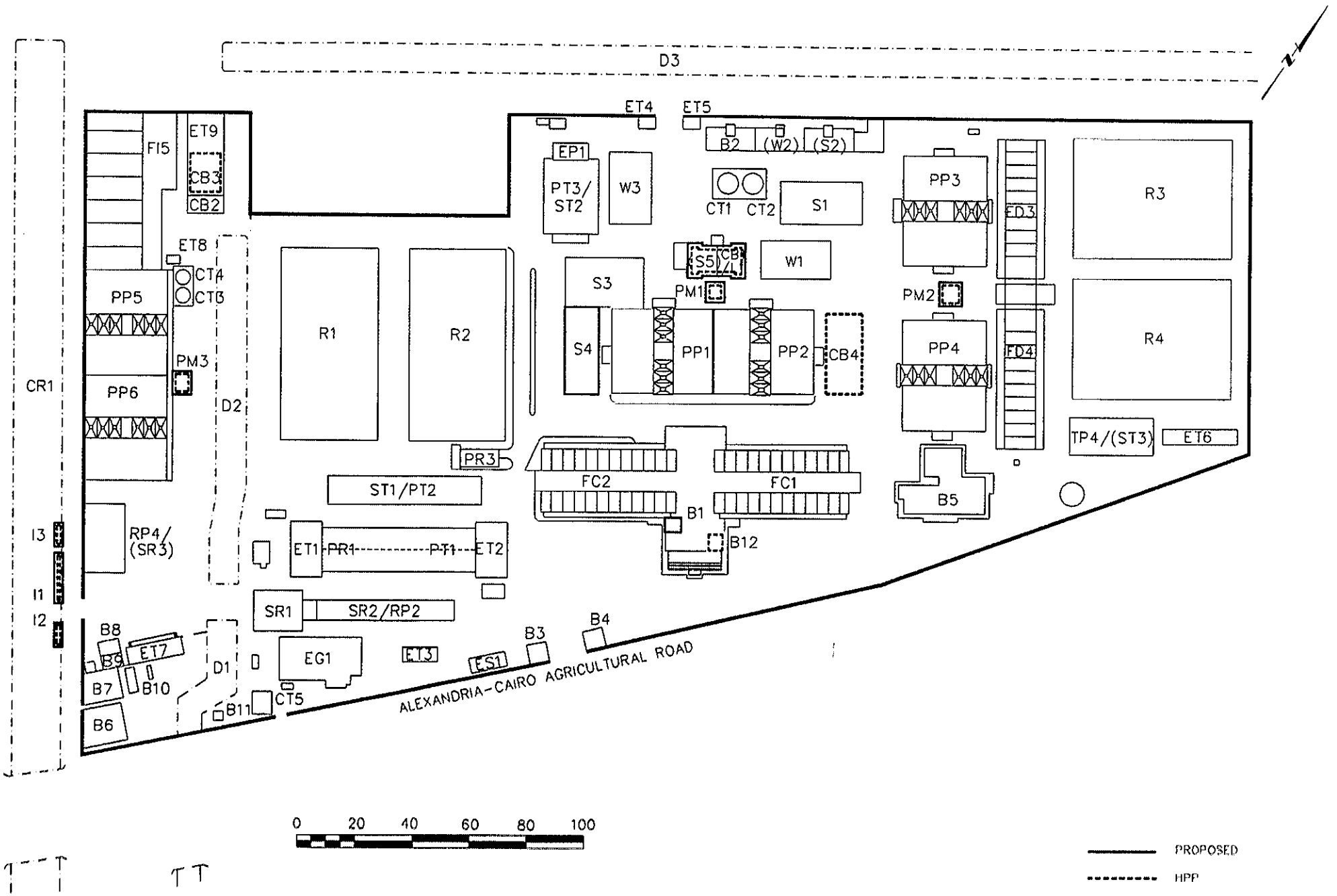
Alexandria Water General Authority, Egypt Utilities Management/Associates, USAID Grant No. 263-0270.08, Contract No. 263-C-00-01-00019-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

ROND POINT WTP

SHEET 1

43



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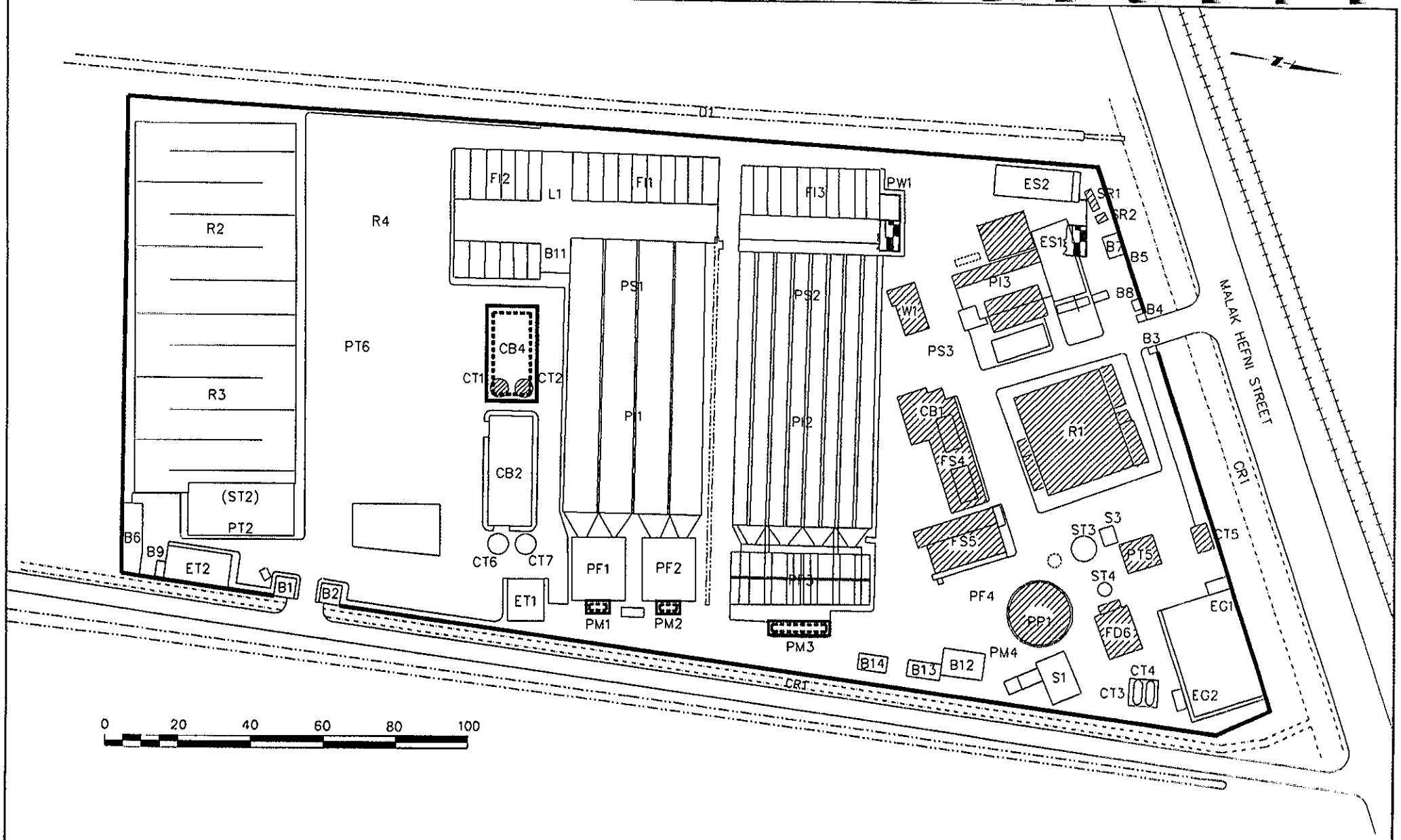
Alexandria Water General Authority
Egypt Utilities Modernization/Alexandria
USAID Grant No. 263-0272.00
Contract No. 263-C-00-01-00016-00

CONSULTANT

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

MANSHIA WTP

SHEET 1



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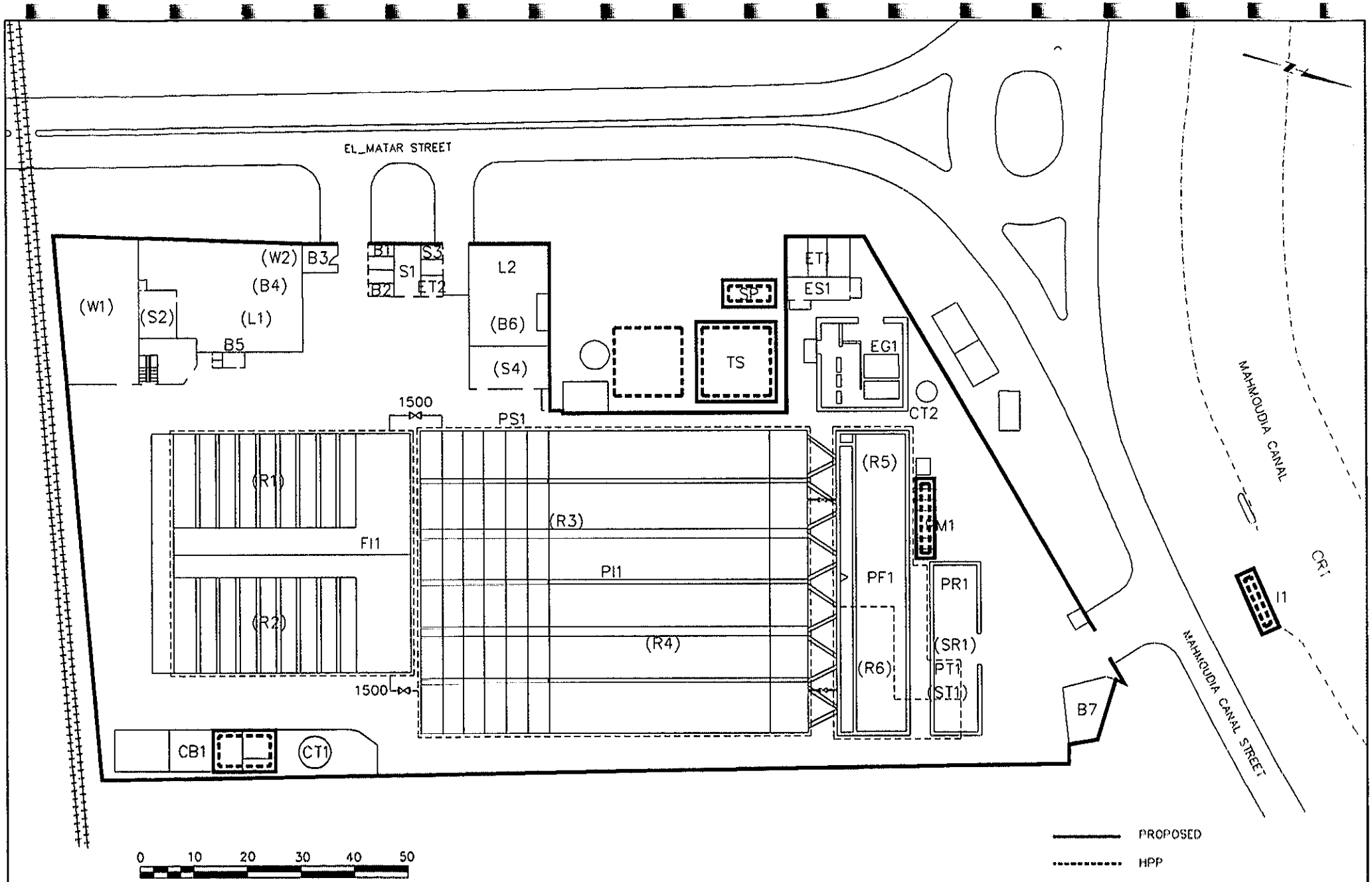
AAW

Alexandria Water General Authority
Egypt Utilities Management Assistance
USAID Grant No. 263-0270.06
Contract No. 263-C-00-01-00016-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

MAAMOURA WTP

SHEET 1



46

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MWH
MONTGOMERY WATSON HARZA

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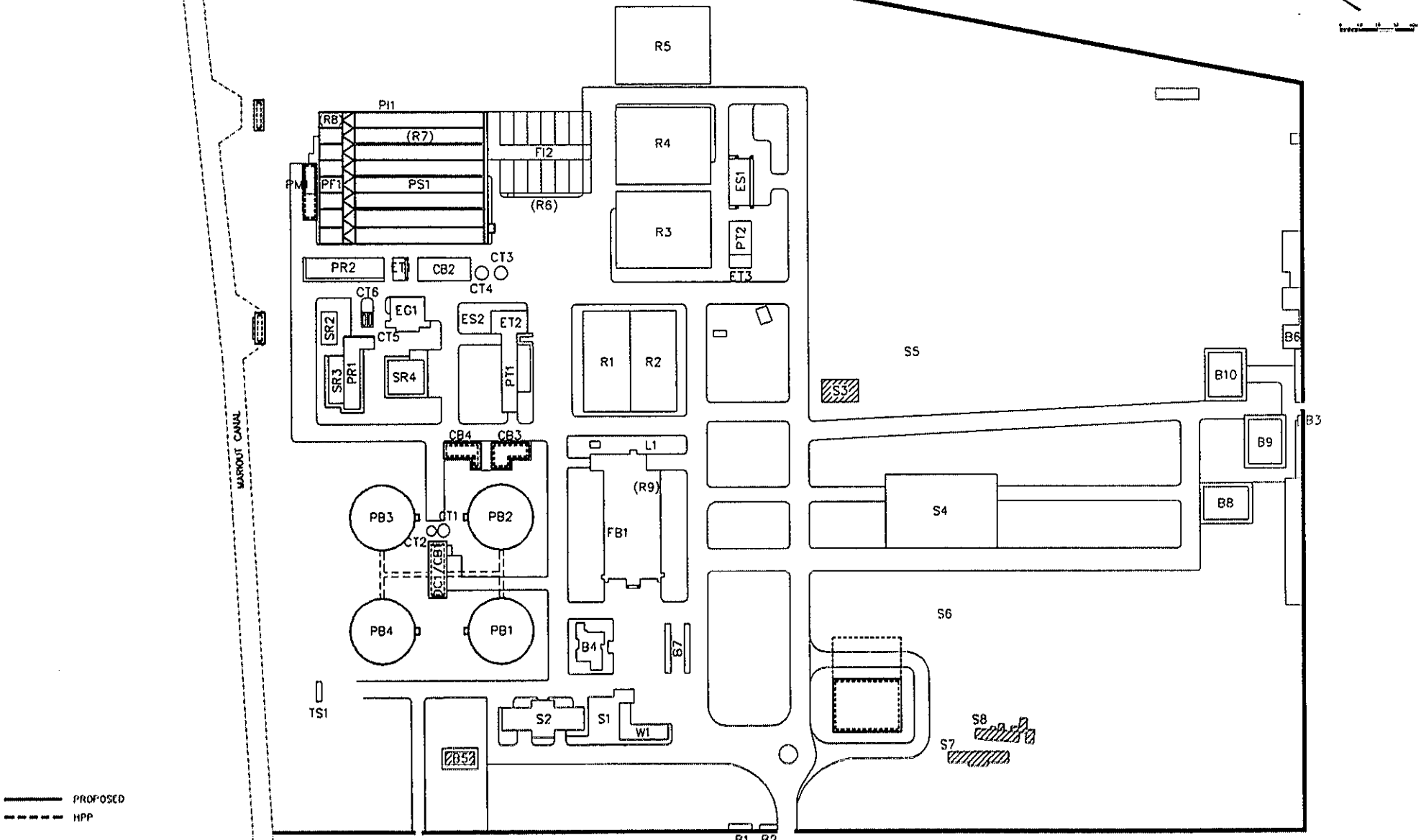
Alexandria Water General Authority
Egypt Utilities Management/Alexandria
USAID Grant No. 263-0270.02
Contract No. 263-C-00-01-00015-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

NOZHA WTP

SHEET 1



REV	DATE	BY	DESCRIPTION

SCALE

AS DRAWING

WARNING
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MWH
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CH2M HILL Middle East
AAW
PA Government Services

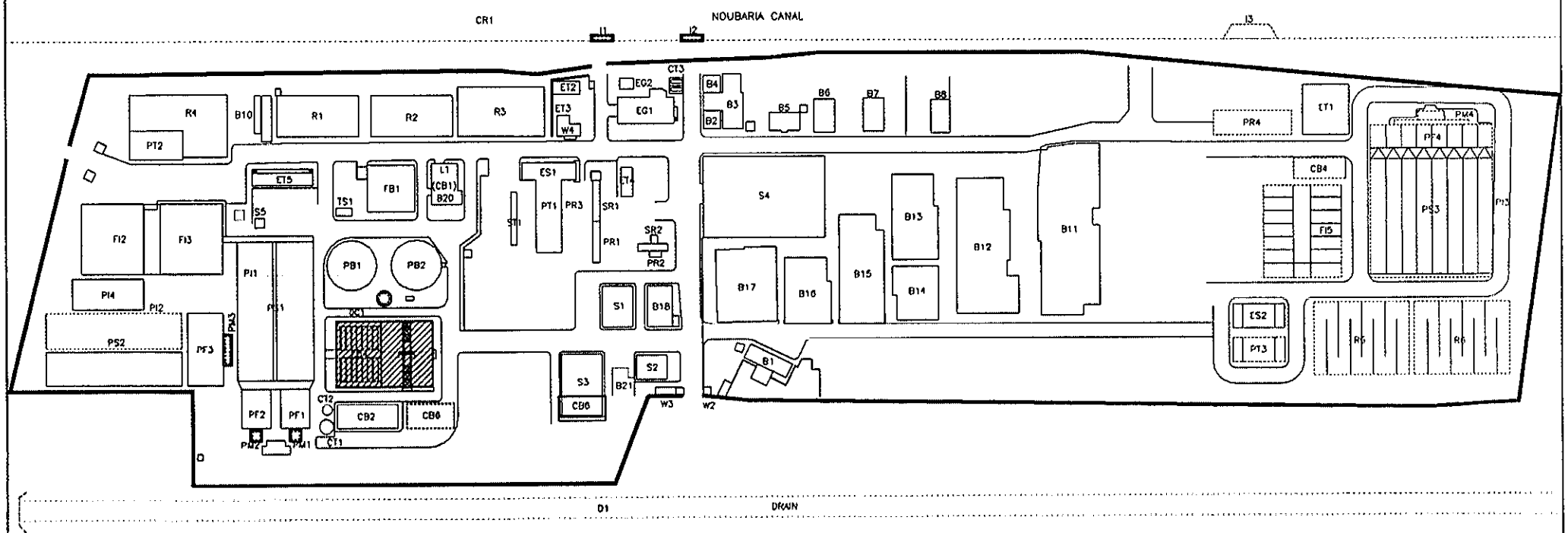
Alexandria Water General Authority
Egypt Utilities Management/Alexandria
USAID Grant No. 263-0270.02
Contract No. 268-C-00-01-00016-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

BORG EL ARAB WTP

SHEET
1

47



REV	DATE	BY	DESCRIPTION

SCALE: AS DRAWING

WARNING: IF THIS BAR DOES NOT MEASURE 3cm THEN DRAWING IS NOT TO SCALE

DESIGNED AZ
DRAWN SS
CHECKED SC

MWH
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Alexandria Water General Authority
Egypt Utilities Management/Alexandria
USAID Grant No. 263-0270-A8
Contract No. 263-C-00-01-00016-00

WATER TREATMENT PLANT IMPROVEMENTS
SITE PLAN

NOUBARIA WTP

SHEET 1

Table 2
Preliminary List of Technical Specifications
Basis of Design Report, WTP Projects

Division 01 General Requirements
01010 Summary of Work
01012 Summary of Work - Procurement
01025 Measurement and Payment
01060 Regulatory Requirements
01070 Abbreviations of Institutions
01090 Reference Standards
01300 Contractor Submittals
01301 Schedule of Values
01309 Barchart Construction Schedule
01311 CPM Construction Schedule
01312 Construction Sequencing
01313 Construction and Schedule Constraints
01400 Quality Control
01505 Mobilization
01510 Temporary Utilities
01520 Security
01530 Protection of Existing Facilities
01532 Site Condition Surveys
01535 Settlement Monitoring
01550 Site Access and Storage
01580 Project Sign
01590 Field Offices, Equipment, and Services
01600 Products, Materials, Equipment and Substitutions
01610 Owner-Furnished Equipment
01640 Demolition and Reconstruction
01660 Equipment Testing and Plant Startup
01700 Project Closeout

Division 02 Sitework
02100 Site Preparation
02140 Dewatering
02160 Excavation Support Systems
02164 Earth Anchors
02200 Earthwork
02268 Erosion Control Barrier
02270 Erosion Control (Vegetative)
02271 Gabions
02340 Boring and Jacking
02345 Microtunneling
02347 Horizontal Directional Drilling
02361 Structural Steel Piles
02362 Precast Concrete Piles
02363 Cast-in-Place Concrete Piles
02390 Sheet Piles
02460 A.C. Pavement and Base

02460 Roadways, Parking Areas, and Sidewalks
02460 A.C. Pavement and Base
02460 A.C. Pavement and Base
02460 A.C. Pavement and Base
02464 Portland Cement Concrete Pavement and Base
02465 Bituminous Surface Treatment
02480 Pavement Rehabilitation
02490 Precast Concrete Manholes and Vaults
02545 Vitrified Clay Pipe
02565 Ductile Iron Pipe
02574 Steel Yard Piping
02597 Poly Vinyl Chloride Pressure Pipe, Rubber Joints
02598 Large Poly Vinyl Chloride Pressure Pipe, Rubber Joints
02622 Sanitary and Storm Drainage System Testing

Division 03 Concrete
03100 Concrete Formwork
03200 Reinforcement Steel
03290 Joints in Concrete
03300 Cast-in-Place Concrete
03310 Cast-in-Place Concrete
03315 Grout
03400 Structural Precast Concrete
03430 Architectural Precast Concrete
03700 Concrete Restoration and Cleaning

Division 04 Masonry
04232 Reinforced Concrete Block Masonry

Division 05 Metals
05100 Structural Steel Framing
05120 Structural Steel
05140 Structural Aluminum
05300 Metal Decking
05400 Cold Formed (Light) Metal Framing
05500 Miscellaneous Metalwork
05521 Aluminum Railings

Division 06 Wood and Plastics- NOT USED

Division 07 Thermal and Moisture Protection
07100 Waterproofing
07101 Moisture Protection
07150 Dampproofing
07545S Single Ply (Thermoplastic) Membrane Roofing
07600 Flashing and Sheet Metal
07720 Roof Accessories
07800 Skylights
07920 Sealants and Caulking

Division 08 Doors and Windows
08110 Steel Doors and Frames
08120 Aluminum Doors and Frames
08330 Overhead Coiling Doors
08710 Finish Hardware
08800 Glazing

Division 09 Finishes
09310 Ceramic Tile
09800 Protective Coating
09820 Cementitious Coatings
09900 Architectural Paint Finishes

Division 10 Specialties
10200 Louvers and Vents
10800 Toilet and Bath Accessories
10850 Miscellaneous Architectural Accessories

Division 11 Equipment
11000 Equipment General Provisions
11030 Mechanical Variable Speed Drives
11100 Pumps, General
11107 Vertical Split Case Pumps
11173 Chemical Pumps, Metal Body
11174 Chemical Pumps, Plastic Body
11258 Chemical Feeding Equipment, General
11259 Metering Pumps
11262 Rotary Volumetric Liquid Feeders
11268 Calibration Columns
11281 Chlorination Equipment
11332 Mechanically-Raked Bar Screens
11510 Compressors, Base-Mounted, Reciprocating

Division 12 Furnishings
12625 Office Furniture
12670 Rugs and Mats

Division 13 Special Construction
13260S Chlorine Vapor Removal Systems

Division 14 Conveying Systems
14520 Drum Handling Equipment
14600 Hoists and Cranes, General
14605 Electric Monorail Systems
14606 Manual Monorail Systems
14610 Fixed Hoists
14611 Jib Cranes
14620 Trolley Hoists
14630 Bridge Cranes
14632 Bridge Cranes, Double Beam, Underhung

14635 Bridge Cranes, Double Beam, Top Running

Division 15 Mechanical
15000 Piping, General
15006 Pipe Supports M 10/01/2000
15025 Steel Pipe
15060 Poly Vinyl Chloride Pressure Pipe, Solvent-Welded
15065 Chlorinated Poly Vinyl Chloride Pressure Pipe, Solvent Welded
15075 Meters, General
15089 Ultrasonic Flow Meters (Field-Mounted)
15095 Averaging Pitot Tubes
15183 Gauges
15200 Valves, General
15201 Valve and Gate Actuators
15202 Butterfly Valves
15203 Check Valves
15204 Ball Valves
15206 Gate Valves
15210 Pinch Valves
15252 Flap Gates
15254 Slide/Stop Gates
15430 Plumbing Piping and Specialties
15440 Plumbing Fixtures
15450 Plumbing Equipment
15570 Fans, Blowers, and Ventilators

Division 16 Electrical
16050 Electrical Work, General
16110 Electrical Raceway Systems
16111 Underground Raceway Systems
16120 Wires and Cables
16140 Wiring Devices
16450 Grounding
16455 Variable Frequency Drive Units
16460 Electric Motors
16480 Low Voltage Motor Control Center
16485 Local Control Stations and Miscellaneous Electrical Devices
16500 Lighting
16611 Uninterruptible Power System, Single Phase
16620 Standby Generator System

Division 17 Instrumentation
17000 Prequalification for Process Control and Instrumentation Systems
17100 Process Control and Instrumentation Systems
17102 In-Line Liquid Flow Measuring Devices
17108 Pressure Measuring Systems
17109 Pressure Detection Switches
17200 Control Panels
17201 Control Panel Instrumentation
17300 Control Strategies

17400 DCS Prequalifications
17410 Distributed Control Systems
17510 PLC-Based Control Systems Hardware
17520 PLC-Based Control Systems Software
17700 Graphic Presentation Systems, General
17710 Graphic Presentation Systems Hardware
17720 Graphic Presentation Systems Software

Table 3
Preliminary List of Drawings
Basis of Design Report, WTP Projects

No.	List	Discipline	Drawing Name
1	G-1	General	Cover Sheet
2	G-2	General	List of Drawings
3	G-3	General	Legend, Abbreviations, General Notes
4	G-4	General	Legend, Abbreviations, General Notes
5	G-5	General	Undefined
6	G-6	General	Undefined
7	C-1	Civil	Standard Civil Details
8	C-2	Civil	Standard Civil Details
9	C-3	Civil	Site Piping- Siouf
10	C-4	Civil	Site Piping- Rond Point
11	C-5	Civil	Site Piping- Manshia
12	C-6	Civil	Site Piping- Nozha
13	C-7	Civil	Site Piping- Maamoura
14	C-8	Civil	Site Piping- Borg El Arab
15	C-9	Civil	Site Piping- Noubaria
16	C-10	Civil	Piping Details
17	C-11	Civil	Sewer-Plan/Profile-Siouf
18	C-12	Civil	Sewer-Plan/Profile-Siouf
19	C-13	Civil	Manholes, Details
20	C-14	Civil	Undefined
21	C-15	Civil	Undefined
22	A-1	Architectural	Standard Architectural Details, General Notes
23	A-2	Architectural	Standard Architectural Details
24	A-3	Architectural	Floor Plan- Chlorine Bulk Storage- Borg El Arab
25	A-4	Architectural	Elevations- Chlorine Bulk Storage- Borg El Arab
26	A-5	Architectural	Sections, Details- Chlorine Bulk Storage- Borg El Arab
27	A-6	Architectural	Floor Plan- Chlorine Storage- Siouf
28	A-7	Architectural	Sections, Details- Chlorine Storage- Siouf
29	A-8	Architectural	Floor Plan- Chlorine Storage- Rond Point
30	A-9	Architectural	Sections, Details- Chlorine Storage- Rond Point
31	A-10	Architectural	Floor Plan- Chlorine Storage- Manshia
32	A-11	Architectural	Sections, Details- Chlorine Storage- Manshia
33	A-12	Architectural	Floor Plan- Chlorine Storage- Nozha
34	A-13	Architectural	Sections, Details- Chlorine Storage- Nozha
35	A-14	Architectural	Floor Plan- Chlorine Storage- Maamoura
36	A-15	Architectural	Sections, Details- Chlorine Storage- Maamoura
37	A-16	Architectural	Floor Plan- Chlorine Storage- Borg El Arab
38	A-17	Architectural	Sections, Details- Chlorine Storage- Borg El Arab
39	A-18	Architectural	Floor Plan- Chlorine Storage- Borg El Arab
40	A-19	Architectural	Sections, Details- Chlorine Storage- Borg El Arab
41	S-1	Structural	Standard Structural Details, General Notes
42	S-2	Structural	Standard Structural Details
43	S-3	Structural	Central Chlorine Building- Siouf
44	S-4	Structural	Sections, Details- Siouf
45	S-5	Structural	Central Chlorine Building- Rond Point
46	S-6	Structural	Sections, Details- Rond Point
47	S-7	Structural	Central Chlorine Building- Manshia
48	S-8	Structural	Sections, Details- Manshia

49	S-9	Structural	Central Chlorine Building- Nozha
50	S-10	Structural	Sections, Details- Nozha
51	S-11	Structural	Central Chlorine Building- Maamoura
52	S-12	Structural	Sections, Details- Maamoura
53	S-13	Structural	Central Chlorine Building- Borg El Arab
54	S-14	Structural	Sections, Details- Borg El Arab
55	S-15	Structural	Central Chlorine Building- Noubaria
56	S-16	Structural	Sections, Details- Noubaria
57	S-17	Structural	Bulk Chlorine Storage Facilities- Borg El Arab
58	S-18	Structural	Bulk Chlorine Storage- Sections, Details- Borg El Arab
59	S-19	Structural	Bulk Chlorine Storage- Sections, Details- Borg El Arab
60	S-20	Structural	Sludge Storage Tank- Siouf
61	S-21	Structural	Sections, Details- Siouf
62	S-22	Structural	Sludge Storage Tank- Rond Point
63	S-23	Structural	Sections, Details- Rond Point
64	S-24	Structural	Sludge Storage Tank- Nozha
65	S-25	Structural	Sections, Details- Nozha
66	S-26	Structural	Sections, Details- Nozha
67	S-27	Structural	Intake Structure- Manshia
68	S-28	Structural	Intake Structure- Manshia
69	S-29	Structural	Intake- Sections Details- Manshia
70	S-30	Structural	Intake Structure- Nozha
71	S-31	Structural	Intake- Sections Details- Nozha
72	S-32	Structural	Intake- Sections Details- Nozha
73	S-33	Structural	Intake Structure- Borg El Arab
74	S-34	Structural	Intake- Sections Details- Borg El Arab
75	S-35	Structural	Intake Structure- Noubaria
76	S-36	Structural	Intake- Sections Details- Noubaria
77	S-37	Structural	Mahmoudia Canal Outlet Structure
78	S-38	Structural	Mahmoudia Canal Outlet Structure- Details
79	S-39	Structural	Meter Vaults, Misc. Structures
80	S-40	Structural	Meter Vaults, Misc. Structures
81	S-41	Structural	Undefined
82	S-42	Structural	Undefined
83	M-1	Mechanical	Standard Mechanical Details
84	M-2	Mechanical	Standard Mechanical Details
85	M-3	Mechanical	Piping Details
86	M-4	Mechanical	Chlorination System- Siouf
87	M-5	Mechanical	Chlorination System- Rond Point
88	M-6	Mechanical	Chlorination System- Manshia
89	M-7	Mechanical	Chlorination System- Nozha
90	M-8	Mechanical	Chlorination System- Maamoura
91	M-9	Mechanical	Chlorination System- Borg El Arab
92	M-10	Mechanical	Chlorination System- Noubaria
93	M-11	Mechanical	Chlorination System Details
94	M-12	Mechanical	Chlorination System Details
95	M-13	Mechanical	Screens, Materials Handling- Manshia
96	M-14	Mechanical	Details-Screens, Materials Handling- Manshia
97	M-15	Mechanical	Screens, Materials Handling- Nozha
98	M-16	Mechanical	Details-Screens, Materials Handling- Nozha
99	M-17	Mechanical	Screens, Materials Handling- Borg El Arab
100	M-18	Mechanical	Details-Screens, Materials Handling- Borg El Arab
101	M-19	Mechanical	Screens, Materials Handling- Noubaria
102	M-20	Mechanical	Details-Screens, Materials Handling- Noubaria
103	M-21	Mechanical	Chemical Feed, Mixing- Siouf

104	M-22	Mechanical	Details- Chemical Feed, Mixing- Siouf
105	M-23	Mechanical	Chemical Feed, Mixing, Flow Measurement- Rond Point
106	M-24	Mechanical	Details- Chemical Feed, Mixing- Rond Point
107	M-25	Mechanical	Chemical Feed, Mixing, Flow Measurement- Manshia
108	M-26	Mechanical	Details- Chemical Feed, Mixing- Manshia
109	M-27	Mechanical	Chemical Feed, Mixing, Flow Measurement- Nozha
110	M-28	Mechanical	Details- Chemical Feed, Mixing- Nozha
111	M-29	Mechanical	Chemical Feed, Mixing, Flow Measurement- Maamoura
112	M-30	Mechanical	Details- Chemical Feed, Mixing- Maamoura
113	M-31	Mechanical	Chemical Feed, Mixing, Flow Measurement- Borg El Arab
114	M-32	Mechanical	Details- Chemical Feed, Mixing- Borg El Arab
115	M-33	Mechanical	Chemical Feed, Mixing, Flow Measurement- Noubaria
116	M-34	Mechanical	Details- Chemical Feed, Mixing- Noubaria
117	M-35	Mechanical	Mahmoudia Canal- Gates
118	M-36	Mechanical	Details- Mahmoudia Canal- Gates
119	M-37	Mechanical	Sludge Handling Facilities- Siouf
120	M-38	Mechanical	Sludge Handling Facilities- Rond Point
121	M-39	Mechanical	Sludge Handling Facilities- Nozha
122	M-40	Mechanical	Standby Power Support Facilities- Siouf
123	M-41	Mechanical	Standby Power Support Facilities- Noubaria
124	M-42	Mechanical	Standby Power Support Facilities- Mahmoudia Pump Station
125	M-43	Mechanical	Undefined
126	M-44	Mechanical	Undefined
127	E-1	Electrical	Standard Electrical Details
128	E-2	Electrical	Standard Electrical Details
129	E-3	Electrical	Electrical- Chlorination System- Siouf
130	E-4	Electrical	Electrical- Chlorination System- Rond Point
131	E-5	Electrical	Electrical- Chlorination System- Manshia
132	E-6	Electrical	Electrical- Chlorination System- Nozha
133	E-7	Electrical	Electrical- Chlorination System- Maamoura
134	E-8	Electrical	Electrical- Chlorination System- Borg El Arab
135	E-9	Electrical	Electrical- Chlorination System- Noubaria
136	E-10	Electrical	Electrical- Chlorination System Details
137	E-11	Electrical	Electrical- Sludge Handling Facilities- Siouf
138	E-12	Electrical	Electrical- Sludge Handling Facilities- Siouf
139	E-13	Electrical	Electrical- Sludge Handling Facilities- Rond Point
140	E-14	Electrical	Electrical- Sludge Handling Facilities- Rond Point
141	E-15	Electrical	Electrical- Sludge Handling Facilities- Nozha
142	E-16	Electrical	Electrical- Sludge Handling Facilities- Nozha
143	E-17	Electrical	Electrical- Standby Power Support Facilities- Siouf
144	E-18	Electrical	Electrical- Standby Power Support Facilities- Siouf
145	E-19	Electrical	Electrical- Standby Power Support Facilities- Noubaria
146	E-20	Electrical	Electrical- Standby Power Support Facilities- Noubaria
147	E-21	Electrical	Electrical- Standby Power Support Facilities- Noubaria
148	E-22	Electrical	Electrical- Standby Power Support Facilities- Mahmoudia Pump Station
149	E-23	Electrical	Electrical- Standby Power Support Facilities- Mahmoudia Pump Station
150	E-24	Electrical	Electrical- Standby Power Support Facilities- Mahmoudia Pump Station
151	E-25	Electrical	Electrical- Intake Screens, Materials Handling- Manshia
152	E-26	Electrical	Electrical- Intake Screens, Materials Handling- Manshia
153	E-27	Electrical	Electrical- Intake Screens, Materials Handling- Nozha
154	E-28	Electrical	Electrical- Intake Screens, Materials Handling- Nozha
155	E-29	Electrical	Electrical- Intake Screens, Materials Handling- Borg El Arab

156	E-30	Electrical	Electrical- Intake Screens, Materials Handling- Borg El Arab
157	E-31	Electrical	Electrical- Intake Screens, Materials Handling- Noubaria
158	E-32	Electrical	Electrical- Intake Screens, Materials Handling- Noubaria
159	E-33	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Siouf
160	E-34	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Rond Point
161	E-35	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Manshia
162	E-36	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Nozha
163	E-37	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Maamoura
164	E-38	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Borg El Arab
165	E-39	Electrical	Electrical- Chemical Feed, Mixing, Flow Measurement- Noubaria
166	E-40	Electrical	Electrical- Chlorine Residual, Turbidity- Siouf
167	E-41	Electrical	Electrical- Chlorine Residual, Turbidity- Rond Point
168	E-42	Electrical	Electrical- Chlorine Residual, Turbidity- Manshia
169	E-43	Electrical	Electrical- Chlorine Residual, Turbidity- Nozha
170	E-44	Electrical	Electrical- Chlorine Residual, Turbidity- Maamoura
171	E-45	Electrical	Electrical- Chlorine Residual, Turbidity- Borg El Arab
172	E-46	Electrical	Electrical- Chlorine Residual, Turbidity- Noubaria
173	E-47	Electrical	Undefined
174	E-48	Electrical	Undefined
175	E-49	Electrical	Undefined
176	IC-1	I&C	Standard I&C Details
177	IC-2	I&C	Standard I&C Details
178	IC-3	I&C	P&ID- Siouf
179	IC-4	I&C	P&ID- Rond Point
180	IC-5	I&C	P&ID- Manshia
181	IC-6	I&C	P&ID- Nozha
182	IC-7	I&C	P&ID- Maamoura
183	IC-8	I&C	P&ID- Borg El Arab
184	IC-9	I&C	P&ID- Noubaria
185	IC-10	I&C	Central Computer Control- Siouf
186	IC-11	I&C	Central Computer Control- Rond Point
187	IC-12	I&C	Central Computer Control- Manshia
188	IC-13	I&C	Undefined
189	IC-14	I&C	Undefined

Table 4
Preliminary Bill of Quantities
Basis of Design Report, WTP Projects

Description of Project	Units	Siouf	Rond Point	Manshia	Nozha	Maamoura	Borg El Arab	Noubaria
WTP Rated Capacity	m^3/d	980,000	610,000	380,000	240,000	180,000	326,000	272,000
Average Capacity	m^3/d	735,000	458,000	285,000	180,000	135,000	245,000	204,000
		Qty.	Qty.	Qty.	Qty.	Qty.	Qty.	Qty.
WTG-7: Chlorine Related Projects								
WTP Chlorine Systems								
Site Work	sq. m.	510	365	325	72	270	300	432
Concrete	sq. m.	510	365	325		270		432
Allowance for Piles	sq. m.	510	365	325		270		432
Masonry	sq. m.	510	365	325		270		432
Thermal & Moistyre Protection	sq. m.	510	365	325		270		432
Doors & Windows	L.S.	1	1	1	1	1	1	
Finishes	sq. m.	510	365	325	72	270	300	432
Chlorination System	L.S.	1	1	1	1	1	1	1
Instrumentation	L.S.	1	1	1	1	1	1	1
Monorail & Hoist	L.S.	1	1	1	1	1	1	1
Mechanical	sq. m.	510	365	1	72	270	300	432
Electrical	sq. m.	510	365	325	72	270	300	432
Chlorine Solution Piping- 2 inch	L. m.	2,500	1,500	3,300	700	1,100	600	900
Chlorine Solution Piping- 4 inch	L. m.	1,000	600	-	-	-	350	-
Central Bulk Chlorine Storage Building								
Site Work	sq. m.						1,580	
Concrete	sq. m.						1,580	
Allowance for Piles	sq. m.						1,580	
Masonry	sq. m.						1,580	
Thermal & Moistyre Protection	sq. m.						1,580	
Doors & Windows	L.S.						1	
Finishes	sq. m.						1,580	
Chlorination System								
Instrumentation	L.S.						1	
Monorail & Hoist	L.S.						1	
Mechanical	sq. m.						1,580	
Electrical	sq. m.						1,580	
WTG-2,4: Chemical Mixing, Dosing, & Flow Measurement								
Alum Chemical Mixing Systems								
Concrete	cu. M.	36	12	-	12	24	12	12
Weir Gate	each	12	4	-	4	8	4	4
Trough includes Injector	each	12	4	-	4	8	4	4
Plant Water Pipe	L.m.	450	150	-	150	300	150	150
Alum Feed Facilities								
New Alum Feed Pumps	each	3	8	4	-	3	3	1
Alum Feed Control Panels	each	6	5	3	1	2	2	2
Raw Water Flow Meters- new								
800mm	No.	1	-	2	-	-	-	-
Wire & conduit	L.m.	440	-	440	-	-	-	-
1000mm	No.	4	-	4	-	-	-	3
Wire & conduit	L.m.	1,240	-	2,000	-	-	-	1,560
1200mm	No.	-	-	-	-	-	1	-
Wire & conduit	L.m.	-	-	-	-	-	650	-
1400 mm	No.	1	-	-	-	-	-	-
Wire & conduit	L.m.	3,800	-	-	-	-	-	-
1500mm	No.	2	-	-	1	2	2	1
Wire & conduit	L.m.	1,040	-	-	400	880	1,500	780
Raw Water Flow Meters- existing								
	No.		-	-	2	-	-	-
WT5-1: Nozha WTP Rehabilitation/Startup								
Piping Connection at Manshia WTP	LS				1			
1000mm Pipeline	L.m.				20			
1000mm Butterfly Valves	each				1			
700mm Butterfly Valves	each				4			
Nozha Site Investigation/Hydraulic Testing/Rehab Recommendations	per-mo.				12			
O&M Services	per-mo.				10			
WTG-3: Filter Control System Upgrades								
Number of Operational Filters		44	31	43	10	16	24	14
Filter Control Equipment Replacement								
200mm Valves	each	-	-	24	-	-	-	-
250mm Valves	each	-	-	48	-	-	-	-
300mm Valves	each	-	-	24	-	-	-	-
400mm Valves	each	24	-	24	-	-	-	-
600mm Valves	each	24	-	-	-	-	-	-
Pneumatic Actuators	each	48	-	120	-	-	-	-
Flow Meters (pitot)	each	8	31	43	-	-	-	-
Filter Level Control Transmitter (bubble type)	each	8	31	43	-	-	-	-
Instrument Air Skid	each	8	5	5	-	-	-	-
Filter Control Desks (one per filter)	each	8	-	24	-	-	-	-
Spare Parts								
Valve Seats, gaskets	each	26	19	26	6	10	14	8
Flowmeters	each	4	3	4	1	1	2	1
Level Control	each	4	3	4	1	1	2	1
Valves, misc. sizes	each	2	1	2	-	-	1	-
Pneumatic Actuators	each	2	1	2	-	-	1	-
Filter Control Desk Complete	each	2	3	4	5	6	8	9
Pushbuttons, lights, guages, windows, etc. for filter control panels	each	4	3	4	1	2	2	1

Table 4
Preliminary Bill of Quantities
Basis of Design Report, WTP Projects

Description of Project	Units	Siouf	Rond Point	Manshia	Nozha	Maamoura	Borg El Arab	Noubaria
WTP Rated Capacity	m^3/d	980,000	610,000	380,000	240,000	180,000	326,000	272,000
Average Capacity	m^3/d	735,000	458,000	285,000	180,000	135,000	245,000	204,000
		Qty.	Qty.	Qty.	Qty.	Qty.	Qty.	Qty.
WTG-9: On-Line Turbidity and Chlorine Residual Analyzers								
WTP Criteria								
Number of Operational Filter Units	each	4	3	3	1	2	2	3
Number of Filter Batteries	each	8	7	5	2	2	4	6
Number of Treated Water Pump Stations	each	4	5	4	1	2	2	2
On-Line Turbidimeters (New)								
On Line Turbidimeters (1/filter battery)	each	8	7	5	2	2	4	6
Turbidimeter Interface Control Unit (1/bldg.)	each	4	3	3	1	2	2	3
Sample Pumps (one/analyzer)	each	8	7	5	2	2	4	6
Spares- Tyrbidimeters	each	2	2	2	1	1	1	1
Wire and Conduits (power to analyzers)	L.m.	200	320	200	40	80	240	60
On Line Chlorine Residual Analyzers (New)								
No. of Chlorine Residual Analyzers (1 per treated water PS)	each	4	5	4	1	2	2	2
Sample Pumps (1 per discharge pipe)	each	8	10	8	2	4	4	4
Spares- Chlorine Analyzers	each	2	2	2	1	1	1	1
Wire and Conduits (power to analyzers)	each	100	100	100	20	20	80	40
1-Year Service Contract								
Service Contract for Turbidimeters, Chlorinators and Chlorine Analyzers	each	1	1	1	1	1	1	1
WTG-14: Computerized Process Monitoiring and Control								
Central Process Control Room - under separate AWGA funded project								
Local Process Unit (LPU) Housing								
Alum. Separation (2 sides) 3x5 m	LS	1	1	1				
Interior plaster, painting walls & ceiling (2 sides)	sq.m.	30	30	30				
Ceramic Floor Tile	sq.m.	15	15	15				
Carpet	sq.m.	15	15	15				
Split A/C	each	1	1	1				
Electrical Work	LS	1	1	1				
Sub-Total (per location)								
Number of Locations								
Sub-total								
Field Mounted Sensors								
Pressure Element Transmitters	each	9	11	6				
Level Element Transmitters	each	11	8	4				
Central Processing Unit (CPU)								
PLC, Cabinet, work Station	LS	1	1	1				
Local Process Unit (LPU)								
PLC, Cabinet, Operator Touchpad interface display, I/O rack	LS	1	1	1				
Number of Locations								
Sub-total								
Data Highway (coaxial cable and ductbank between LPU and CPU)								
Data Highway	L.m.	4,500	2,800	2,100				
WTG-10: Raw Water Intake and Canal Outlet Structure Upgrades And Sanitary Survey Mahmoudia Canal								
Intake Structure								
Remove Existing Structures/Earthwork/Sitework	LS			1	1		1	1
Piles	LS			1	1			
New Concrete	LS			1	1			1
Retrofit Existing Concrete	LS						1	1
Screening Equipment	LS			1	1		1	1
Gates/Stop Logs	LS			1	1		1	1
Piping	LS			1				1
Electrical/Controls	LS			1	1		1	1
Sub-Total								
Outlet Structure (Mahoudia Canal)								
Piles	LS							
New Concrete	LS							
Retrofit Existing Concrete	LS							
Screening Equipment	LS							
Gates/Stop Logs	LS							
Piping	LS							
Electrical/Controls	LS							
Sub-Total								
WTG-5: Emergency Standby Generators								
Generators								
3.3 KV, 1,200 KW Fixed Generator	LS			1				
Synchronizer w/ panel, verta trick switch, and all terminal connections	LS	1						
380 KV; 1,200 KW Fixed Generator (Mahmoudia PS)	LS							
WTG-8: Process Residuals Handling System for Mahmoudia Canal WTPs								
Sludge Equalization Tank								
Excavation	LS	1	1		1			
Piles	LS	1	1		1			
Backfill	LS	1	1		1			
Plain Concrete	LS	1	1		1			
Concrete Base Slab	LS	1	1		1			

Table 4
Preliminary Bill of Quantities
Basis of Design Report, WTP Projects

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WTP Rated Capacity	m^3/d	980,000	610,000	380,000	240,000	180,000	326,000	272,000
Average Capacity	m^3/d	735,000	458,000	285,000	180,000	135,000	245,000	204,000
		Qty.	Qty.	Qty.	Qty.	Qty.	Qty.	Qty.
Concrete Walls	LS	1	1		1			
Sludge Pumping Station (to AGOSD System)								
Enclosure/Base Slab	LS	1	1		1			
Pumps	LS	1	1		1			
Piping/Valves	LS	1	1		1			
Electrical/Controls	LS	1	1		1			
WT1-2: Diversion of Sanitary Waste at Siouf WTP								
Sanitary Sewer								
8 inch PVC Sewer Pipe	L.m.	1,500						
Reinforced Concrete Manholes	each	16						
Manhole (w/two submersible pumps @ 5 l/s)	each	2						
Connections	LS	1						

APPENDIX A
Water Quality Standards

Egyptian Standards
WHO Guidelines

APPENDIX A- Water Quality Standards

Water Quality Parameter	Egyptian Standards	WHO Guidelines
Bacteriological Constituents		
cyptosporidium	*NR*	*NR*
e. coli (thermotolerant coliform)	*NR*	free
fecal coliform	free	*NR*
fecal floating bacteria	free	*NR*
giardia lamblia	*NR*	*NR*
legionella	*NR*	*NR*
total coliform bacteria	3 cells/100 ml	free
total bacteria	< 50 cells/ml in 24 hrs at 37 oC < 50 cells/ml in 48 hrs at 22 oC	*NR*
turbidity	5 JTU for filtered water 10 JTU for groundwater	5 NTU
viruses	*NR*	*NR*
Inorganic Constituents (mg/l)		
aluminum	0.2	*NR*
antimony	*NR*	0.005 *(PG)*
arsenic	0.05	0.01 *(PG)*
asbestos (fibers > 0.01 mm)	*NR*	*NR*
barium	*NR*	0.7
beryllium	*NR*	*NR*
boron	*NR*	0.3
bromate	----- *see disinfection byproducts* -----	
cadmium	0.005	0.003
calcium	200	*NR*
chromium	0.05	0.05 *(PG)*
copper	1	2 *(PG)*
cyanide	0.05	0.07
fluoride	0.8	1.5
lead	0.05	0.01
mercury (total)	0.001	0.001
molybdenum	*NR*	0.07
nickel	*NR*	0.02
nitrate	10 as N	50 as NO3
nitrite	0.005 as N	3 as NO2 *(PG)*
nitrate + nitrite	*NR*	(nitrate/50 + nitrite/3) < 1
selenium	0.01	0.01
silver	*NR*	*NR*
sulfate	400	250
tin	*NR*	*NR*
thallium	*0.01*	*0.01*
zinc	5	3

APPENDIX A (continued)

Water Quality Parameter	Egyptian Standards	WHO Guidelines
Organic Constituents (ug/L)		
Chlorinated alkanes		
carbon tetrachloride	2	2
dichloromethane	20	20
1,1 - dichloroethane	*NR*	*NR*
1,2 - dichloroethane	30	30
1,1,1 - trichloroethane	200	2000 *(PG)*
1,1,2 - trichloroethane	*NR*	*NR*
Chlorinated ethylenes		
vinyl chloride	5	5
1,1 - dichloroethylene	30	30
1,2 - dichloroethylene	50	50
trichloroethylene	70	70 *(PG)*
tetrachloroethylene	40	40
Aromatic hydrocarbons		
benzene	10	10
toluene	100	700
xylenes	*NR*	500
ethybenzene	*NR*	300
styrene	*NR*	20
benzo(a)pyrene	0.7	0.7
Chlorinated benzene		
monochlorobenzene	300	300
1,2 - dichlorobenzene	1000	1000
1,3 - dichlorobenzene	*NR*	*NR*
1,4 - dichlorobenzene	300	300
trichlorobenzenes (total)	20	20
Miscellaneous		
acrylamide	0.5	0.5
dialkyltins	*NR*	*NR*
di (2-ethylhexyl) adipate	80	80
di(2-ethylhexyl) phthalate	8	8
edenic acid (EDTA)	200	200 *(PG)*
epichlorohydrin	0.4	0.4 *(PG)*
glyphosphate	*NR*	*NR*
hexachlorobutadiene	0.6	0.6
hexachlorocyclopentadiene	*NR*	*NR*
oxamyl (vdate)	*NR*	*NR*
nitrilotriacetic acid	200	200
picloram	*NR*	*NR*
tributyltin oxide	*NR*	2

APPENDIX A (continued)

Water Quality Parameter	Egyptian Standards	WHO Guidelines
Pesticides & PCBs (ug/L)		
alachlor	20	20
aldicarb	10	10
aldicarb sulfone	*NR*	*NR*
aldicarb sulfoxide	*NR*	*NR*
aldrin/dieldrin	0.03	0.03
atrazine	2	2
bentazone	30	30
carbofuran	5	5
chlordane	0.2	0.2
chlorotoluron	30	30
dalapon	*NR*	*NR*
DDT	2	2
1,2-dibromo-3-chloropropane	1	1
2,4-D	30	30
1,2 - dichloropropane	20	20 *(PG)*
1,3 - dichloropropane	20	*NR*
1,3 - dichloropropene	*NR*	20
dinoseb	*NR*	*NR*
diquat	*NR*	*NR*
endothal	*NR*	*NR*
endrin	*NR*	*NR*
ethylene dibromide (EDB)	*NR*	*NR*
heptachlor	*NR*	0.03
heptachlor epoxide	*NR*	0.03
hexachlorobenzene	1	1
isoproturon	9	9
lindane	2	2
MCPA	2	2
methoxychlor	20	20
metolachlor	10	10
molinate	6	6
pendimethalin	20	20
pentachlorophenol	9	9 *(PG)*
permethrin	20	20
PCBs (as decachlorobiphenyl)	*NR*	*NR*
propanil	20	20
pyridate	*NR*	100
simazine	2	2
toxaphene	*NR*	*NR*
2,3,7,8-TCDD (dioxin)	*NR*	*NR*
2,4,5-TP (silvex)	*NR*	*NR*
trifluralin	20	20
chlorophenoxy herbicides other than 2,4-D and MCPA		
2,4-DB	90	90
dichloroprop	100	100
fenoprop	9	9

APPENDIX A (continued)

Water Quality Parameter	Egyptian Standards	WHO Guidelines
MCPB	*NR*	*NR*
mecoprop	10	10
2,4,5-T	9	9
Disinfectants (mg/L)		
monochloramine	3	3
di-and trichloramine	5	*NR*
chlorine	*NR*	5
chlorine dioxide	*NR*	*NR*
chlorate	*NR*	*NR*
chlorite	200	200 *(PG)*
iodine	*NR*	*NR*
Disinfectants Byproducts (ug/L)		
bromate	25	25 *(PG)*
chlorophenols	*NR*	*NR*
2 - chlorophenol	*NR*	*NR*
2,4 - dichlorophenol	*NR*	*NR*
2,4,6 - trichlrophenol	200	200
formaldehyde	*NR*	900
MX	*NR*	*NR*
trihalomethanes (1)	100	*see individual limits*
bromoform	*regulated as sum total*	100
dibromochloromethane	*regulated as sum total*	100
bromodichloromethane	*regulated as sum total*	60
chloroform	*regulated as sum total*	200
halogenated acetic acids	*see individual limits*	*see individual limits*
monochloroacetic acid	*NR*	*NR*
dichloroacetic acid	50	50 *(PG)*
trichloroacetic acid	100	100 *(PG)*
chloral hydrate	10	10 *(PG)*
chloroacetone	*NR*	*NR*
halogenated acetonitriles	*see individual limits*	*see individual limits*
dichloroacetonitrile	90	90 *(PG)*
dibromoacetonitrile	100	100 *(PG)*
bromochloroacetonitrile	*NR*	*NR*
trichloroacetonitrile	1	1 *(PG)*
cyanogen chloride (as CN)	70	70
chloropicrin	*NR*	*NR*
Radioactive Constituents		
gross alpha activity	0.1 Micro Curie/Litre	0.1 Bq/L
gross beta activity	1 Micro Curie/Litre	1 Bq/L
radium-226 + radium-228	*NR*	*NR*
radium-226	*NR*	*NR*
radium-228	*NR*	*NR*
radon	*NR*	*NR*
uranium	*NR*	*NR*

APPENDIX A (continued)

Water Quality Parameter	Egyptian Standards	WHO Guidelines
Aesthetic Standards		
color	<20-30 (Cobalt Platinum Scale)	15 TCU
taste and odor	acceptable	acceptable
temperature	*NR*	acceptable
pH	6.5-9.2	*NR*
Other Aesthetics (mg/l)		
aluminum	0.2	0.2
ammonia	*NR*	1.5
chloride	500	250
hardness	500	*NR*
hydrogen sulfide	*NR*	0.05
iron	0.3 for filtered water	0.3
	1 for underground water	-
manganese	0.1 for filtered water	0.5 *(PG)*
	0.5 for groundwater	-
dissolved oxygen	*NR*	*NR*
sodium	200	200
sulfate	---------- *see inorganics above* ----------	
total dissolved solids	1200	1000
zinc	---------- *see inorganics above* ----------	

Note: *NR* means not currently regulated or no recommended value. *(PG)* means provisional guideline value. TT means that a treatment technique is mandated in lieu of a parameter concentration limit (the value in parenthesis is a treatment goal). *(P)* means proposed for regulation. *(N)* means new regulation. *(O)* means old regulation.