

FOR TENDER

# **Pemba Provincial Hospital**

Pemba, Cabo Delgado, Mozambique

## **Medical Gas Concept Design**

A summary of the existing and proposed medical gas and vacuum installation of the Pemba Provincial Hospital, Cabo Delgado Province, Mozambique as conceived in the Medical Gas Scoping Report dated 26 December 2025. The document includes a concept design that will ultimately serve as the output specification for a design and supply contract to upgrade the MGPS.

**04 January 2026**



The report is prepared by Saftek Consulting



for the Ministry of Health



República de Moçambique  
Ministério da Saúde

as requested by CHAI



with funding from the Global Fund



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## ABBREVIATIONS

Abbreviations Used in the Report	
<b>ACLS</b>	Advanced Cardiac Life Support
<b>ASU</b>	Air Separation Unit
<b>ATLS</b>	Advanced Trauma Life Support
<b>AVSU</b>	Area Valve Service Unit
<b>DSTC</b>	Definitive Surgical Trauma Care
<b>HINO</b>	High Flow Nasal Oxygen units
<b>ICU</b>	Intensive Care Unit ( <i>Cuidados Intensivos</i> )
<b>LOX</b>	Liquid Oxygen
<b>MA</b>	Medical Air ( <i>Ar Medico</i> )
<b>MGPS</b>	Medical Gas Pipeline System
<b>N<sub>2</sub>O</b>	Nitrous Oxide
<b>O<sub>2</sub></b>	Oxygen
<b>PSA</b>	Pressure Swing Adsorption
<b>TBSA</b>	Total Body Surface Area
<b>TU</b>	Terminal Unit
<b>VAC</b>	Vacuum
<b>VIE</b>	Vacuum Insulated Evaporators

## VERSION CONTROL

Version	Date	Description
Draft 1	28 December 2025	Draft for Internal Review
Draft 2	29 December 2025	Draft for CHAI Review
For Tender	04 January 2026	Final Report for Tendering

## DISTRIBUTION LIST

Type	Distribution List
Electronic Report	Mr. Chishamiso Mudenyanga
Electronic Report	Published for Tender



## 1 DOCUMENT OVERVIEW

This concept design report for Pemba Provincial Hospital in Mozambique provides the basis of design for the upgrading of hospital's medical air, oxygen, nitrous oxide and vacuum installations.

The concept design is based on the recommendations made in the Pemba Provincial Hospital Scoping Report as well as feedback from the Mozambican Ministry of Health (MISAU) and the Implementation Agent, Clinton Health Access Initiative (CHAI).

This document will form the basis of consensus between the Primary Recipient (MISAU) and the Funder (The Global Fund) for the above-mentioned scope of work. It will also serve as the output specification for the installation that will be executed as a Design, Supply, Installation, Testing and Commissioning contract.

## 2 APPROACH

A scoping visit was conducted at the facility on Monday 22 December 2025. This resulted in a Scoping Report dated 26 December 2025. This report provided:

- a detail clinical needs assessment based on the patient and clinical load,
- an overview of the existing medical gas and vacuum installation
- quantifying the medical gas and vacuum needs gap.

The scoping report, with recommendations, were reviewed by the hospital and the Ministry of Health and forms the basis of this concept design report.

### 2.1 Existing Installation

The existing medical gas installation does not meet the requirement of the hospital in that:

- 1) The existing piped installation is limited to the Theatre complex, Intensive Care Unit and CT Scanner in Radiology. The number of installed Terminal Unit (TU) are insufficient to meet patient needs in terms of number of outlets and location.
- 2) The installed TUs are of different standards limiting interoperability of equipment within of the hospital. It creates a potentially life-threatening situation in that respiratory equipment may not fit into TUs where the equipment is needed in an emergency.



Figure 1: Various standards - British Standard in New ICU (left) SANS1409 in the old ICU (right).

### 2.2 Summary of Required Installation

The following interventions are required:

- That the new **medical gas plant room** that are located behind Medical 1 Ward, recently built by others, be used to house a new medical air and vacuum plant. The adjacent **primary cylinder manifold room**, also recently built by others, should contain the secondary and reserve oxygen manifolds as well as the secondary and reserve medical air manifolds. The newly constructed **secondary cylinder manifold room** near the Radiology department, should house the theatre Nitrous Oxide primary and secondary manifolds. A small nitrous oxide manifold (1x2 cylinders) should be installed in the **passage of the Ophthalmology building** to supply the Ophthalmology theatre.
- A new **Medical Air (MA)** plant, consisting of duplex (two) compressors, each rated at 120% of diversified demand of 960 litres per minute (to accommodate desiccant dryer losses), dual accumulators, dual filtration and dual desiccant dryers, is installed as a primary MA source. The MA plant should be backed up by an automatic change-over MA cylinder manifold and pressure control station as secondary and reserve supply located in the new cylinder manifold room. The single existing MA TU in the CT Scanner room should be removed and a total of 25 new TUs should be installed in the locations stipulated in Addendum 1.
- A new Liquid Oxygen (LOX) Vacuum Insulated Evaporator (VIE), installed by others, will be used as primary **Oxygen** supply. The VIE will be backed up by a 10x2 Oxygen automatic change-over cylinder manifold and pressure control station as secondary and reserve supplies. The existing Oxygen piped system and 30 TUs should be removed and a total of 237 new TUs should be installed in the locations stipulated in Addendum 1.
- Install a new triplex **Vacuum** pump installation with an accumulator and bacterial filtration. Each Vacuum pump should have a capability of at least 75% of the diversified vacuum demand of 1'965 litres per minute. The existing Vacuum piped system and 13 TUs should be removed and a total of 226 new TUs should be installed in the locations stipulated in Addendum 1.
- A new 2x2 **Nitrous Oxide** automatic change-over cylinder manifold and pressure control station is installed as a primary and secondary supply in the manifold room near Radiology to supply the main theatre complex.
- 1x2 **Nitrous Oxide** automatic change-over cylinder manifold and pressure control station is installed as a primary and secondary supply in the service passage of the Ophthalmology theatre building to supply the Ophthalmology theatre when required. Should the Ophthalmology theatre passage be deemed unsuitable due to ventilation concerns, the nitrous bank shall be in the primary cylinder manifold room.
- A central **alarm installation** is installed at a location that is monitored 24 hours per day.
- Supply and installation of 189 off 300mm and 23 of 600mm **equipment rails**.
- **Bedhead Trunking** for Neonatal ICU due to the high density of TUs. Please allow 25 meters trunking according to Table 7 in Addendum 3.
- Supply and installation of **Medical Gas and Vacuum Equipment** such a flowmeters, vacuum regulators and ancillary equipment according to Table 7 in Addendum 3 to enable the hospital to effectively use the new medical gas and vacuum installation.
- **Plant Electrical Connections** of all plant to a single electrical DB supplied by others inside the plantroom.
- That **medical gas probes** of the existing respiratory equipment in the new ICU are upgraded to the common Mozambiquan standard (SANS1409) according to Table 7 in Addendum 3.
- **Trenching:** All subterranean trenching to house pipes between buildings.

## 2.3 Exclusions

The following exclusions are noted:

- 1) Medical Gas Plantroom: A purpose-built medical gas plantroom will be available to house a new medical air and vacuum plant.
- 2) Cylinder Manifold Rooms: A primary- and secondary cylinder manifold room will be available to house all manifold banks for Medical Air, Oxygen and Nitrous Oxide.

### 3 ROLE-PLAYERS

The following role-players will be associated with this project:

Table 1: Project Role-players

Role	Entity
Principal Recipient (PR):	Mozambican Ministry of Health (MISAU)
Funder:	The Global Fund
Implementing Agent:	Clinton Health Access Initiative (CHAI), Mozambique
Contractual Client:	Clinton Health Access Initiative (CHAI), Mozambique
Contractor:	To be determined by tender.
Concept Engineers:	Saftek Consulting (Pty) Ltd, South Africa
Oversight Engineers:	CurisFM (Pty) Ltd, South Africa

### 4 TIMELINES

This project must reach Practical Completion by 31 March 2026.

## 5 HOSPITAL SITUATIONAL ANALYSIS GUIDING OXYGEN STRATEGY

### 5.1 Location

The Pemba Provincial Hospital (*Portuguese: Hospital Provincial de Pemba or HPP*) is located in the city of Pemba in the Cabo Delgado province of Mozambique. It is 2 443 km by road or a 2-hour flight northeast from Maputo, the capital of Mozambique.

In terms of Liquid Oxygen supply, the hospital is located 1 366 km by road from Beira which is the closest in-country Air Separation Unit (ASU) however, this ASU was not operational at the time of the scoping visit. Liquid Oxygen is also available from Dar es Salaam, Tanzania that is some 1 065 km (5.5 hours) away by road or 250 km by sea to Pemba.

Oxygen cylinders – owned by the MoH - are filled on site with Oxygen 93 by means of a Pressure Swing Adsorption (PSA) filling plant. The plant can supply the current hospital's oxygen demand of about 20 Type J (10.4kg) cylinders per day. The plant also supplies oxygen to clinics and healthcare centres in the region. In an emergency, cylinders can be obtained from Nacala.



### 5.2 Hospital Infrastructure

#### 5.2.1 Current Facility

Pemba Provincial Hospital is a 325-bed secondary-level referral hospital in the northern part of Mozambique. The hospital is operated by the Ministry of Health. The hospital also provides lower-level services for Pemba and surrounding areas, and a referral service for the entire northern part of the country. It is the highest level of care in the Cabo Delgado region with Nampula Hospital as its only referral facility.



The hospital has an average bed occupancy of 67%. The occupancy fluctuates with seasonal peaks:

- Diarrhea and malaria in the rainy season.
- Natural disaster related trauma in the cyclone season; and
- Trauma specifically linked to conflict situations with unpredictable frequency.

The hospital consists of an in-patient section in numerous loose-standing interlinked-buildings against a steep incline with a small double-story section.

The hospital makes an impression of an old central facility in need of urgent maintenance and renovation, with numerous buildings added to the original colonial-style main building. Equipment seems limited, but the newer Intensive Care Unit (ICU) is equipped with modern equipment. A few areas were upgraded in the complex. A new Ophthalmology Complex is functional is the most recent addition.

The hospital is organised in:

- Emergency Department
- Intensive Care Unit
- Neonatal Intensive Care
- Surgical Wards
- Medical Wards
- Orthopaedic Wards
- Paediatric Ward complex
- Theatre block
- Maternity section including Gynaecology
- Ophthalmology facility
- Private Clinic

### 5.2.2 Future Facility

No future plans for expansion were mentioned by the hospital management.

## 6 EXISTING MEDICAL GAS AND VACUUM SUPPLY

### 6.1 Reticulation

Medical gas is reticulated to limited areas in the hospital.

- Theatre has been reticulated for Oxygen, Nitrous Oxide and Vacuum. Except for oxygen, the piped installations are not operational.
- ICU has only been reticulated with Oxygen.
- The Neonatal ICU has not been reticulated with any medical gas.
- The Ophthalmology theatre is serviced with flexible hoses that has been installed through the wall as a temporary solution.



Figure 2: Current Oxygen Manifold for ICU.

Nitrous Oxide is reticulated in theatre however, the source of the nitrous oxide could not be established.

In general, the piping installation is of fair quality but has not been maintained for many years. As the reticulation does not comply with current standards such as ISO7396-1, the existing piped medical gas installation will be removed in its entirety and replaced with new. The existing oxygen reticulation in Theatre and ICU shall be maintained during installation of the new reticulation until patients can be transferred to the new installation.

## 6.2 Medical Air Supply

One MA TU was observed inside the CT Scanner room however, the source of the MA could not be established.

No central MA capability could be established during the site visit. All MA is currently supplied to patients are from cylinders fitted with regulators.

## 6.3 Oxygen Supply

- A loose standing PSA plant (i.e. not connected to the hospital pipe installation) with cylinder-filling capabilities is operated by a sperate entity on site. Cylindered Oxygen93 is therefore available on site.
- Oxygen is supplied from an existing 6+4 cylinder manifold outside ICU.
- Loose standing cylinders are being used in non-reticulated areas and at non-functional Terminal Units.
- Oxygen concentrators are used for oxygenation in especially in Neonatal Area.

## 6.4 Vacuum Supply

The hospital is not equipped with a piped vacuum installation.

## 7 MEDICAL GAS AND VACUUM INSTALLATION REQUIREMENT

### 7.1 Plantroom

The following scope has been performed by a civil contractor and are excluded from this scope:

- Two plantrooms have been constructed and is secured with a lockable security door.
- The main plant- and cylinder manifold building has separate manifold and compressor plant rooms. It is envisaged that the main plantroom will house the primary MA and vacuum plants and that the primary manifold room will house the MA and Oxygen secondary and reserve cylinder manifolds.



Figure 3: Main plant- and adjacent primary cylinder manifold building (left) and secondary manifold building (right)

- It is envisaged that the secondary manifold room will house the theatre Nitrous Oxide primary and secondary supplies.
- It is envisioned that a small nitrous oxide manifold bank will be installed in the Ophthalmology theatre service passage to supply the Ophthalmology theatre or alternatively, inside the primary manifold room.

### 7.2 Electrical Installation

The following criteria should drive the electrical detail design:

- 1) A local distribution board, connected to a back-up emergency generator, shall be installed by others to supply all power to the plantroom.
- 2) The local distribution board will make provision for circuit breakers for room general lighting, three plugs, central alarm system, three vacuum pumps, two desiccant dryers, two medical air compressors and automatic blowdowns to the specifications supplied by the MGPS Contractor.

### 7.3 Reticulation

The Contractor will provide a Medical Air, Oxygen, Nitrous Oxide and Vacuum gas installation on a design and supply basis. The following criteria will direct the detail design:

- Terminal Units shall be to SANS1409.
- Reticulation shall comply with ISO7396-1.
- The existing piped medical gas installation and manifold cage(s) shall be removed and replaced with new.
- All existing pipes, AVSUs and terminal units shall be removed and discarded responsibly and in accordance with the laws of Mozambique.



- The oxygen main pipe distribution shall be of a ring-main architecture with valves on both sides of a spur supplying individual wards/units. This will enable sections of the central ring main to be maintained/repared without shutting down the hospital.
- Oxygen, Medical Air and Nitrous Oxide may be distributed at high pressure however, each pressure reducing station shall be backed up by a local medical gas supply.
- Each AVSU with a vacuum supply shall have a liquid trap installed on the demand side of the valve i.e. inside the Ward/Unit.
- Each Ward/Unit shall have an AVSU with an integrated local medical gas and vacuum line failure alarm.
- Subterranean piping shall be in Meditrac flexible medical gas piping or equivalent. The installation of the pipe (i.e.. trenching and making good) is included in the MGPS contractor scope of work.
- Inter-building piping will utilise the existing walkways as far as possible. As this hospital faces frequent adverse weather conditions, the pipes shall be installed using the concrete beams as protection as far as possible.



Figure 4: Interlinking walkway with concrete beams<sup>1</sup>

## 7.4 Medical Air

Based on the clinical need, the existing 1 Terminal Unit needs to be increased by 24 to a total of 25.

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<sup>1</sup> Note the construction and refer to recommendations for mounting piping against the concrete sections to protect against the impact of adverse weather conditions

The diversified flow to support the Terminal Units, based on Table 18 of the HTM-02<sup>2</sup> is calculated as 960 litres of medical air per minute. Please refer to Addendum 2 for the calculation result per department/ward.

A duplex compressor with filtration and desiccant drying capability to deliver medical air to ISO8573 shall be installed. The compressors shall be connected to an emergency power supply i.e. backed up by an emergency generator. The risk of compressor failure will be mitigated by the installation of a 6x2 automatic change-over Medical Air manifold<sup>3</sup>.

The MA change-over pressure control station shall have a left and right bank supply (accepting Type J Bull-nose cylinders) regulated from manifold pressure to 600kPa, a mechanical change-over protected by a non-return valve, a primary MA supply inlet of 700kPa (also protected by a non-return valve) and two line pressure regulators, all with appropriate valves, gauges with alarm outputs and pressure relief valves. The pressure control station will deliver a MA pressure of 420kPa and shall be balanced with the Oxygen pressure.

Please refer to Addendum 4 for a concept reticulation lay-out.

## 7.5 Oxygen



Figure 5: Main plantroom (left) and primary manifold room (right) under construction

Based on the clinical need, the existing 30 Terminal Units needs to be increased by 207 to a total of 237 Oxygen Terminal Units.

The diversified flow to support the Terminal Units, based on Table 13 of the HTM-02 is calculated as 1'755 litres of oxygen per minute. Please refer to Addendum 2 for the calculation result per department/ward.

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<sup>2</sup> Health Technology Memorandum 02:01 Medical Gas Pipeline Systems

<sup>3</sup> Actual sizing will be determined in the Contractor's Detail Design.



A LOX primary source, installed under a separate contract, shall be supported by a 10x2<sup>4</sup> automatic change-over cylinder manifold that will serve as a secondary and reserve supply.

The existing oxygen supplies and pipe reticulation cannot support the oxygen needs of the hospital and shall be removed entirely as it is not fit for purpose.

The pipe distribution will be designed as a ring feed. Each ward take-off would be flanked by two isolation valves. This will enable sections of the central ring main to be maintained/repared without shutting down the hospital.

The oxygen change-over pressure control station shall have a left and right bank supply (accepting Type J Bull-nose cylinders) regulated from manifold pressure to 800kPa, a mechanical change-over protected by a non-return valve, a primary oxygen supply inlet of 1 000kPa (also protected by a non-return valve) and two line pressure regulators, all with appropriate valves, gauges with alarm outputs and pressure relief valves. The pressure control station will deliver an Oxygen pressure of 420kPa and shall be balanced with the MA pressure.

Please refer to Addendum 5 for a concept reticulation lay-out.

## 7.6 Vacuum

Based on the required need, the existing 13 TUs needs to be increased by 213 to a total of 226 Vacuum Terminal Units.

The diversified flow to support the TUs, based on Table 21 of the HTM-02<sup>5</sup> is calculated as 1965 litres of flow per minute. Please refer to Addendum 2 for the calculation.

A triplex oil lubricated vane vacuum pump system with the required accumulator and bacterial filters should be considered. The vacuum pumps should be supplied by an emergency power source.

The installation of vacuum terminal units will require rails to connect the suction regulator and suction bottle to. Please refer to the relevant section on equipment.

Please refer to Addendum 6 for a concept reticulation lay-out.

## 7.7 Nitrous Oxide

Based on the required need, the existing 6 Terminal Units needs to be replaced with the same number.

The diversified flow, based on Table 15 of the HTM-02<sup>6</sup> is calculated as 54 litres of Nitrous Oxide per minute. Please refer to Addendum 2 for the calculation result.

Based on the flowrate, a 2x2 automatic change-over manifold is proposed for the main theatre complex, located in the secondary manifold room. A 1x2 automatic change-over manifold, located in the service passage at the back of the Ophthalmology theatre or inside the primary cylinder manifold room, is proposed for the Ophthalmology theatre that will act as a primary and secondary source.

Please refer to Addendum 7 for a concept reticulation lay-out.

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<sup>4</sup> Actual sizing will be determined in the Concept Design.

<sup>5</sup> Health Technology Memorandum 02:01 Medical Gas Pipeline Systems

<sup>6</sup> Health Technology Memorandum 02:01 Medical Gas Pipeline Systems



Figure 6: Possible position for Nitrous Oxide manifold bank for Ophthalmology complex

## 7.8 Alarm System

A central alarm system will be required, expandable with slave panels if required, in an area that is manned 24 hours per day. The central alarm system will have the following alarms:

- 1) Oxygen VIE Failure (set at 900kPa)
- 2) Oxygen Cylinder Left and Right Bank Failure (set at 600kPa)
- 3) Oxygen Line Pressure Failure at 340kPa
- 4) Medical Air Compressor Failure (set at 700kPa)
- 5) Medical Air Cylinder Left and Right Bank Failure (set at 600kPa)
- 6) Medical Air Line Pressure Failure (set at 340kPa)
- 7) Nitrous Oxide Cylinder Left and Right Bank Failure (set at 600kPa)
- 8) Nitrous Oxide Line Pressure Failure (set at 340kPa)
- 9) Vacuum Line Pressure Failure (set at -40kPa)

A local alarm will be installed at the AVSU in each ward/unit supplied by an AVSU.

- 1) Oxygen Line Pressure Failure set at 340kPa.
- 2) Medical Air Line Pressure Failure set at 340kPa (If applicable).
- 3) Vacuum Line Pressure Failure set at -35kPa.

Provision will be made for the alarm to operate for at least 1 hour with the external electrical supply disconnected.

## 7.9 Summary Of Proposed Medical Gas Flow Per Unit/Ward

The diversified flowrate required per AVSU is provided to assist in the interpretation of where the highest potential flow of oxygen into the hospital is likely to be and to size the AVSUs.

Table 2: Access to Oxygen Indicators for Treatment Spaces

Unit/Ward	Beds	Diversified Flow (l/min)				AVSU Size
		MA	O2	VAC	N2O	
Emergency	35	0	143	100	0	2T
ICU	12	520	59.5	150	0	3T
Radiology	2	40	12	45	0	3T
Theatre	8	70	142	220	33	4T
Surgical	48	0	71	150	0	2T
Orthopaedic	49	0	38.5	40	0	2T
Paediatric	53	0	60.5	80	0	2T
NNU	26	0	809	270	0	2T
Maternity	73	0	100	230	0	2T
Peads Emerg.	29	280	71.5	220	0	3T
Clinic	6	0	13	40	0	2T
Medical 2	40	0	50	110	0	2T
Medical 1	44	0	53	110	0	2T
Ophthalmology	5	50	130	200	21	4T
<b>TOTAL</b>	<b>430</b>	<b>960</b>	<b>1753</b>	<b>1965</b>	<b>54</b>	<b>14</b>

## 8 MEDICAL GAS SUPPORTING EQUIPMENT REQUIREMENT

Please refer to the schedule in Addendum 3 for the equipment required to support the MGPS.

### 8.1 Equipment Rails

The installation of vacuum terminal units will require rails to connect the suction regulator and suction bottle to. Provision for 300mm long equipment rails to be installed generally in non-critical areas and rails with a length of 600mm generally in critical areas such as ICU and Neonatal Units where more equipment may need to be connected to the rail.



Figure 7: Equipment Rail to support vacuum equipment.

### 8.2 Trunking

Medical Gas trunking shall be installed in the NNU due to high medical gas outlet density. The bedhead units should be pre-installed with all required TUs to enable quick installation and connection.

Coordination with electrical services should be considered when choosing a suitable bedhead design. If possible, the existing electrical socket outlets should not be interfered with. Only if unavoidable, should the existing electrical outlets be transferred onto the bedhead units.

### 8.3 Vacuum Regulators

Vacuum regulators should consist of a vacuum regulator, suction gauge, yellow flexible pipe with male vacuum wall-outlet probe, a liquid container of at least 1 Liter capacity, liquid valve and all interconnecting flexible tubing.



Figure 8: Equipment Rail to support vacuum equipment

### 8.4 Oxygen Flowmeters

Single and dual oxygen flowmeters with ball flow indicator, capable of delivery 0 to 15 litres per minute , shall have individual humidifier bottles and be fitted with a compatible male oxygen outlet probe.



Figure 9: Example of single Oxygen flowmeter with humidifier bottle.

### 8.5 Medical Gas Probes

Replacement of all respiratory equipment medical gas male probe compliant to SANS1409 and crimped with Oetiker clamps.



*Figure 10: Example of male medical gas probes.*



## 9 ADDENDUM 1 – Existing and Additional TUs and Equipment Rails

The number of existing and new TUs are provided in this Addendum.

The abbreviations that are used in the main table are explained in the table below.

Table 3: Description Key

Abbreviation	Description
Beds	The number of beds in the room that will be supplied with medical gas. Please note this is not necessarily the number of operational beds.
MA Exist.	Number of Medical Air TU in the room at the time of the site survey
MA Add.	Number of additional Medical Air TUs that is recommended based on the clinical needs assessment
Oxygen Exist.	Number of Oxygen Terminal Units in the room at the time of the site survey
Oxygen Add.	Number of additional Oxygen TUs that are recommended based on the clinical needs assessment
Vacuum Exist.	Number of Vacuum TUs in the room at the time of the site survey
Vacuum Add.	Number of additional Vacuum TUs that are recommended based on the clinical needs assessment
Nitrous Exist.	Number of Nitrous Oxide TUs in the room at the time of the site survey
Vacuum Add.	Number of additional Nitrous Oxide TUs that are recommended based on the clinical needs assessment
Rail 300	Recommended number of 300mm long Gabler®-type equipment rails to clip equipment and the suction bottle on.
Rail 600	Recommended number of 600mm long Gabler®-type equipment rails to clip equipment and the suction bottle on.
TR	It is recommended that the TU are installed inside trunking due to the high density of services

Table 4: Existing and Additional TUs and Equipment Rails

Unit	Location	Beds	MA		Oxygen		Vacuum		Nitrous		Rail	
			Exist	Add.	Exist	Add.	Exist	Add.	Exist	Add.	300	600
Emergency	Mass Casualty	4	-	-	-	2	-	2	-	-	2	-
	Reception Area	2	-	-	-	1	-	1	-	-	1	-
	Triage 1	1	-	-	-	-	-	-	-	-	-	-
	Triage 2	1	-	-	-	-	-	-	-	-	-	-
	Triage 3	1	-	-	-	-	-	-	-	-	-	-
	New Asthmatic Rm	3	-	-	-	3	-	-	-	-	-	-
	New Resus Room	3	-	-	-	3	-	3	-	-	3	-
	Sala de Guesso (POP)	2	-	-	-	2	-	2	-	-	2	-
	Minor Theatre	2	-	-	-	2	-	2	-	-	2	-
	Male Observation	8	-	-	-	4	-	4	-	-	4	-
	Female Observation	8	-	-	-	4	-	4	-	-	4	-

Unit	Location	Beds	MA		Oxygen		Vacuum		Nitrous		Rail	
			Exist	Add.	Exist	Add.	Exist	Add.	Exist	Add.	300	600
ICU	Old ICU	8	-	8	8	8	-	8	-	-	-	8
	New ICU	4	-	4	4	4	-	4	-	-	-	4
Radiology	CT Scanner	1	1		1	-	1	0	-	-	1	-
	Buckey Room	1	-	-		1	-	1	-	-	1	-
Theatre	Recovery	4	-	1	3	-	2	1	-	-	3	-
	Th 1	1	-	1	1	-	1	1	-	1	-	2
	Th 2	1	-	1	1	1	1	2	-	1	-	3
	Th 3	1	-	1	1	-	1	1	-	1	-	2
	Th 4	1	-	1	1	-	1	1	-	1	-	2
Surgical	High Care	8	-	-	-	4	-	4	-	-	4	-
	Private Room	2	-	-	-	1	-	1	-	-	1	-
	Ward 8 Staff	2	-	-	-	1	-	1	-	-	1	-
	Ward 7 Male Septic	6	-	-	-	2	-	2	-	-	2	-
	Ward 5 Male Gen.	8	-	-	-	4	-	4	-	-	4	-
	Ward 3 Fem. Gen.	6	-	-	-	2	-	2	-	-	2	-
	Ward 2 Fem. Gen.	8	-	-	-	2	-	2	-	-	2	-
	Ward 1 Fem. Septic	8	-	-	-	2	-	2	-	-	2	-
Orthopaedic	Ward 4	7	-	-	-	4	-	4	-	-	4	-
	Ward 1	8	-	-	-	2	-	2	-	-	2	-
	Ward 2	8	-	-	-	4	-	4	-	-	4	-
	Ward 3	8	-	-	-	4	-	4	-	-	4	-
	Ward 5	6	-	-	-	2	-	2	-	-	2	-
	Ward 8 Staff	8	-	-	-	2	-	2	-	-	2	-
	Private 1	2	-	-	-	1	-	1	-	-	1	-
	Private 2 Staff	2	-	-	-	1	-	1	-	-	1	-
Paediatrics	Malnutrition	8	-	-	-	2	-	2	-	-	2	-
	Ward 2 Post Partum	8	-	-	-	4	-	4	-	-	4	-
	Ward 3 Respiratory	8	-	-	-	4	-	4	-	-	4	-
	Ward 4 High Care	8	-	-	-	8	-	8	-	-	8	-
	Ward 5 General	8	-	-	-	4	-	4	-	-	4	-
	Ward 6 Surgical	8	-	-	-	4	-	4	-	-	4	-
	Private 1	2	-	-	-	1	-	1	-	-	1	-
	Private 2 Isol.	2	-	-	-	1	-	1	-	-	1	-
	Treatment Room	1	-	-	-	1	-	1	-	-	1	-
NNU	Kangaroo	8	-	-	-	4	-	4	-	-	4	-
	NNU	14	-	-	-	14	-	14	-	-	TR	-
	High Care Isol.	3	-	-	-	3	-	3	-	-	3	-
	Private 1	1	-	-	-	1	-	1	-	-	1	-

Unit	Location	Beds	MA		Oxygen		Vacuum		Nitrous		Rail	
			Exist	Add.	Exist	Add.	Exist	Add.	Exist	Add.	300	600
Maternity	Sale de Parto	5	-	-	3	2	2	3	-	-	5	-
	Eclampsia	1	-	-	-	1	-	1	-	-	1	-
	Complications 1	2	-	-	2	1	2	1	-	-	3	-
	Complications 2	2	-	-	2		1	1	-	-	2	-
	Abortions	2	-	-	-	2	-	2	-	-	2	-
	Observation	5	-	-	-	2	-	2	-	-	2	-
	Obst. 1 Pre/Post	8	-	-	-	2	-	2	-	-	2	-
	Obst. 2 Complic.	8	-	-	-	2	-	2	-	-	2	-
	Obst. 3 High Care	8	-	-	-	4	-	4	-	-	4	-
	Post Partum Observ.	2	-	-	3	-1	1	1	-	-	2	-
	C-Section Observ.	8	-	-	-	1	-	1	-	-	1	-
	Gynae 2	8	-	-	-	2	-	2	-	-	2	-
	Gynae 3	8	-	-	-	2	-	2	-	-	2	-
	Private 1	2	-	-	-	1	-	1	-	-	1	-
Peads Emerg.	Private 2	2	-	-	-	1	-	1	-	-	1	-
	Private 3	2	-	-	-	1	-	1	-	-	1	-
	Peads Treatment	4	-	-	-	4	-	4	-	-	4	-
	New Peads High Care	4	-	4	-	4	-	4	-	-	4	-
	Peads Observ.	6	-	-	-	4	-	4	-	-	4	-
	Malaria 1	8	-	-	-	4	-	4	-	-	4	-
Clinic	Malaria 2	6	-	-	-	2	-	2	-	-	2	-
	Minor Theatre	1	-	1	-	1	-	1	-	-	1	-
	SAP Ward 1	2	-	-	-	1	-	1	-	-	1	-
	SAP Ward 2	2	-	-	-	1	-	1	-	-	1	-
Medical 2	SAP Ward 3	2	-	-	-	1	-	1	-	-	1	-
	Ward 3 High Care	4	-	-	-	4	-	4	-	-	4	-
	Ward 1 General	8	-	-	-	2	-	2	-	-	2	-
	Ward 2 General	8	-	-	-	2	-	2	-	-	2	-
	Ward 4 Respiratory	8	-	-	-	4	-	4	-	-	4	-
	Ward 5 TB	8	-	-	-	2	-	2	-	-	2	-
	Private 2	2	-	-	-	1	-	1	-	-	1	-
Medical 1	Private 1	2	-	-	-	1	-	1	-	-	1	-
	Ward 3 High Care	4	-	-	-	4	-	4	-	-	4	-
	Ward 1 General	8	-	-	-	2	-	2	-	-	2	-
	Ward 2 General	8	-	-	-	2	-	2	-	-	2	-
	Ward 4 Respiratory	8	-	-	-	4	-	4	-	-	4	-
	Ward 5 TB	8	-	-	-	2	-	2	-	-	2	-

Unit	Location	Beds	MA		Oxygen		Vacuum		Nitrous		Rail	
			Exist	Add.	Exist	Add.	Exist	Add.	Exist	Add.	300	600
	Ward 6 Chemo	4	-	-	-	2	-	2	-	-	2	-
	Private 2	2	-	-	-	1	-	1	-	-	1	-
	Private 1	2	-	-	-	1	-	1	-	-	1	-
Ophthalmology	Theatre 1	1	-	1		1	-	1	-	1	-	1
	Theatre 2	1	-	1		1	-	1	-	1	-	1
	Recovery	2	-	-		1	-	1	-	-	1	-
	Laser Room	1	-	-		1	-	1	-	-	1	-
<b>TOTAL</b>		<b>430</b>	<b>1</b>	<b>24</b>	<b>30</b>	<b>207</b>	<b>13</b>	<b>213</b>	<b>0</b>	<b>6</b>	<b>189</b>	<b>23</b>

## 10 ADDENDUM 2 – Peak and Diversified Flow Calculations

The number of existing and recommended TUs are provided in this Addendum.

Table 5: Description Key

Header Abbreviation	Description
Beds	The number of beds in the room that will be supplied with medical gas. Please note this is not necessarily the number of operational beds.
Peak Flow Rate MA	The design flowrate of Medical Air for each TU in litres per minute
Peak Flow Rate O <sub>2</sub>	The design flowrate of Oxygen for each TU in litres per minute
Peak Flow Rate Vac	The design flowrate of Vacuum for each TU in litres per minute
Peak Flow Rate N <sub>2</sub> O	The design flowrate of Nitrous Oxide for each TU in litres per min.
Diversified Flow MA	The calculated diversified Medical Air flow for each Unit/Ward.
Diversified Flow O <sub>2</sub>	The calculated diversified Oxygen flow for each Unit/Ward
Diversified Flow Vac	The calculated diversified Vacuum flow for each Unit/Ward
Diversified Flow N <sub>2</sub> O	The calculated diversified Nitrous Oxide flow for each Unit/Ward
AVSU 1T, 2T, 3T and 4T	The number of valves in each AVSU. A 1-tier AVSU will make provision for Oxygen, a 2-Tier for Oxygen and Vacuum, a 3-tier for Medical Air, Oxygen and Vacuum and a 4 tier AVSU for Medical Air, Oxygen and Vacuum and Vacuum

Table 6: Peak- and Diversified Flowrate per Unit or Department

Unit	Location	Beds	Peak Flow Rate				Diversified Flow <sup>7</sup>				AVSU			
			MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	1T	2T	3T	4T
Emergency	Mass Casualty	4	-	10	40	-	0	35.5	40	0	0	1	0	0
	Reception Area	2	-	10	40	-								
	Triage 1	1	-	-	-	-								
	Triage 2	1	-	-	-	-								
	Triage 3	1	-	-	-	-								
	New Asthmatic Rm	3	-	10	-	-								
	New Resus Room	3	-	10	40	-	0	103	60	0				
	Sala de Guesso (POP)	2	-	10	40	-								
	Minor Theatre	2	-	10	40	-								
	Male Observation	8	-	10	40	-								
	Female Observation	8	-	10	40	-								

<sup>7</sup> Please note that the flow is calculated on the number of beds in Theatre and ICU but calculated on the number of Terminal Units in the rest of the Units.



Unit	Location	Beds	Peak Flow Rate				Diversified Flow <sup>7</sup>				AVSU			
			MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	1T	2T	3T	4T
ICU	Old ICU	8	40	10	40	-	520	59.5	150	0	0	0	1	0
	New ICU	4	40	10	40	-								
Radiology	CT Scanner	1	40	10	40	-	40	12	45	0	0	0	1	0
	Buckey Room	1	-	10	40	-								
Theatre	Recovery	4	40	10	40	-	0	22	60	0	0	0	0	1
	Th 1	1	40	100	40	15	70	120	160	33				
	Th 2	1	40	100	40	15								
	Th 3	1	40	100	40	15								
	Th 4	1	40	100	40	15								
Surgical	High Care	8	-	10	40	-	0	41.5	110	0	0	1	0	0
	Private Room	2	-	10	40	-	0	29.5	40	0				
	Ward 8 Staff	2	-	10	40	-								
	Ward 7 Male Septic	6	-	10	40	-								
	Ward 5 Male Gen.	8	-	10	40	-								
	Ward 3 Fem. Gen.	6	-	10	40	-								
	Ward 2 Fem. Gen.	8	-	10	40	-								
	Wars 1 Fem. Septic	8	-	10	40	-								
Orthopaedic	Ward 4	7	-	10	40	-	0	38.5	40	0	0	1	0	0
	Ward 1	8	-	10	40	-								
	Ward 2	8	-	10	40	-								
	Ward 3	8	-	10	40	-								
	Ward 5	6	-	10	40	-								
	Ward 8 Staff	8	-	10	40	-								
	Private 1	2	-	10	40	-								
	Private 2 Staff	2	-	10	40	-								
Paediatrics	Malnutrition	8	-	10	40	-	0	50.5	40	0	0	1	0	0
	Ward 2 Post Partum	8	-	10	40	-								
	Ward 3 Respiratory	8	-	10	40	-								
	Ward 4 High Care	8	-	10	40	-								
	Ward 5 General	8	-	10	40	-								
	Ward 6 Surgical	8	-	10	40	-								
	Private 1	2	-	10	40	-								
	Private 2 Isol.	2	-	10	40	-								
	Treatment Room	1	-	10	40	-	0	10	40	0				
NNU	Kangaroo	8	-	-	-	-					0	1	0	0
	NNU	14	-	10	40	-	0	780	170	0				
	High Care Isol.	3	-	10	40	-	0	19	60	0				
	Private 1	1	-	10	40	-	0	16	40	0				

Unit	Location	Beds	Peak Flow Rate				Diversified Flow <sup>7</sup>				AVSU			
			MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	1T	2T	3T	4T
Maternity	Sale de Parto	5	-	10	40	-	0	50	140	0	0	1	0	0
	Eclampsia	1	-	10	40	-								
	Complications 1	2	-	10	40	-								
	Complications 2	2	-	10	40	-								
	Abortions	2	-	10	40	-	0	11.5	50	0				
	Observation	5	-	10	40	-	0	38.5	40	0				
	Obst. 1 Pre/Post	8	-	10	40	-								
	Obst. 2 Complic.	8	-	10	40	-								
	Obst. 3 High Care	8	-	10	40	-								
	Post Partum Observation	2	-	10	40	-								
	C-Section Observ.	8	-	10	40	-								
	Gynae 2	8	-	10	40	-								
	Gynae 3	8	-	10	40	-								
	Private 1	2	-	10	40	-								
	Private 2	2	-	10	40	-								
	Private 3	2	-	10	40	-								
Peads Emerg.	Peads Treatment	4	-	10	40	-	0	14.5	70	0	0	0	1	0
	New Peads High Care	4	40	10	40	-	200	23.5	70	0				
	Peads Observ.	6	-	10	40	-	0	23.5	40	0				
	Malaria 1	8	-	10	40	-								
	Malaria 2	6	-	10	40	-								
	Minor Theatre	1	40	10	40	-	80	10	40	0				
Clinic	SAP Ward 1	2	-	10	40	-	0	13	40	0	0	1	0	0
	SAP Ward 2	2	-	10	40	-								
	SAP Ward 3	2	-	10	40	-								
Medical 2	Ward 3 High Care	4	-	10	40	-	0	23.5	70	0	0	1	0	0
	Ward 1 General	8	-	10	40		0	26.5	40	0				
	Ward 2 General	8	-	10	40	-								
	Ward 4 Respiratory	8	-	10	40	-								
	Ward 5 TB	8	-	10	40	-								
	Private 2	2	-	10	40	-								
	Private 1	2	-	10	40	-								
Medical 1	Ward 3 High Care	4	-	10	40	-	0	23.5	70	0	0	1	0	0
	Ward 1 General	8	-	10	40	-	0	29.5	40	0				
	Ward 2 General	8	-	10	40	-								
	Ward 4 Respiratory	8	-	10	40	-								
	Ward 5 TB	8	-	10	40	-								

Unit	Location	Beds	Peak Flow Rate				Diversified Flow <sup>7</sup>				AVSU			
			MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	MA	O <sub>2</sub>	Vac	N <sub>2</sub> O	1T	2T	3T	4T
	Ward 6 Chemo	4	-	10	40	-								
	Private 2	2	-	10	40	-								
	Private 1	2	-	10	40	-								
Ophthalmology	Theatre 1	1	40	100	40	15	50	110	120	21	0	0	0	1
	Theatre 2	1	40	100	40	15								
	Recovery	2	-	10	40	-	0	10	40	0				
	Laser Room	1	-	10	40	-	0	10	40	0				
<b>TOTAL</b>		<b>430</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>960</b>	<b>1755</b>	<b>1965</b>	<b>54</b>	<b>0</b>	<b>9</b>	<b>3</b>	<b>2</b>

## 11 ADDENDUM 3 –Equipment Schedule

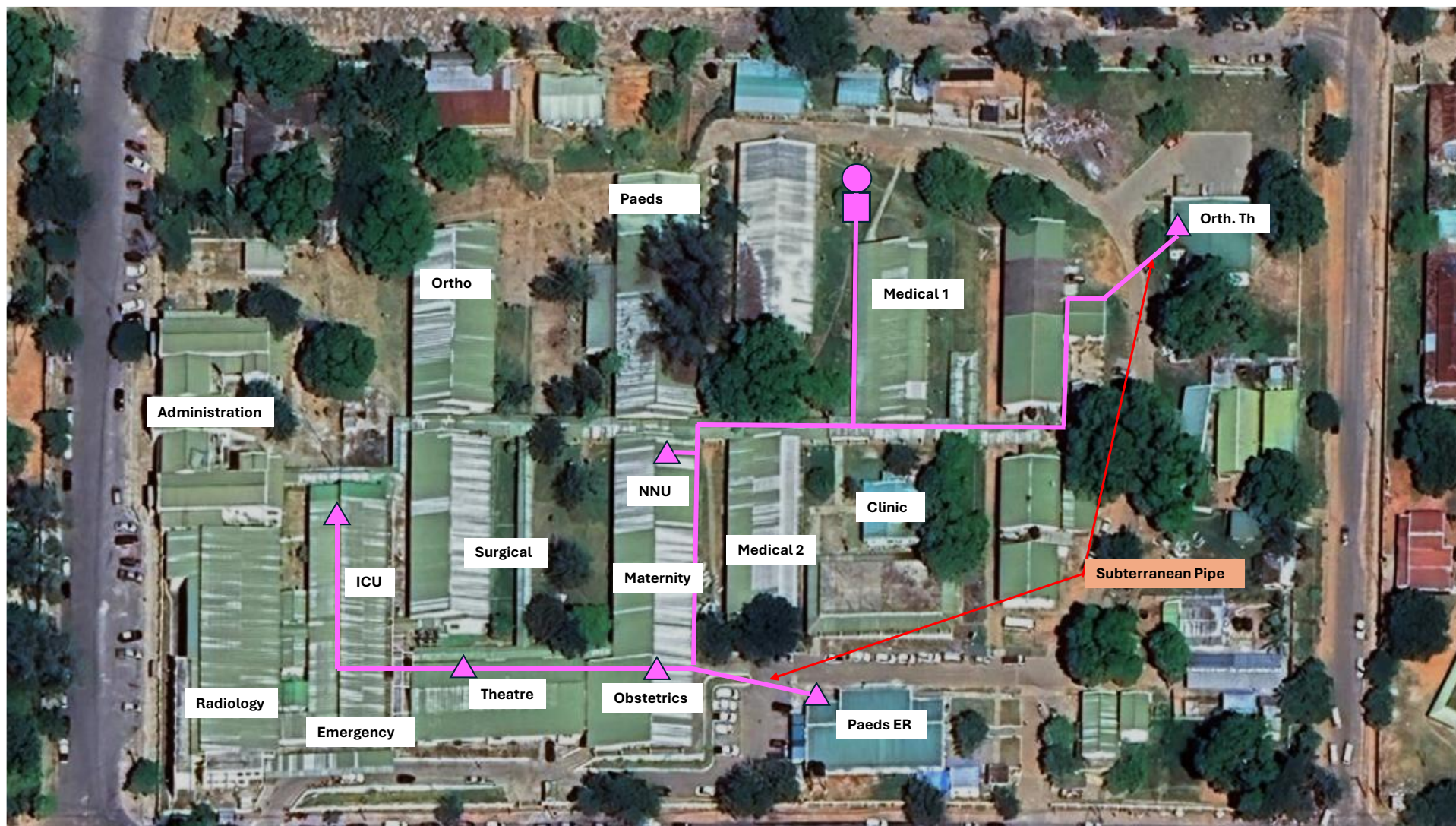
The schedule in this section provides the medical equipment that will be required to support the use of the new MGPS installation.

Table 7: Equipment schedule

Item	Number	Remarks
Flowmeter with SANS1409 wall probe – single	77	(10% redundancy)
Flowmeter with SANS1409 wall probe - double	159	(10% redundancy)
Humidifier bottle – high flow re-usable	236	
Connector oxygen piping to Flowmeter (Christmas Tree)	118	(50% of number of flowmeters)
Wall Suction Unit with regulator and SANS1409 wall probe – re-usable NOT with disposable lining	226	
Medical equipment rail (Gabler Rail) 300 mm	188	-
Medical equipment rail (Gabler Rail) 600 mm	23	-
Male oxygen probes for anaesthetic machines and ventilators to SANS1409	5 sets	MA, O <sub>2</sub> and N <sub>2</sub> O
	8 sets	MA and O <sub>2</sub>
Blenders Oxygen and medical air for neonatal use with two output lines equipped with flowmeters (Bird Blenders) with O <sub>2</sub> and MA probes to SANS1409	7	-
Oxygen bullnose cylinder wrench	5	(28mm and 32mm)
Oxygen Cylinder trolley	5	-
Bedhead Trunking for NNU (linear meter)	25m	Due to high density of TUs

## 12 ADDENDUM 4 –Concept Lay-out of Medical Air Reticulation

● = Primary Supply    ■ = Secondary Supply    ▲ = AVSU    | = Reticulation





### 13 ADDENDUM 5 –Concept Lay-out of Oxygen Reticulation

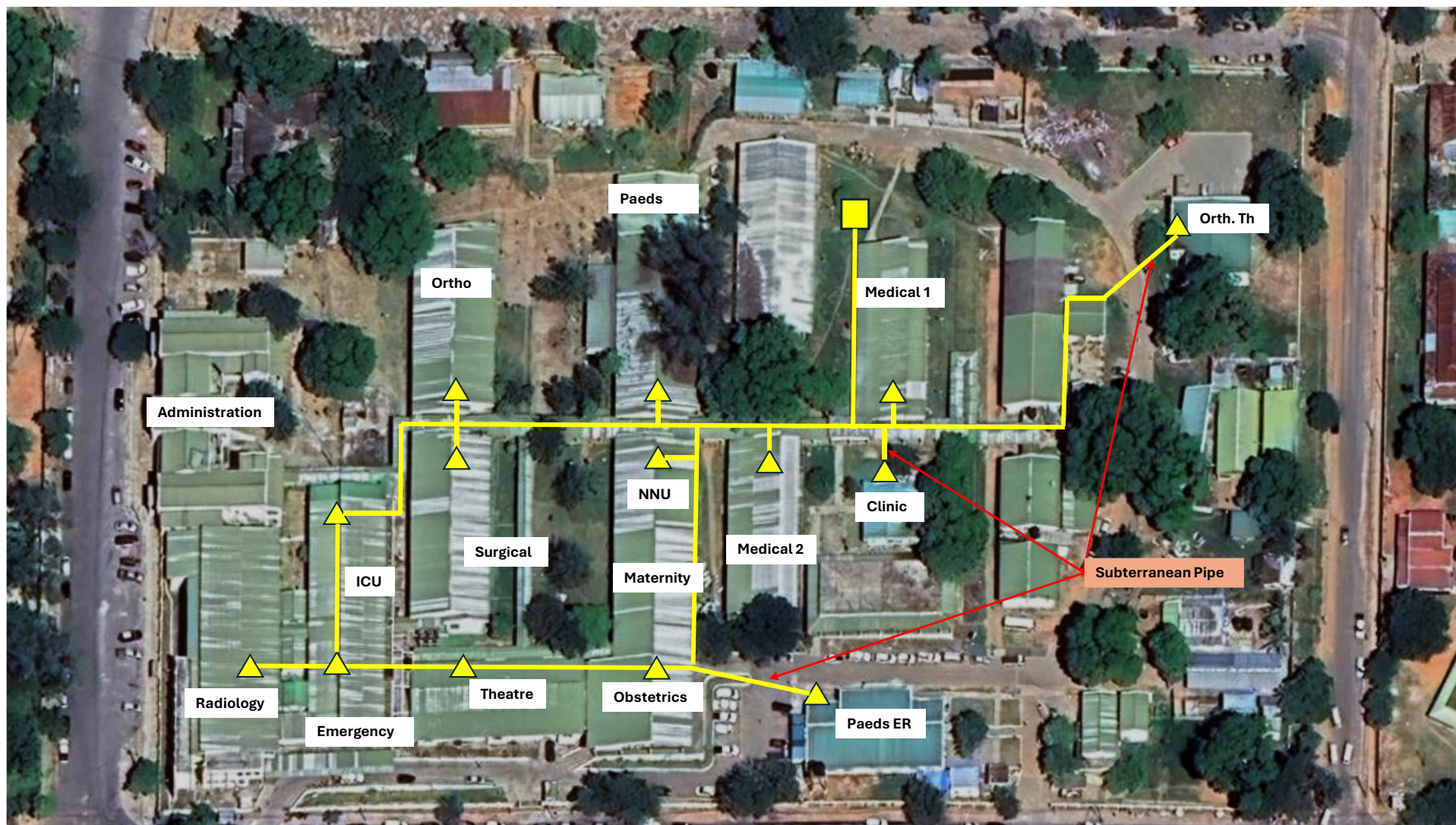
● = Primary Supply    ■ = Secondary Supply    ▲ = AVSU    | = Reticulation





## 14 ADDENDUM 6 –Concept Lay-out of Vacuum Reticulation

● = Primary Supply    ■ = Secondary Supply    ▲ = AVSU    | = Reticulation





## 15 ADDENDUM 7 –Concept Lay-out of Nitrous Oxide Reticulation

● = Primary Supply    ■ = Secondary Supply    ▲ = AVSU    | = Reticulation

