LESS SALT. MORE WATER.
MSSC
Multi-State Salinity Coalition

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Qatar Mega Water Reuse Project, IDRIS Programme Solution in the Middle East

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Acknowledgement

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Safety First

Presentation Overview

- Public Works Authority Overview (ASHGHAL), Qatar
- IDRIS (Inner Doha Re-sewerage Implementation Strategy) Programme Drivers
- Expected Programme Outcomes
- The IDRIS Concept
- Recommended IDRIS Scheme
- Component Details
- On-Going Advanced Activities
- Key Implementation Considerations
- Procurement Considerations
- Summary
- Questions

Presentation Overview

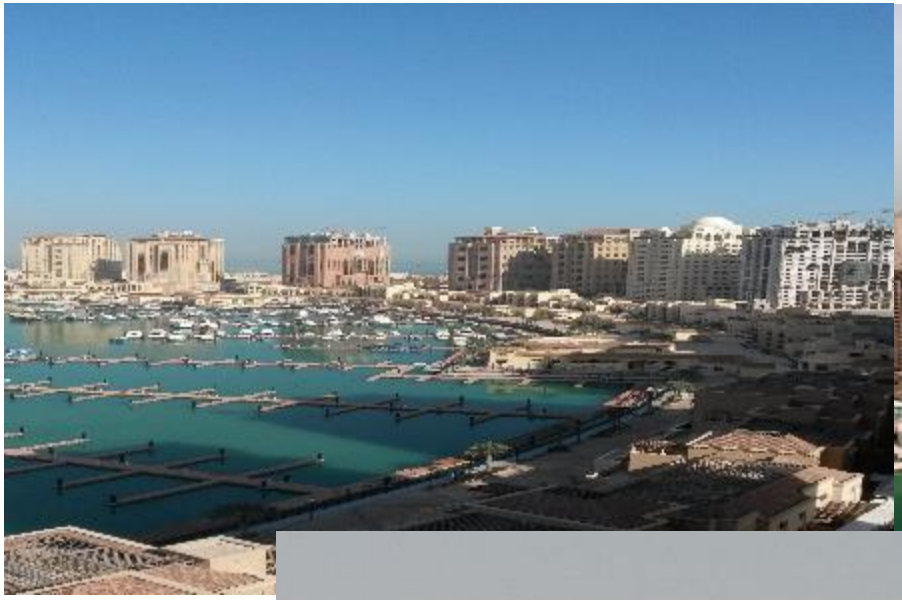
- Qatar
- Public Works Authority Overview (ASHGHAL)
- IDRIS (Inner Doha Re-sewerage Implementation Strategy) Programme Drivers
- IDRIS Programme Drivers
- Expected Programme Outcomes
- The IDRIS Concept
- Recommended IDRIS Scheme
- Component Details
- IDRIS Programme Packages
- Schedule
- Procurement Considerations
- TSE – Treated Sewer Effluent
- Innovative Technologies
- Summary
- Questions

Qatar

WIKIPEDIA

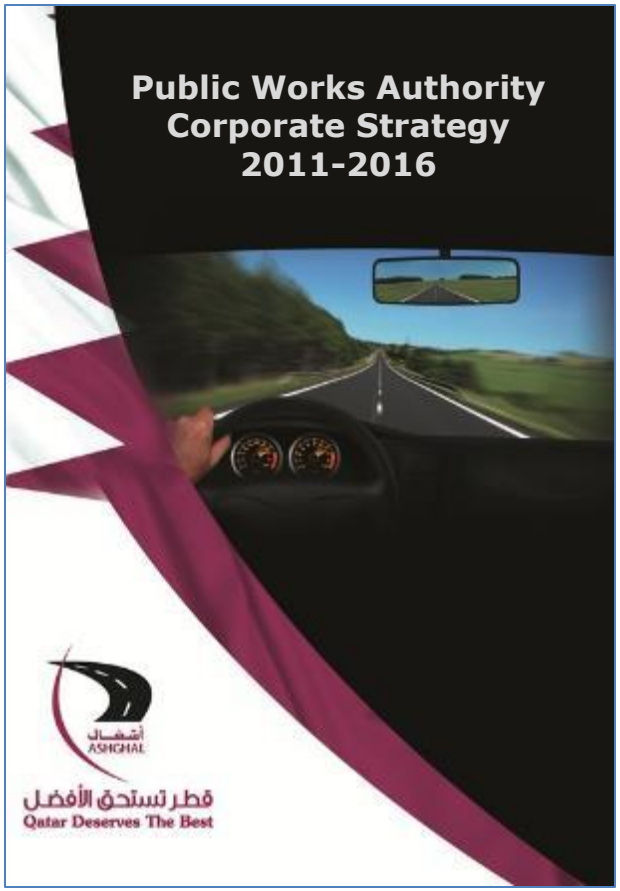
Qatar
Country in the Middle East
Qatar is a peninsular country whose terrain comprises arid desert and a long Persian Gulf shoreline of beaches and dunes.
Capital: Doha
Dialing code: +974
ISO code: QAT
Currency: Qatari riyal
Population: 2.169 million (2013)

Qatar



PUBLIC WORKS AUTHORITY (ASHGHAL)

- Government organisation formed in January 2004 by Emiri Decree No.1
- 1500 employees
- Remit of infrastructure delivery and public amenities
  - Roads
  - Drainage
  - Municipal Buildings
- Planned investment of over $20 billion in next 5 years
- PWA Corporate Strategy 2011-2016 - in complete alignment with the Qatar National Vision 2030



Ashghal's Strategy

MISSION

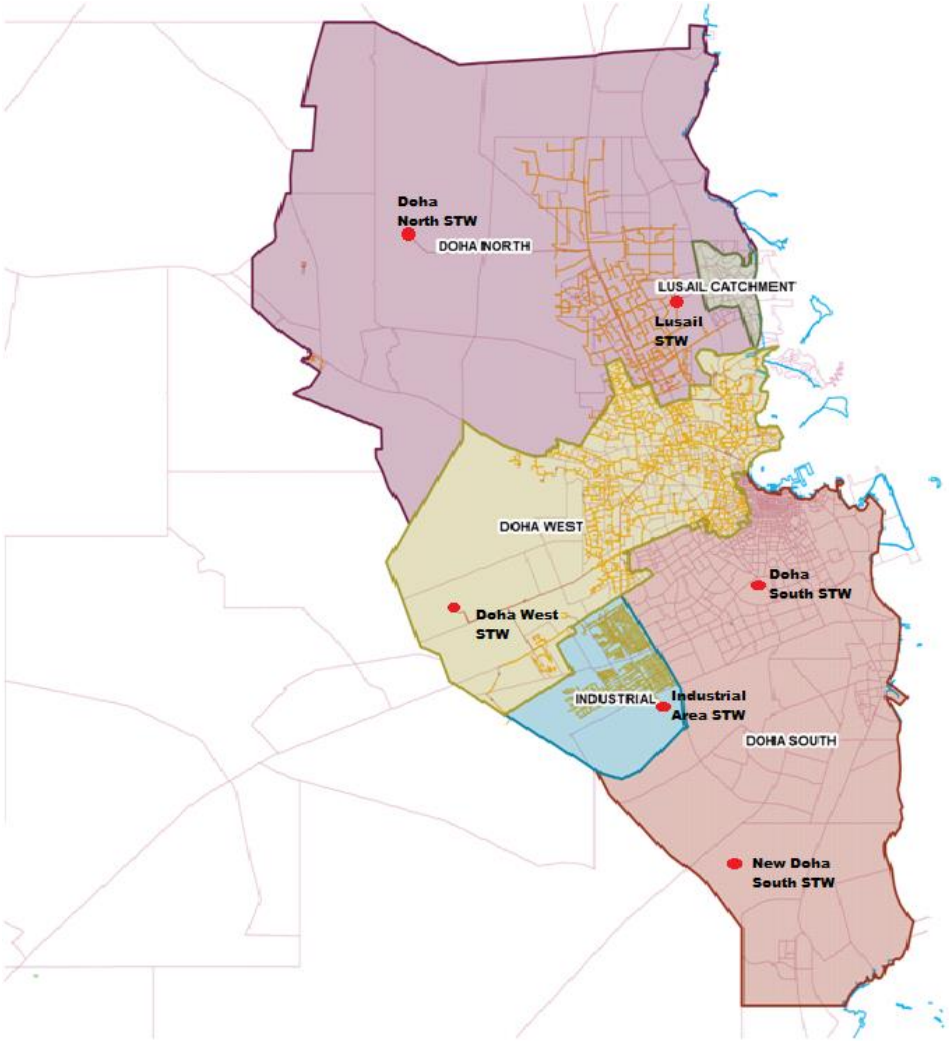
Deliver and manage state-of-the-art, sustainable world class buildings and infrastructure that fulfill the Qatar National Vision 2030

VISION

Ashghal will be a dynamic, responsive and customer centric organization that creates shared value for all stakeholders through outsourcing and partnership with the worlds best.

Themes	Values
Dynamic & Responsive	We Lead
Customer Centric	We Care
Outsourcing & Delivery	We Deliver

Existing Doha Drainage Infrastructure



- Main drainage catchments:
  - Doha South
  - Doha West
  - Doha North
- Two smaller subcatchments:
  - Lusail
  - Doha Industrial Area
- Three main operational STWs:
  - Doha West STW
  - Doha South STW
  - Industrial Area STW

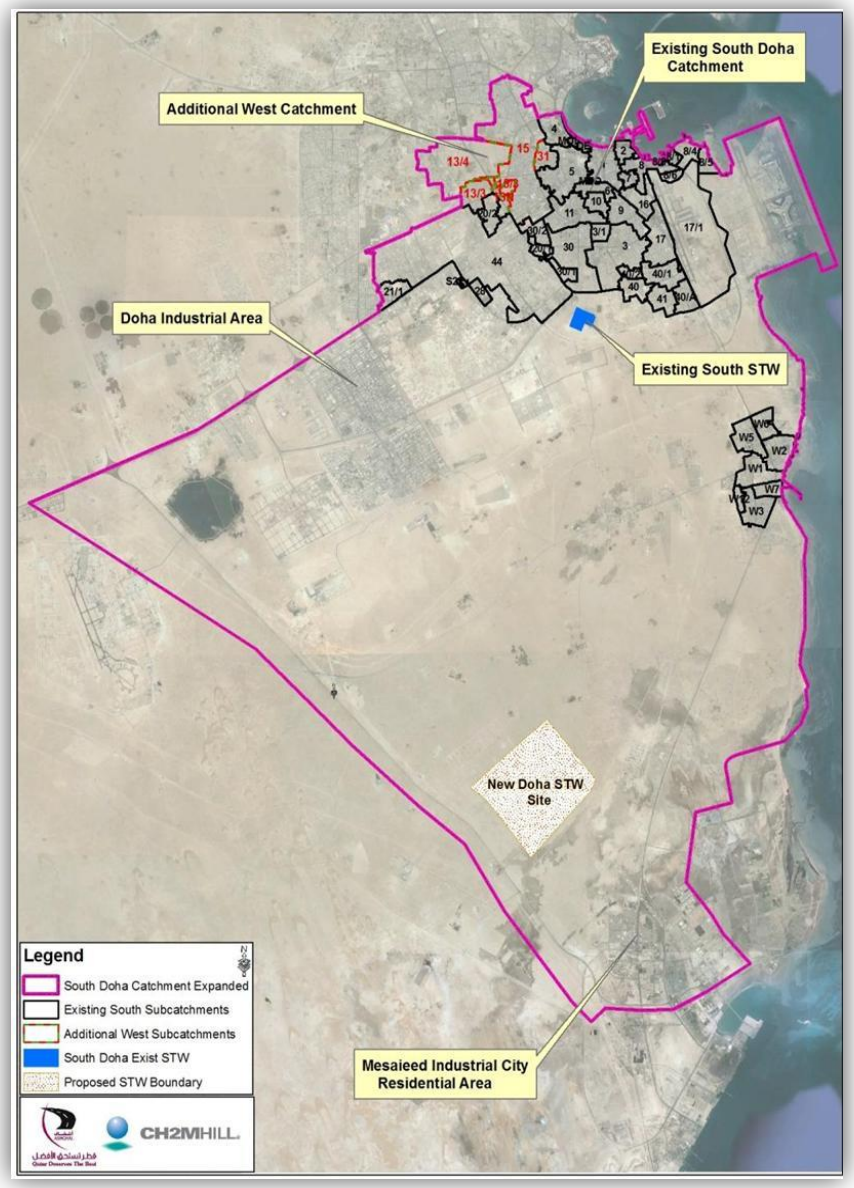
IDRIS Programme Drivers

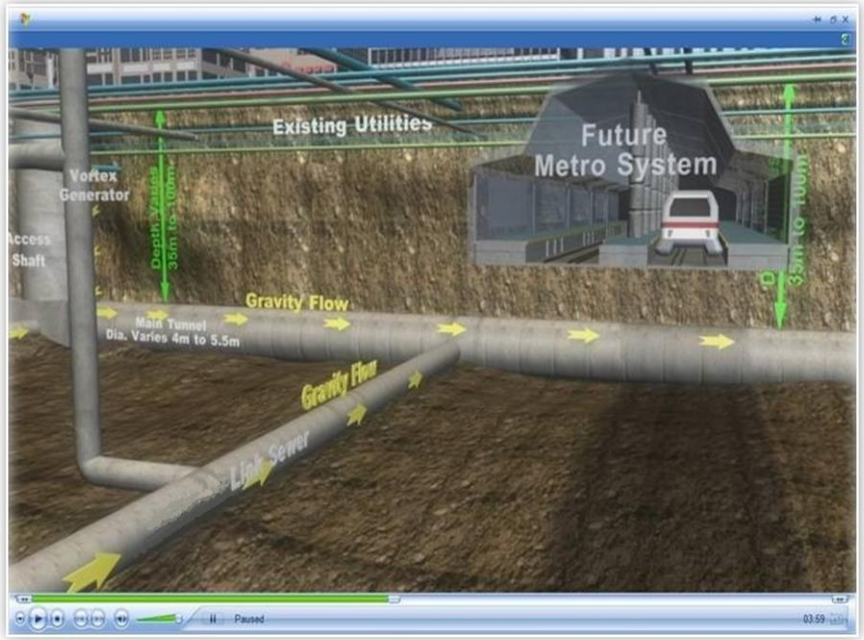
- Existing foul sewerage network hydraulically overloaded – results in street flooding
- Existing key assets under capacity & portions reaching end of useful life
- Extensive on-going & planned development to occur within South Catchment - will only make current situation worse

Expected Programme Outcomes

- Eliminate serious public health issue – foul sewage flooding in over 20 locations in central Doha
- Accommodate economic & planned growth for over an additional million people
- Provide 50 year sewerage solution for Doha's largest catchment
- Eliminate over 30 aging pump stations under IDRIS – nearly 60 total under other ASHGHAL programmes/projects
- Produce up to 500,000 m^3/day high quality TSE (reuse water) by 2030

Implemented in a safe & sustainable manner using innovative and best-in-class approaches that will allow Ashghal to be considered for global recognition

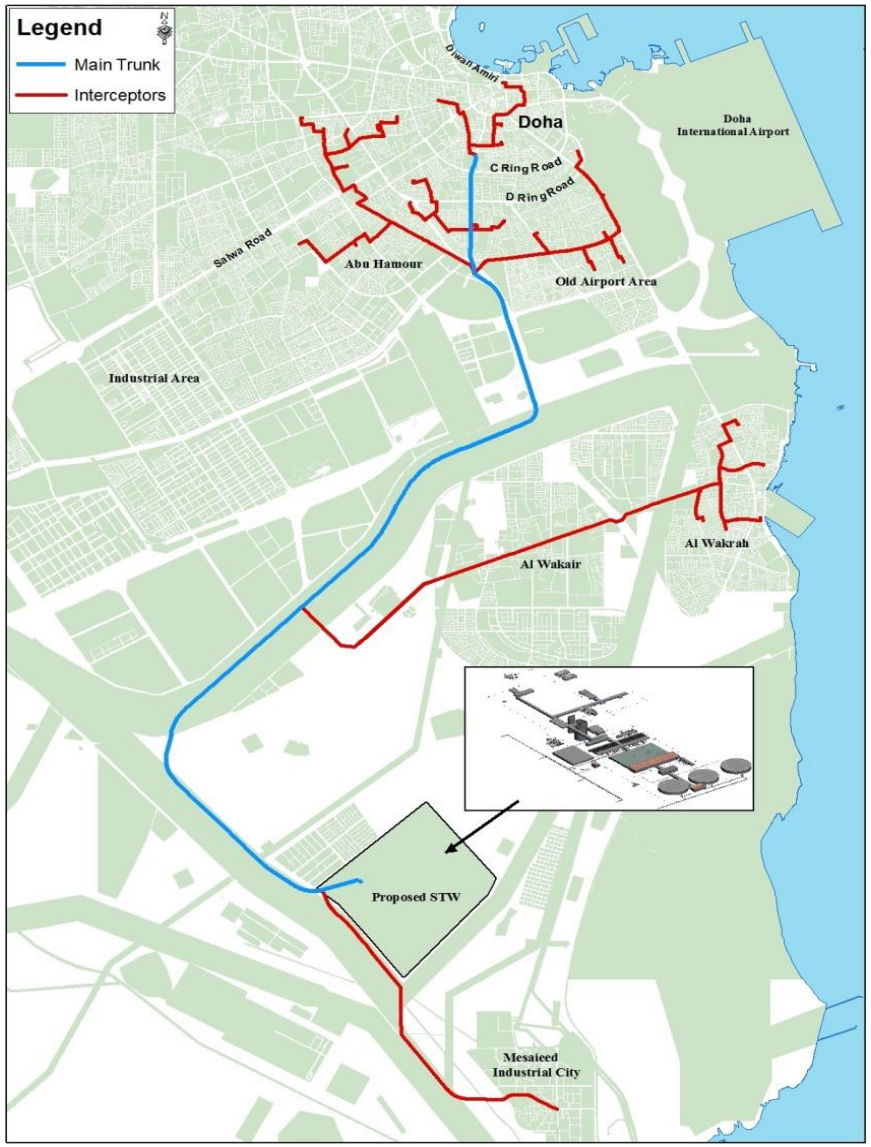




Concept - Implement deep tunnel gravity sewerage system

- Focus is on Doha South Catchment
- Design horizon is 50 years – anticipated that facilities will have longer life
- Eliminate as many existing foul sewage pump stations as possible

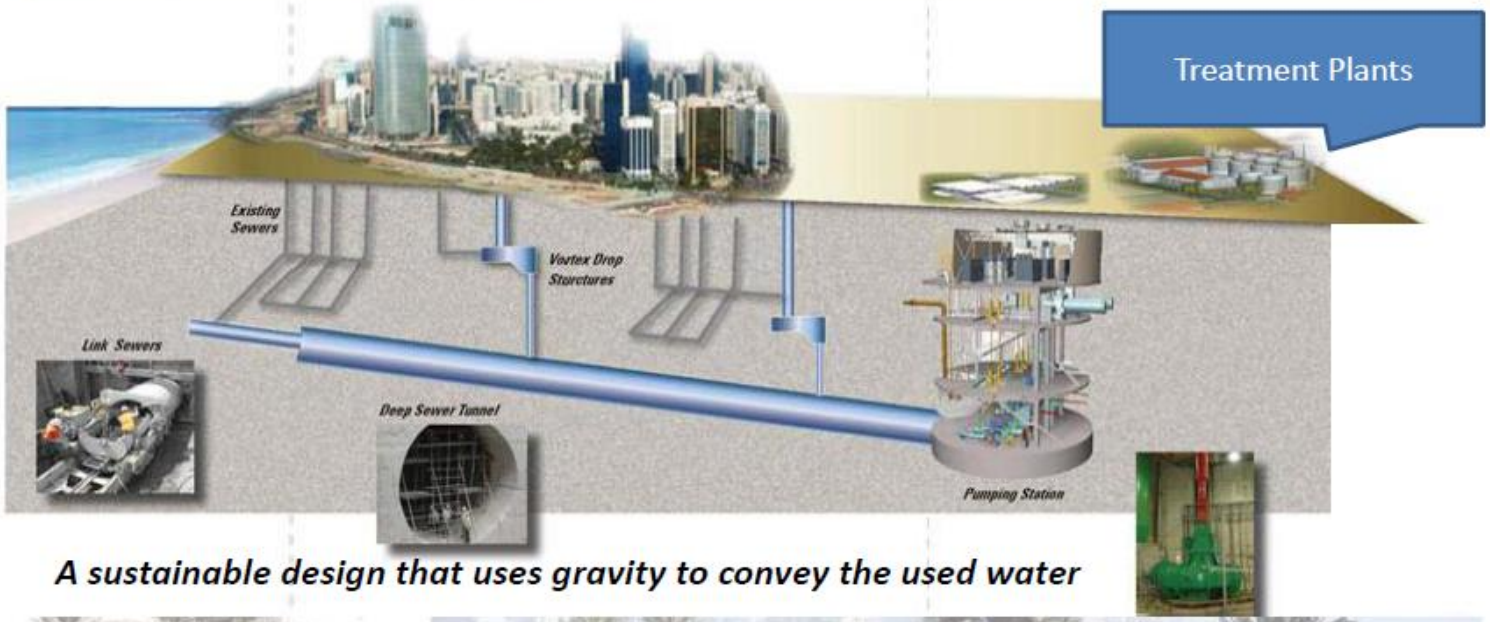
Recommended IDRIS Scheme



- Conveyance System:
  - Lateral interceptors
  - Main trunk sewer
- Terminal Pump Station
- New Doha South STW
- Treated Sewage Effluent (TSE) return system
- Decommissioning existing facilities (PSs & STW)

Deep Tunnel Gravity Sewer Scheme

How it works



A sustainable design that uses gravity to convey the used water

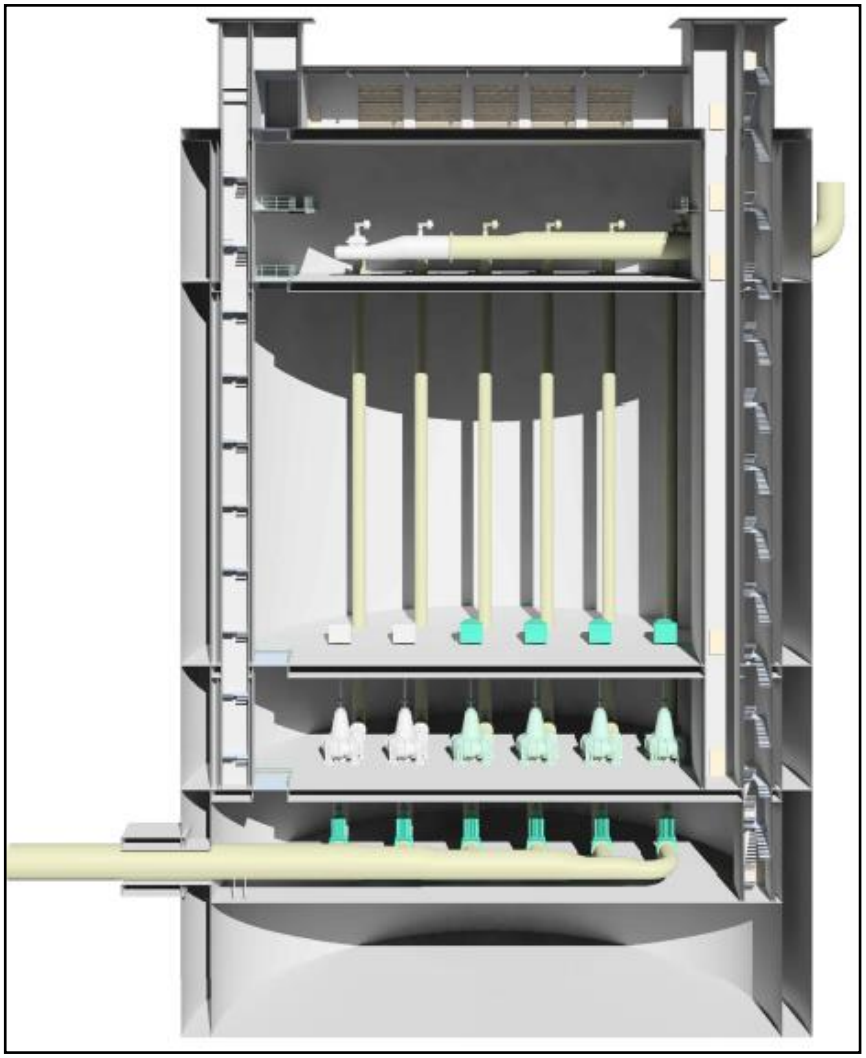
Component Details - Interceptors

- Approximate length of 73 km
- Inside diameters range from 400 to 2400 mm
- Installed depths range from 4m to 40m (average 23m)
- Installed by micro-tunnelling techniques – requiring special jacking pipe
- Divided into three main areas:
  - Central Doha
  - Al-Wakra
  - Mesaieed Industrial City

Component Details – Main Trunk

- Approximate length 40 km
- Inside diameters range from 3000-4500 mm
- Installed depths range from 24m to 59m (average 43m)
- Installed by bored tunnelling techniques – structural lining plus secondary corrosion protection lining
- Divided into three main segments:
  - North Branches
  - Central
  - South

Component Details – Terminal Pump Station

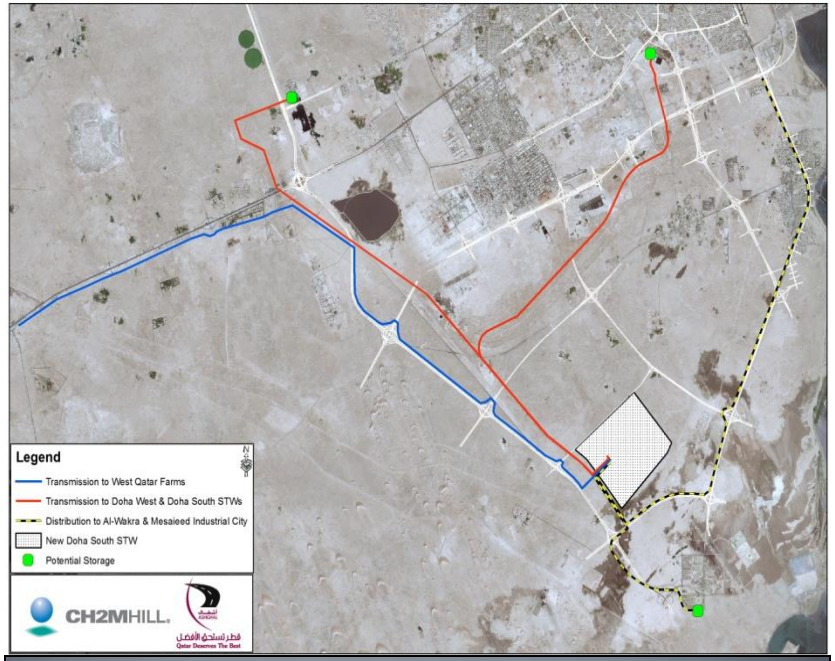


- Initial structure for mid-term capacity needs
- Provisions for installation of adjacent future station to accommodate ultimate flow
- Station depth – 70 m
- Pumping capacity – 12 m^3/sec
- Associated features:
  - Up front screening and flow splitting structure
  - Fully divided station for reliability and redundancy
  - Odour extraction & treatment system (station and partial trunk sewer)
  - Emergency power generation system

Component Details – New Doha South STW

- Initial capacity of 500,000 m^3/day; site configured for ultimate capacity of 2-3 times initial capacity
- Required treatment process:
  - Preliminary (flow measurement, screening & grit removal)
  - Primary clarification
  - Secondary/advanced treatment (BOD, nutrient removal & high level suspended solids reduction)
  - Disinfection
  - Sludge processing (thickening, stabilsation and dewatering)
  - Possible further sludge processing required (subject to Master Plan outcome)

Component Details – TSE Return System

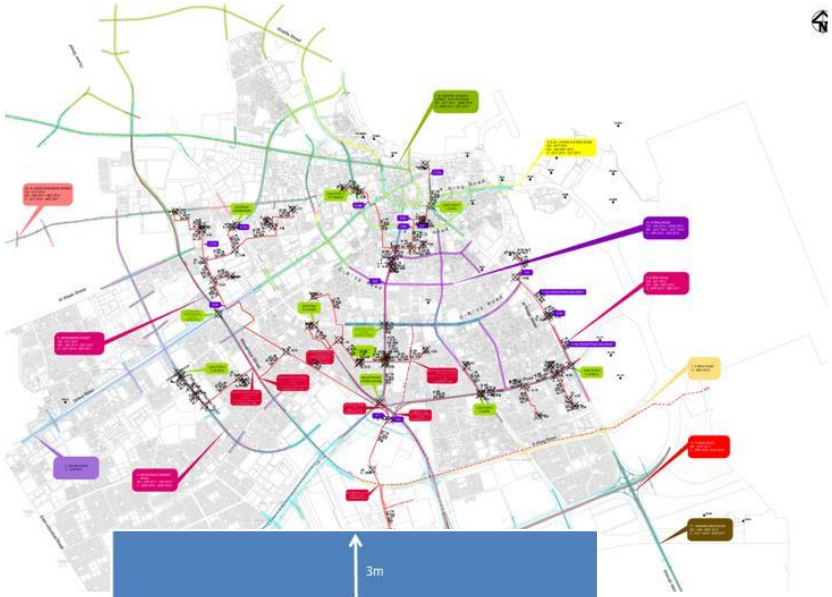


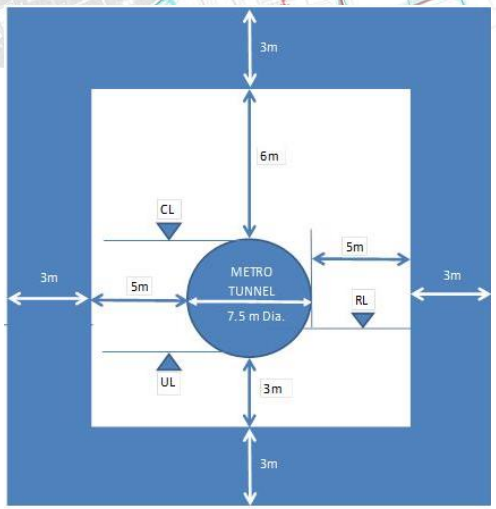
- Planned facilities:
  - TSE pump station – firm pumping capacity of 700,000 m^3/day (part of New Doha South STW)
  - Return pipelines to:
    - West Qatar Farms
    - Doha West & existing Doha South STWs
    - TSE distribution network for Mesaieed Industrial City & Al-Wakra
  - Additional TSE storage at main distribution centres
  - Final requirements pending adoption of Qatar Integrated Drainage Master Plan
- Near surface open cut construction techniques

Advanced Activities - Enabling Works

- Enabling Works initiated:
  - Geotechnical investigations:
    - GSI-01 – MTS & STW Boreholes
    - GSI-02 – Geophysical Investigations
    - GSI-03 – LIS & TSE Boreholes and Environmental Testing
  - Environmental Consultant procurement – prepare two EIAs
  - Topographic surveys

Advanced Activities - Stakeholder Engagement

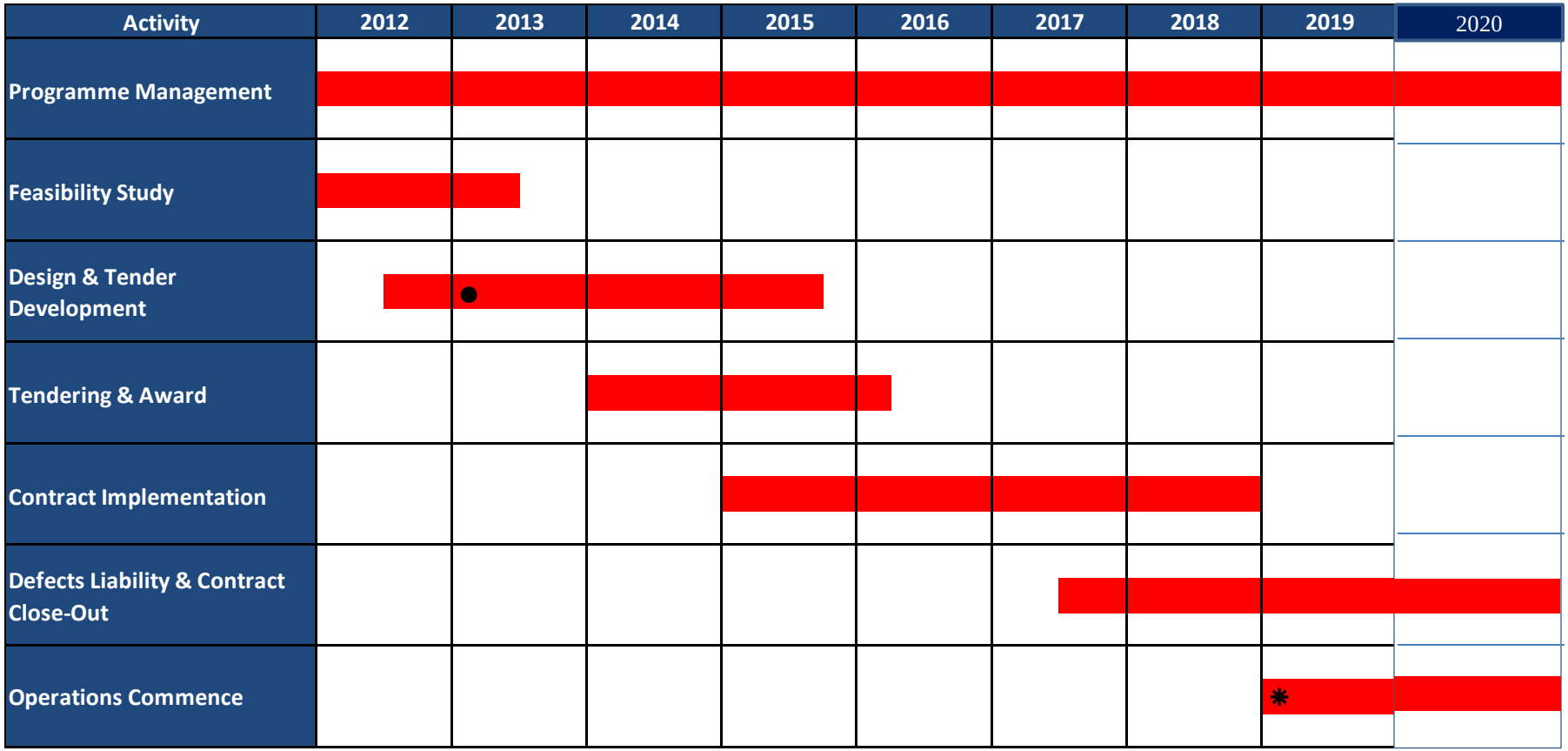




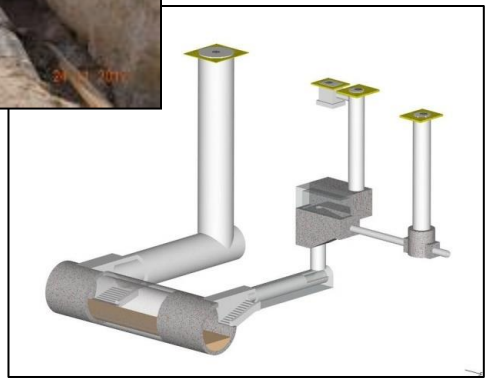
CL - METRO tunnel CROWN LEVEL, mQNHD
RL - METRO tunnel RAIL LEVEL, mQNHD
UL - METRO UNDERSIDE LEVEL, mQNHD

- Key stakeholders:
  - MMUP – Ministry of Municipality and Urban Planning
  - MoE - Ministry of Environment
  - Qatar Rail Company
  - KAHRAMAA- Qatar General Electricity & Water & Company
  - Qatar Petroleum
  - World Cup 2022 Supreme Committee
- Critical interface issue - avoiding potential clashes:
  - Expressways
  - Metro
  - Abu Hamour surface water tunnel
  - MMUP concept plans

Programme Baseline Schedule



Programme Implementation Considerations



- Packaging strategy:
  - 8 construction packages
- Delivery approach:
  - Design/Build – Interceptors, Main Trunk & TSE Return System
  - Design/Build/Operate – TPS & STW
  - Design/Bid/Build – PS Decommissioning
- Tender documents will be based on a Reference Design

Overall Procurement Process

Looking for best international companies with culture aligned with Ashghal Vision

- Early market engagement
- Prequalification (by construction package)
- Tendering (by specific implementation contract)
- Contract awards

QIDMP TSE Standards

These become the IDRIS Guaranteed Performance Levels

Current and Proposed Effluent Discharge Standards

Parameter	Units	Ashghal Current Standard	QIDMP Proposed (90%ile)	QIDMP Proposed (100%ile)
TSS	mg/L	5	5	10
BOD5	mg/L	5	5	10
COD	mg/L	50	50	100
pH		6-9	6-9	5.5-9.5
Ammonia	mg-N/L	1	1	5
Total Nitrogen	mg-N/L	10	5	10
Total Phosphorous	mg-P/L	NA	1	3
Dissolved Oxygen	mg/L	2	2	NA
Free Chlorine	mg/L	0.5-1.0	0.5-1.0	2.0
Turbidity	NTU	2	2	5
Total Dissolved Solids	mg/L	<2,000	<500	1,500
Faecal Coliform	MPN/100 mL	None	None	10
Intestinal Nematodes (Helminths)	Count/L	<1	ND	5
Protozoa (Giardia)	Count/40L	<1	<1	5
Enteric Viruses	**Count/40L**	**<1**	**<1**	**10**

Ashghal standards reflect very high water quality requirements

Comparison of TSE Criteria for "Unrestricted" Reuse

Parameter	Units	QIDMP Proposed (90%ile/100%ile)	IDRIS Contract TPS/STW-01 (90%ile/max)	Queensland, Australia Class A+	Australia National Standards	US EPA Guidelines for Water Reuse (2012)	California Title 22
Treatment Level					tertiary with pathogen reduction	secondary, filtration, disinfection	oxidized, filtered, disinfected
TSS	mg/L	5/10	5/10	5		5	
BOD5	mg/L	5/10	5/10	10		10	
COD	mg/L	50/100	50/75				
pH		6-9	6-9	6-8.5	6-8.5	6-9	
Ammonia	mg-N/L	1/5	1/2				
Total Nitrogen	mg-N/L	5/10	10/20				
Total Phosphorous	mg-P/L	1/3	1/2				
Dissolved Oxygen	mg/L	2/NA	2/NA				
Free Chlorine	mg/L	0.5-1.0/2.0	1.0/2.0	0.2-0.5	1.0	0.5 – 1.0	
Turbidity	NTU	2/5	0.2/0.5	<2/5	<2/<5	2/5	0.2/0.5
Total Coliform	MPN/100 mL						2.2/23/240
Faecal Coliform	MPN/100 mL	ND/10	ND/14	<10 (E. Coli)	<10 (E. Coli)	ND/14	
Intestinal Nematodes (Helminths)	Count/L	ND/5	ND/<1	5 log removal			
Protozoa (Giardia)	Count/40L	<1/5	ND/<1	5 log removal			
Enteric Viruses	Count/40L	<1/10	ND/<1	6 log removal			5 log removal

QIDMP Further Disinfection Requirements

Table 11.34 Adopted Log Removal Through Various Treatment Process

Treatment Process	Indicative Log Reductions			
	Bacteria	**Viruses**	**Protozoa**	**Helminths**
Secondary (BNR)	0.5	0.5	0.5	0.5
Media Filtration	0	0	0	1.0
Ultrafiltration	3.5	2.5	4.0	4.0
UV	3.0	1.5	1.3	0
Chlorination	2.0	4.0	0	0
Total (w/o UV)	6.0	7.0	4.5	5.5
Total (w/UV)	9.0	8.5	5.8	5.5
Required Removal (1)	**5.0**	**6.5**	**5.0**	**5.0**

(1) Standard log removal for Class A+ recycled water (Queensland Department of Natural Resources and Water)

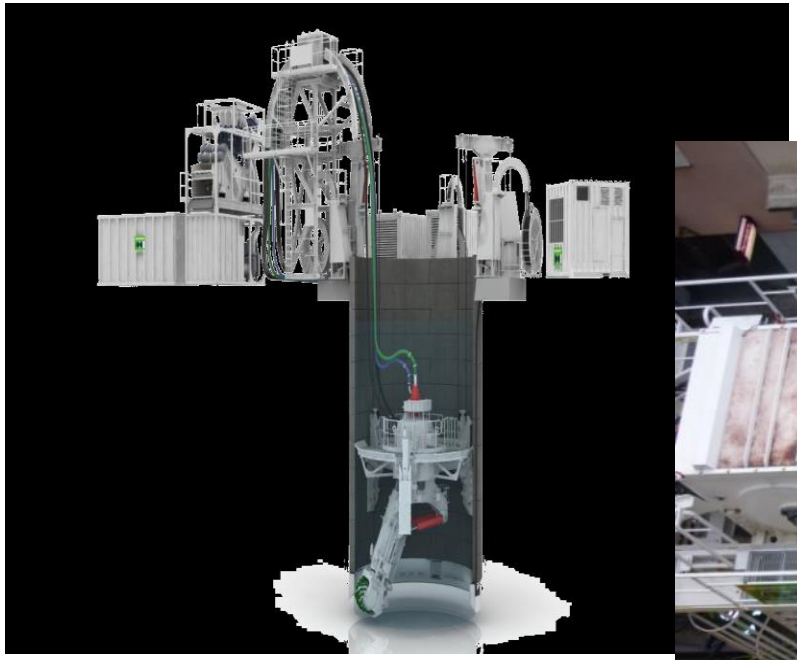
Indicative Log Reductions of Enteric Pathogens

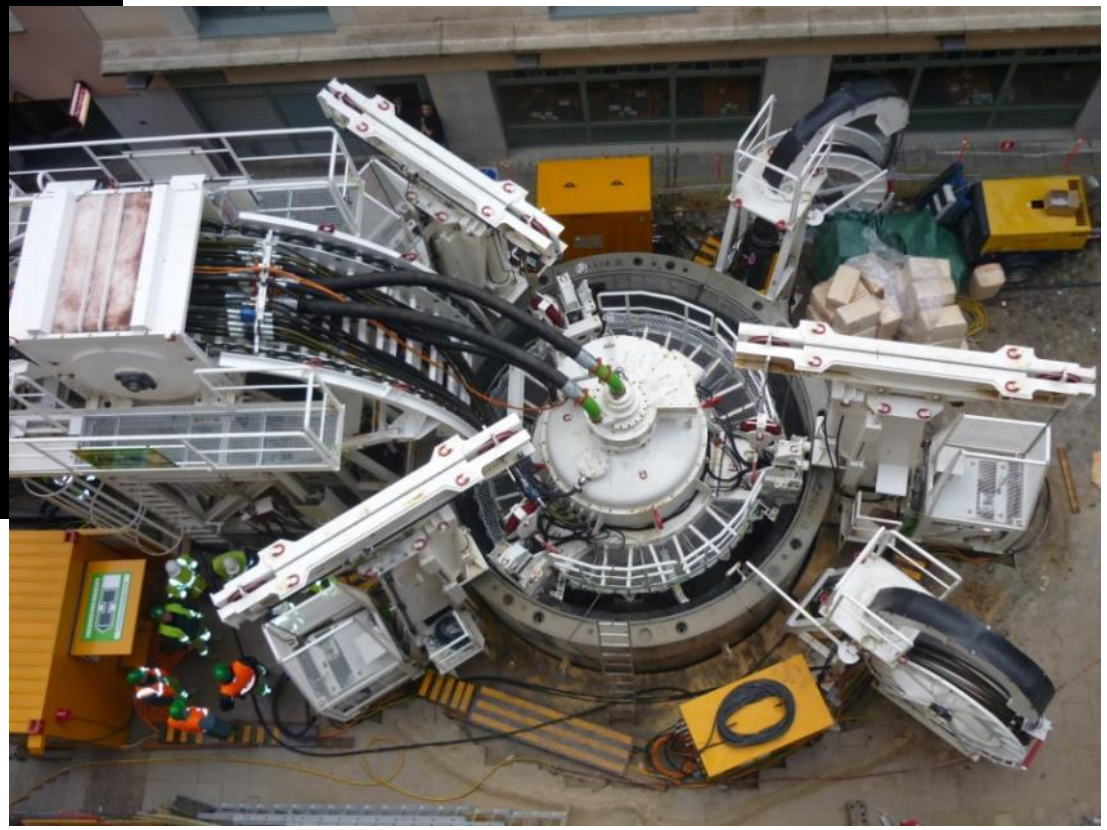
Treatment	Indicative Log Reductions (1)							
	E.coli	Bacterial Pathogens	Viruses	Phage	Giardia	Crypto	Clostridium perfringens	Helminths
Primary Treatment	0-0.5	0-0.5	0-0.1	N/A	0.5-1.0	0-0.5	0-0.5	0-2.0
Secondary Treatment	1.0-3.0	1.0-3.0	0-2.0	0.5-2.5	0.5-1.5	0.5-1.0	0.5-1.0	0-2.0
Dual Media Filtration	0-1.0	0-1.0	0.5-3.0	1.0-4.0	1.0-3.0	1.5-2.5	0-1.0	2.0-3.0
Membrane Filtration	3.5 ->6.0	3.5->6.0	2.5->6.0	3.0->6.0	>6.0	>6.0	>6.0	>3.0
Lagoon Storage	1.0-5.0	1.0-5.0	1.0-4.0	1.0-4.0	3.0-4.0	1.0-3.5	N/A	1.5->3.0
Chlorination	2.0-6.0	2.0-6.0	1.0-3.0	0-2.5	0.5-1.5	0-0.5	1.0-2.0	0-1.0
Ozonation	2.0-6.0	2.0-6.0	3.0-6.0	2.0-6.0	N/A	N/A	0-0.5	N/A
UV Light	2.0->4.0	2.0->4.0	>1.0 adenovirus >3.0 enterovirus, hepatitis A	3.0-6.0	>3.0	>3.0	N/A	N/A
Wetlands – surface flow	1.5-2.5	1.0	N/A	1.5-2.0	0.5-1.5	0.5-1.0	1.5	0-2.0
Wetlands – subsurface flow	0.5-3.0	1.0-3.0	N/A	1.5-2.0	1.5-2.0	0.5-1.0	1.0-3.0	N/A

(1) Source: Draft Australian National Guidelines for Water Recycling (NRMMC & EPHC 2005).

Innovative Technologies Introduced

Vertical Shaft Sinking Machine VSM

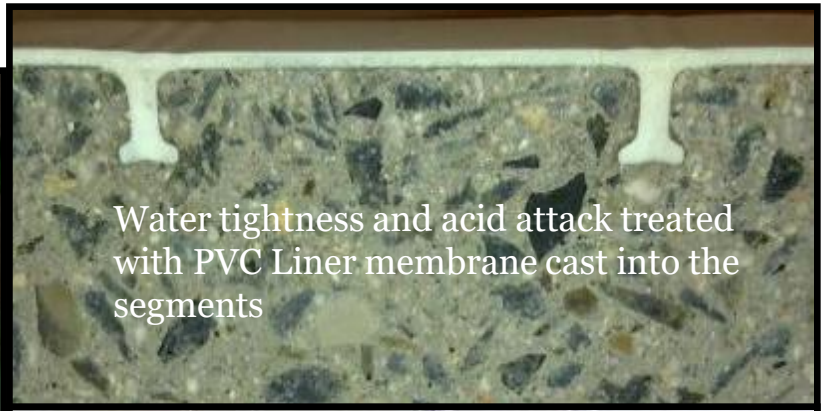




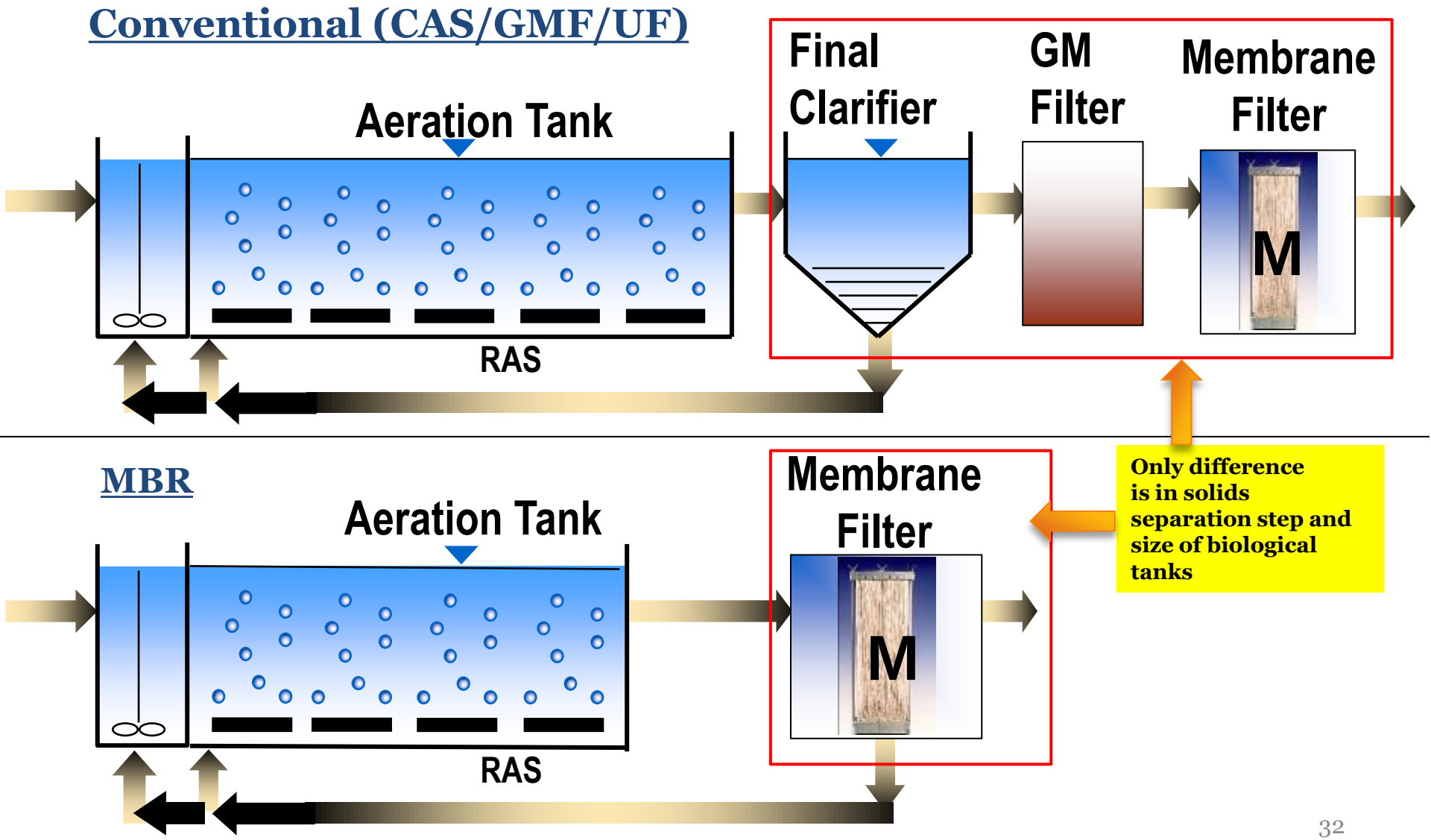
Max. 50m depth
Ø ID 4500, OD 5200

Innovative Technologies Introduced

Integrated HDPE Liner Segments



Innovative Technologies Introduced

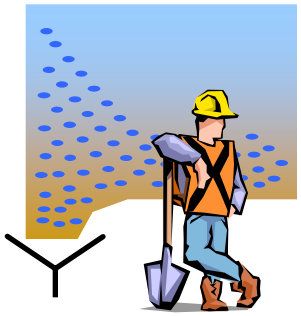


Wastewater Treatment Plant Summary
TAKE AWAY

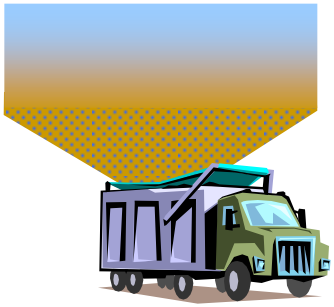
Steps

1. Screen

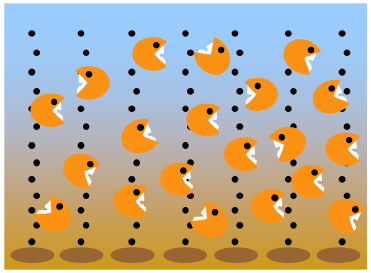
2. Grit Removal



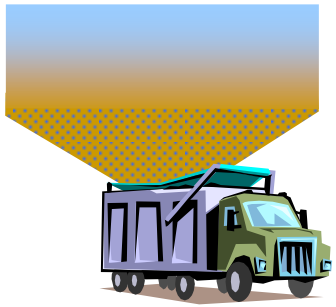
3. Solids Settling 1st



4. Biological Treatment



5. Solids Settling 2nd



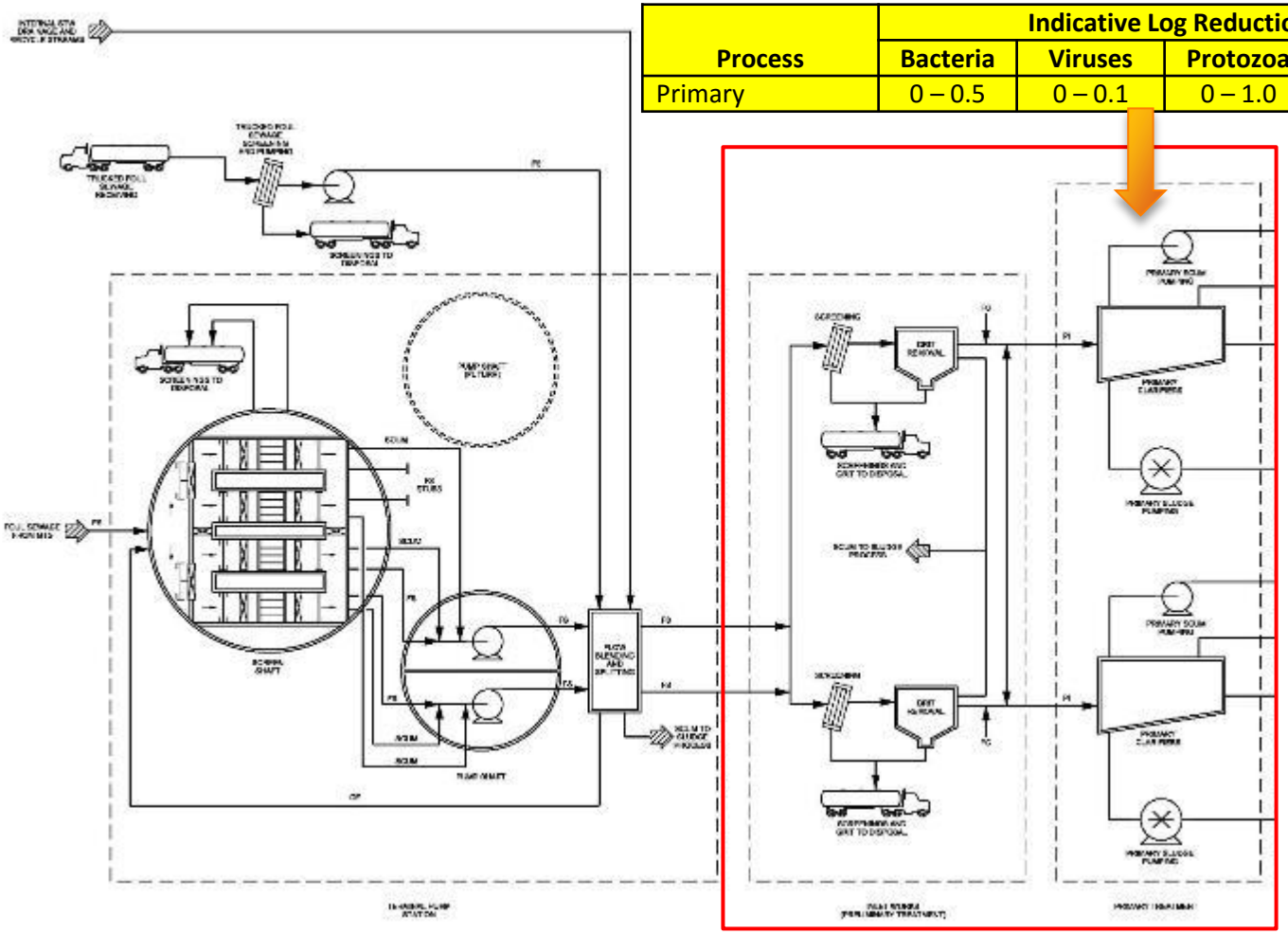
6. Filtration

7. Disinfection

Water Reuse

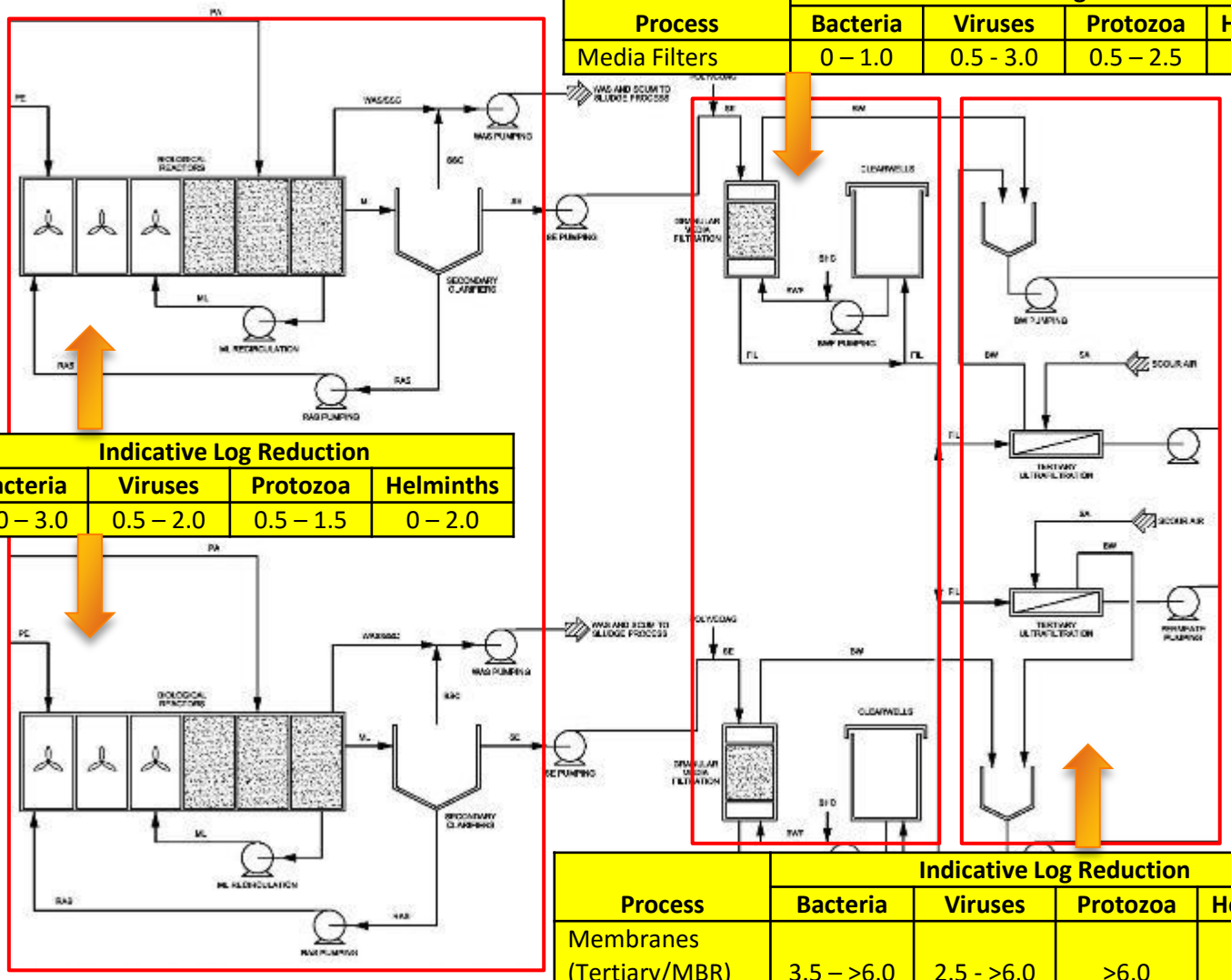
Treatment – Preliminary/Primary

Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
Primary	0 – 0.5	0 – 0.1	0 – 1.0	0 – 2.0



Treatment– Secondary/Tertiary

Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
Media Filters	0 – 1.0	0.5 - 3.0	0.5 – 2.5	2.0 – 3.0

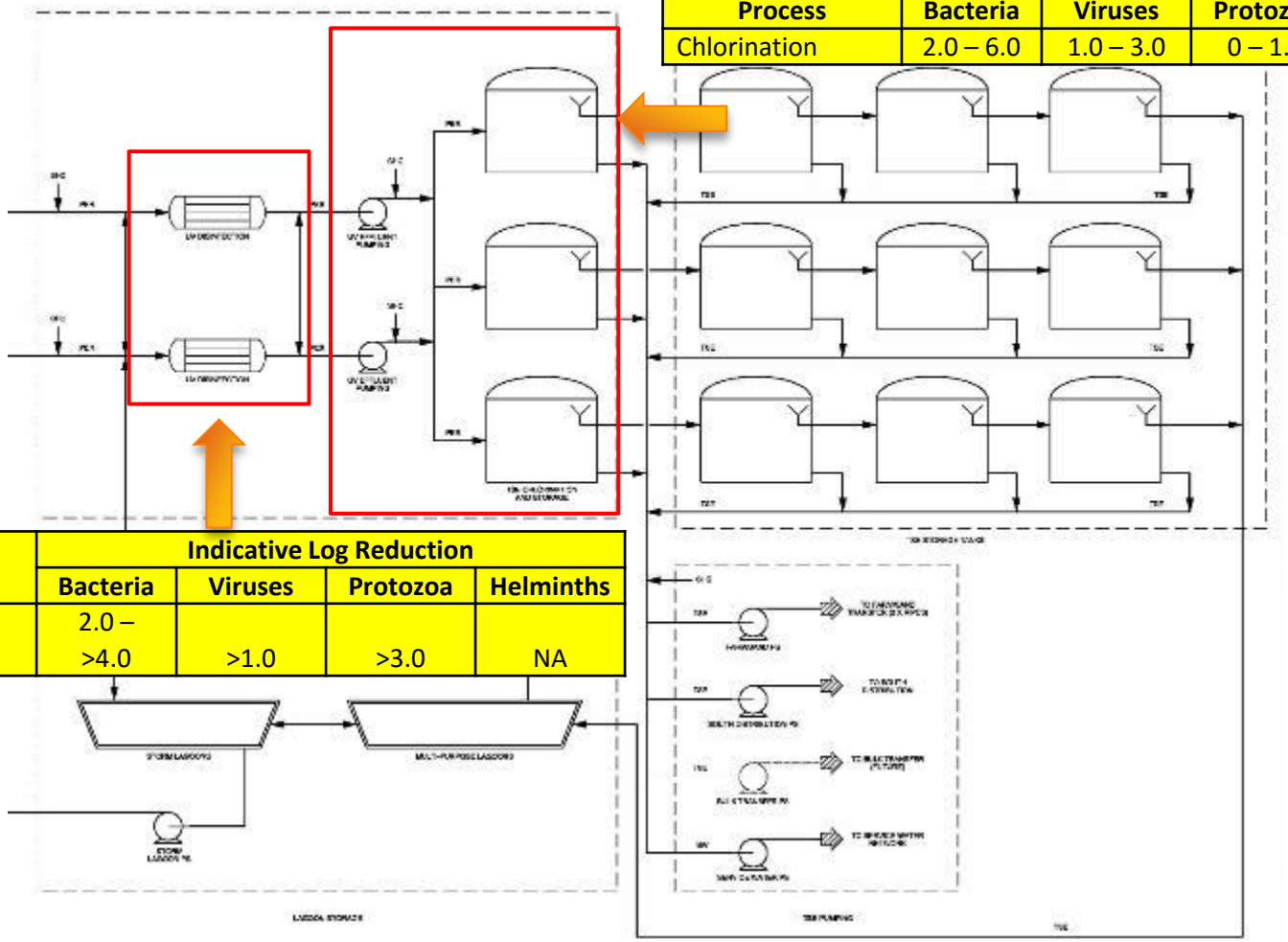


Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
Secondary	1.0 – 3.0	0.5 – 2.0	0.5 – 1.5	0 – 2.0

Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
Membranes (Tertiary/MBR)	3.5 – >6.0	2.5 - >6.0	>6.0	>6.0

Treatment– Disinfection

Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
Chlorination	2.0 – 6.0	1.0 – 3.0	0 – 1.5	0 – 1.0



Process	Indicative Log Reduction			
	Bacteria	Viruses	Protozoa	Helminths
UV Light	2.0 – >4.0	>1.0	>3.0	NA

Summary

- Accept MBR as a proven, equivalent treatment process
- Note that strong incentives exist for the DBOM Contractor to select the best, proven technology for the long-term
- Allow Tender Alternatives, as currently planned
- Note that other viable alternatives exist, e.g. Sequencing Batch Reactor (SBR)
- PWA Senior Managers to decide based on Cost-Benefit
- Let the Market help us decide!

Questions?

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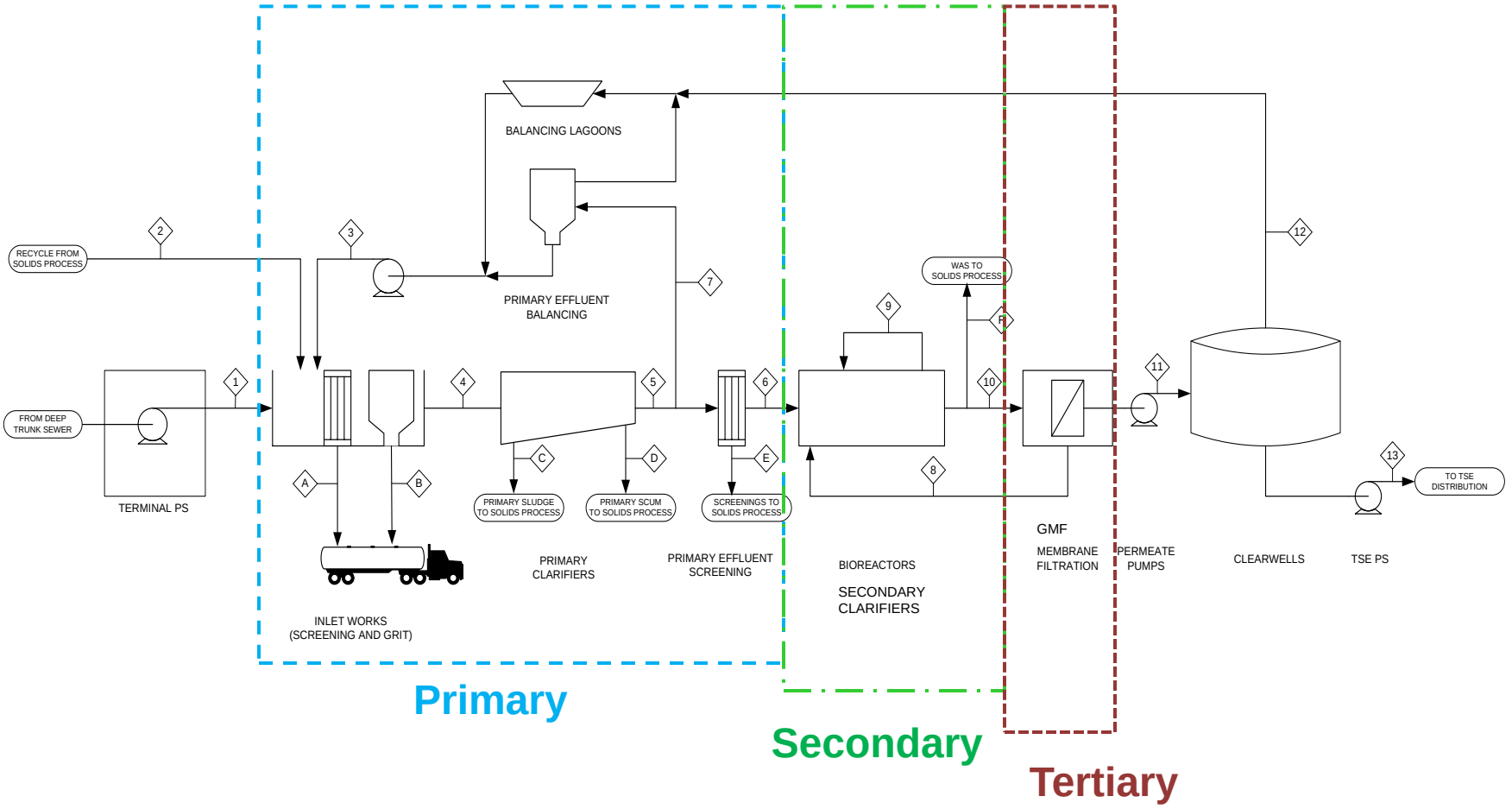
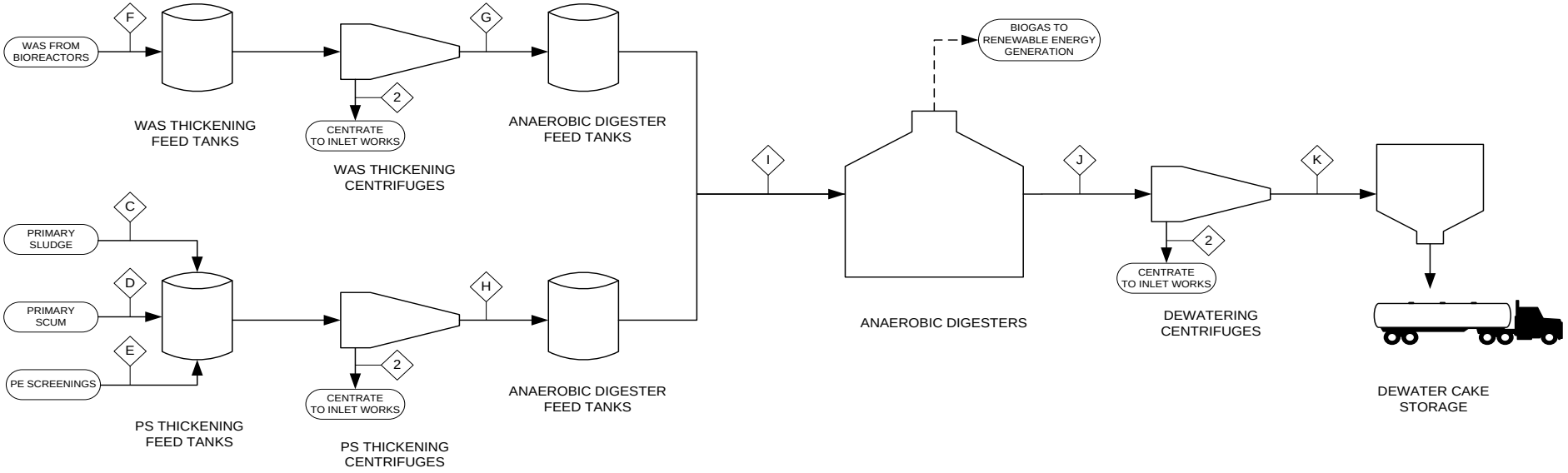
Back-Up Slides

Back-Up Slides

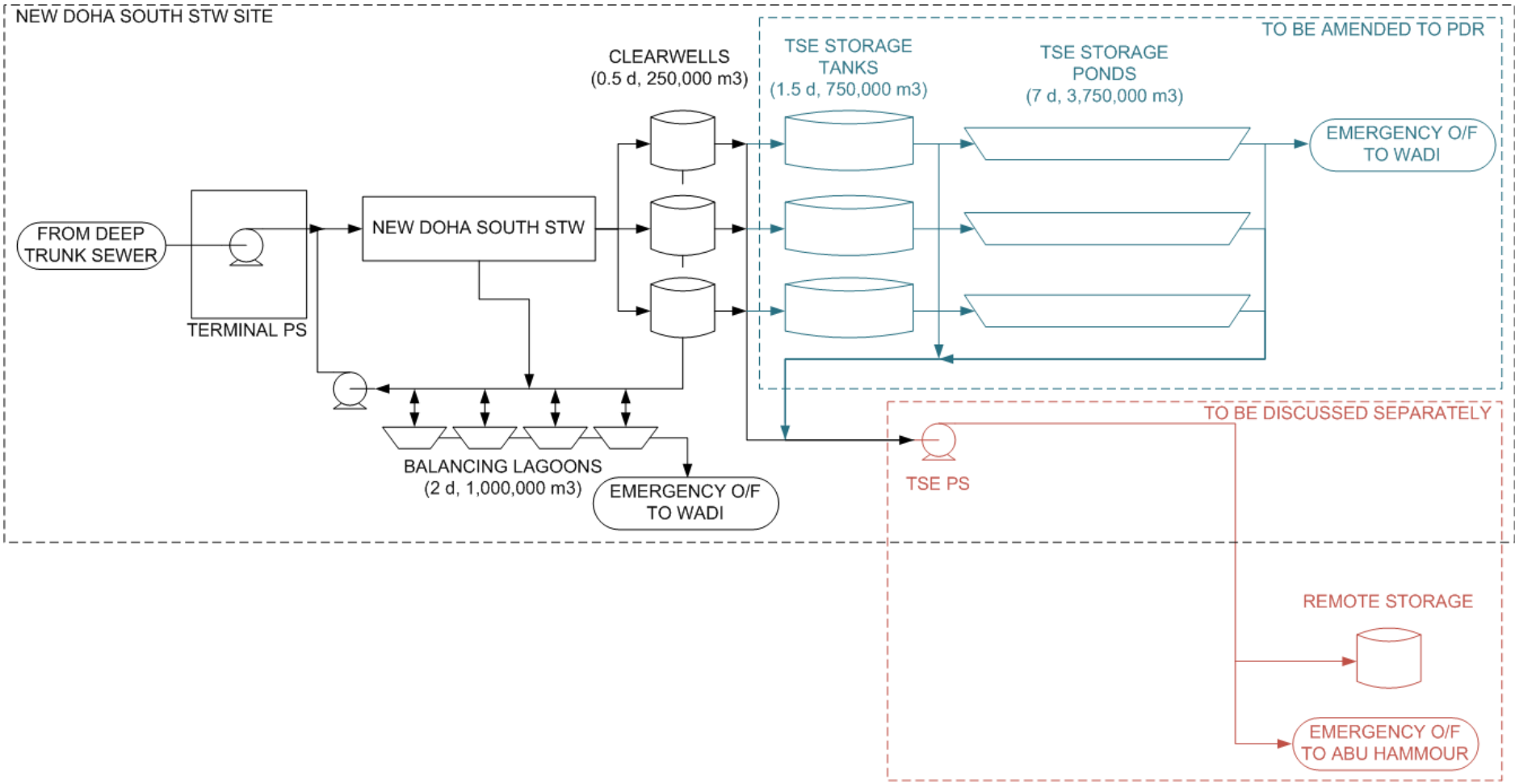
Treatment process diagram – liquid stream



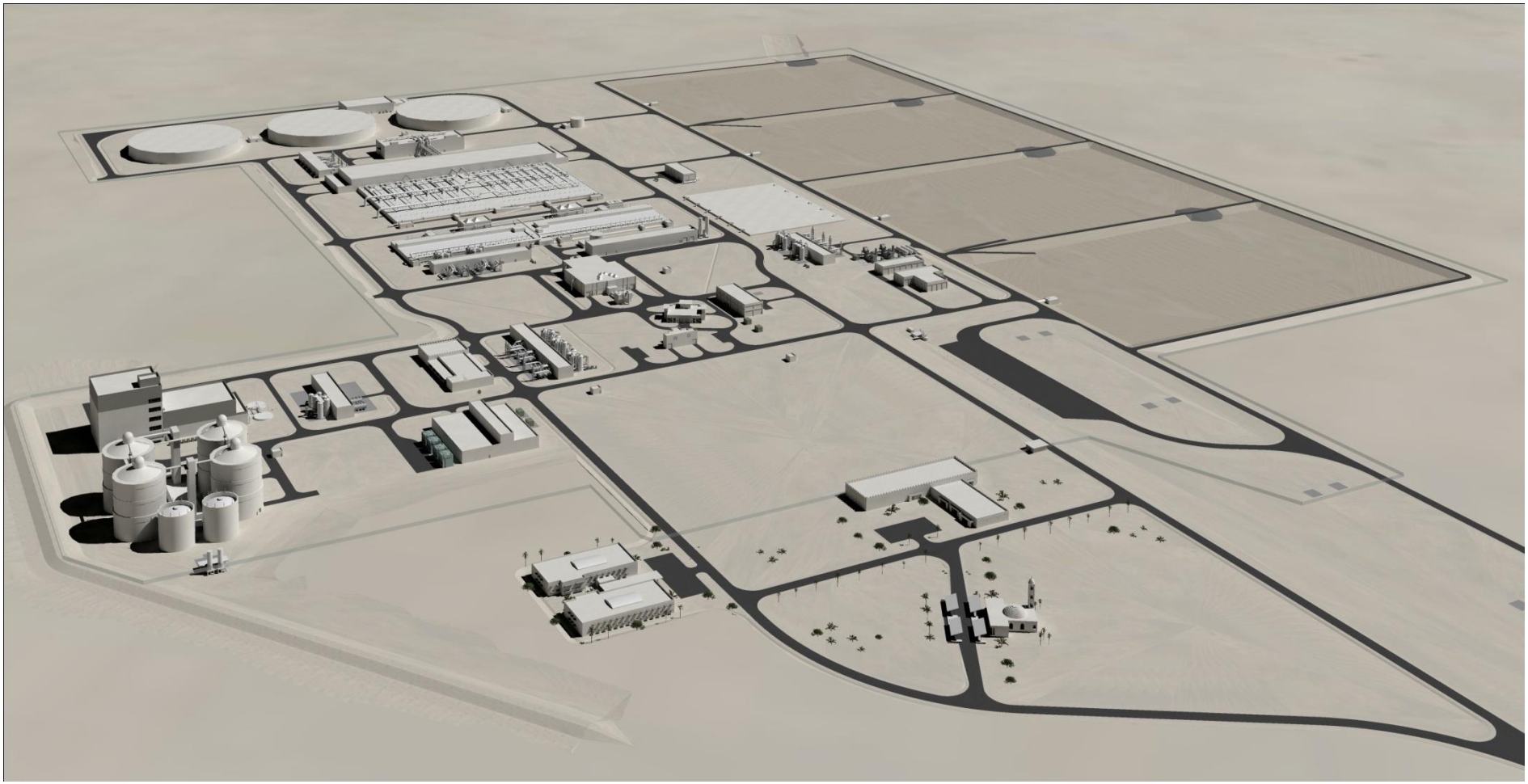
Treatment process diagram – solids stream



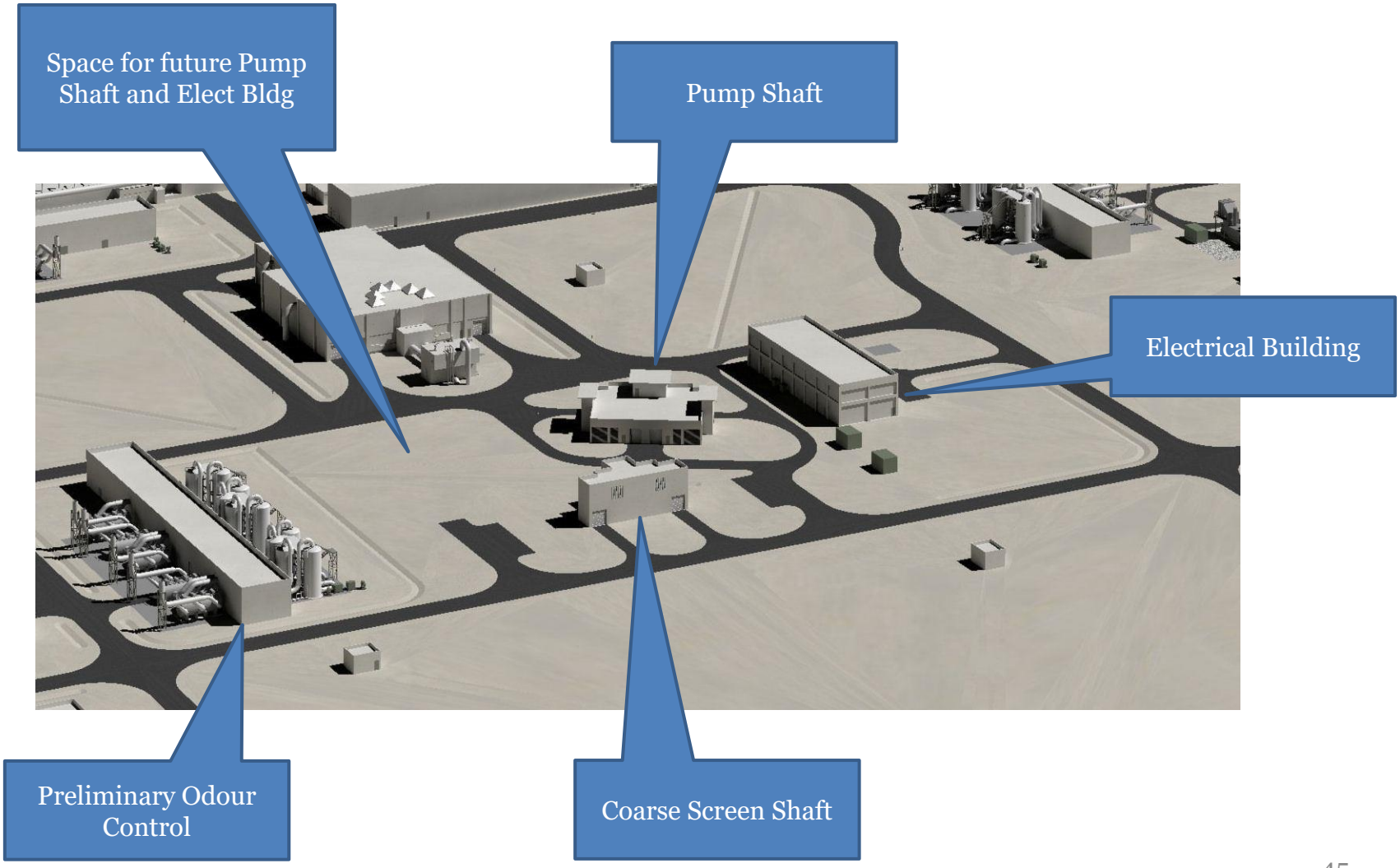
TSE storage and distribution - Water Reuse



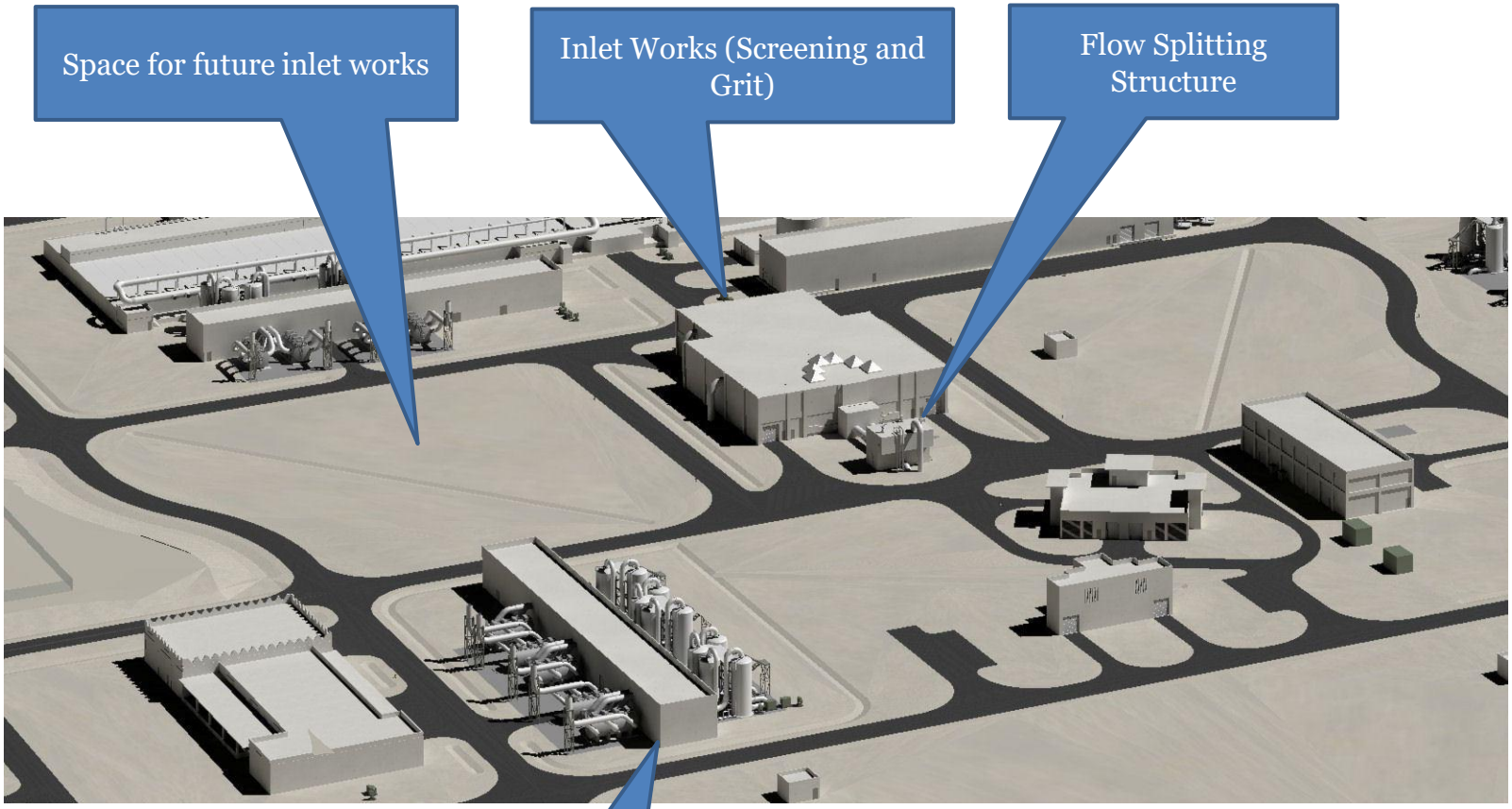
Overview of New Doha South STW preliminary design



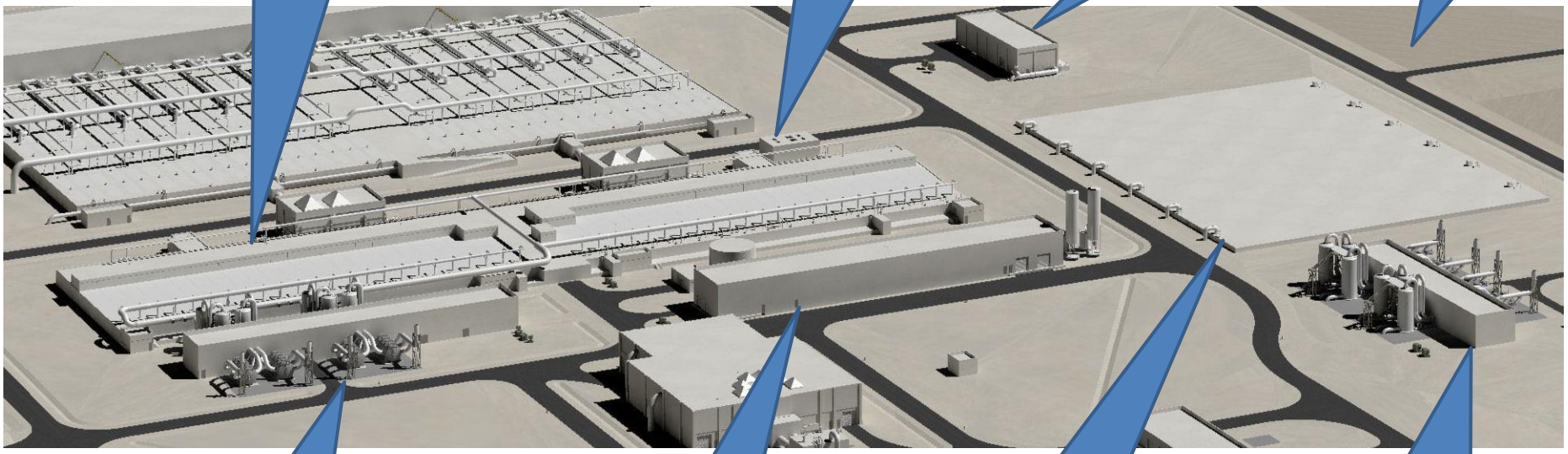
Terminal Pumping Station - TPS



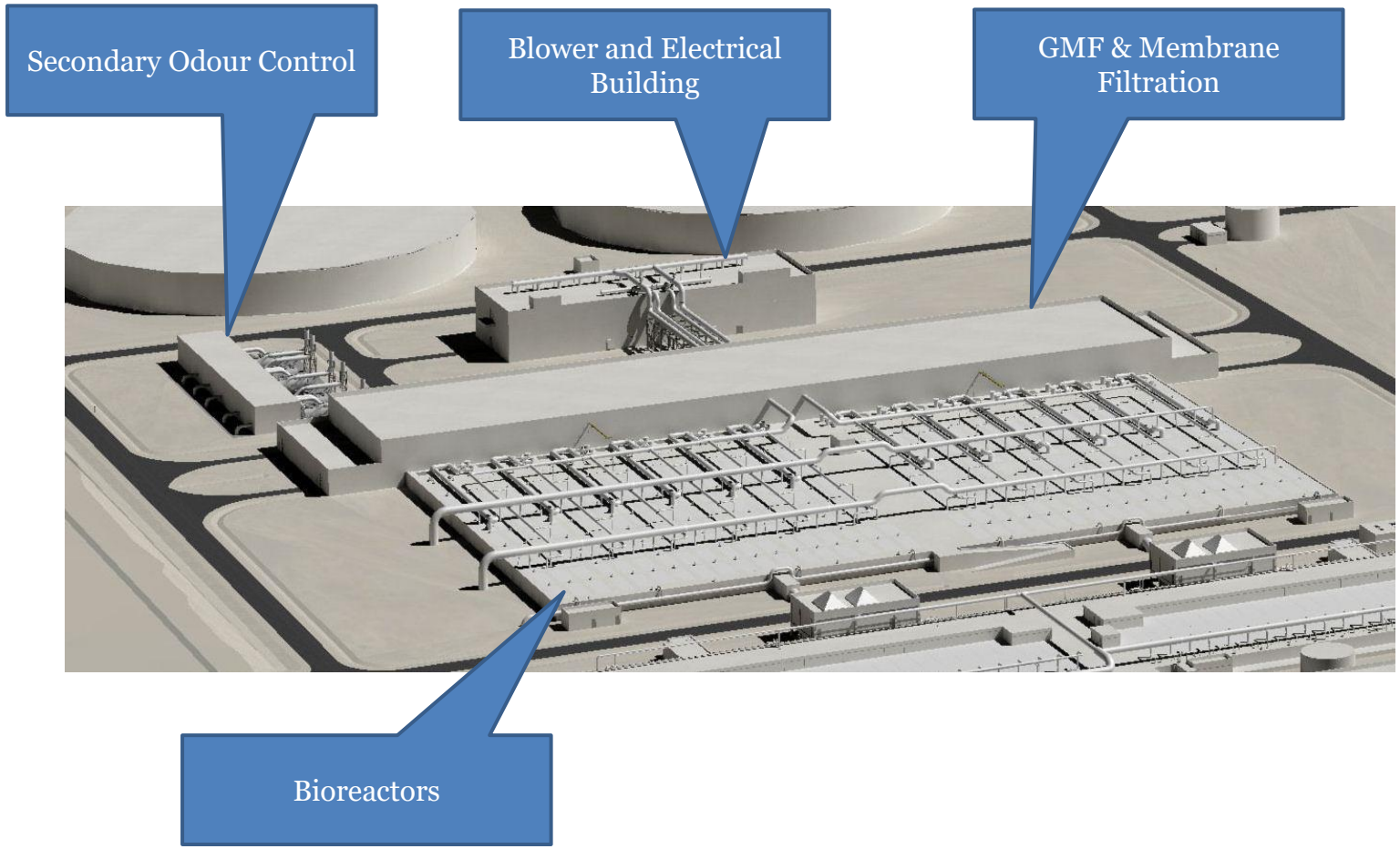
Headworks


Space for future inlet works
Inlet Works (Screening and Grit)
Flow Splitting Structure
Preliminary Odour Control

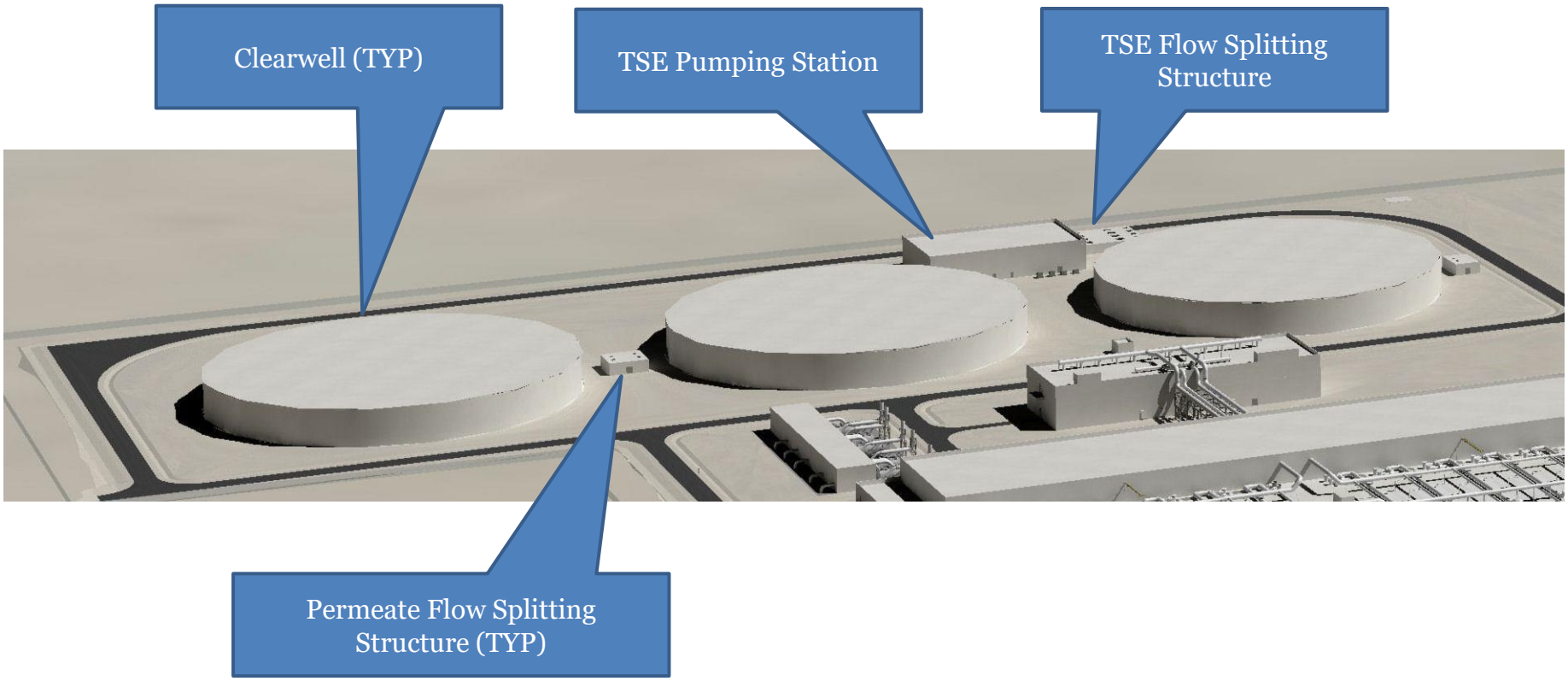
Primary Treatment



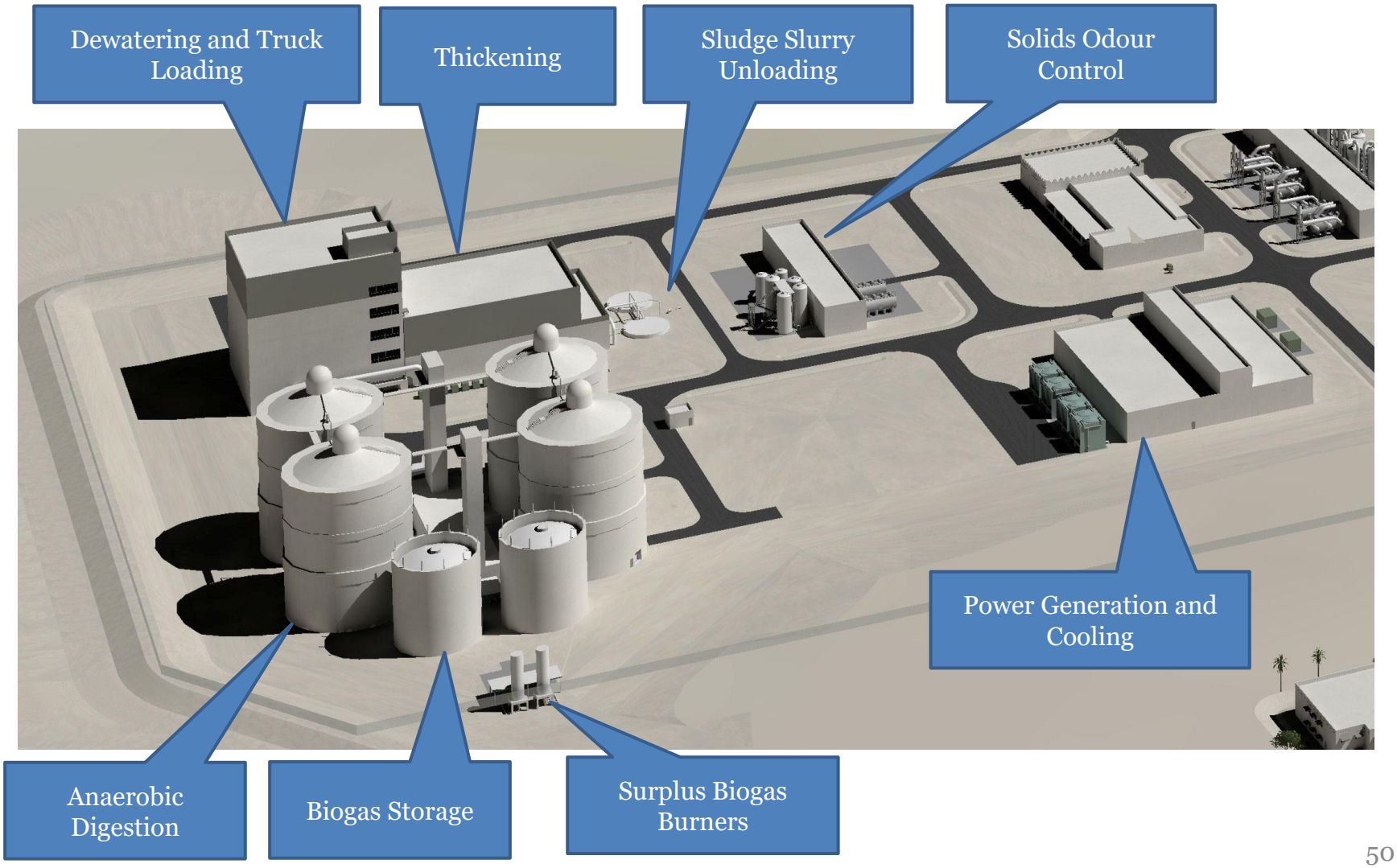
Secondary and Tertiary Treatment



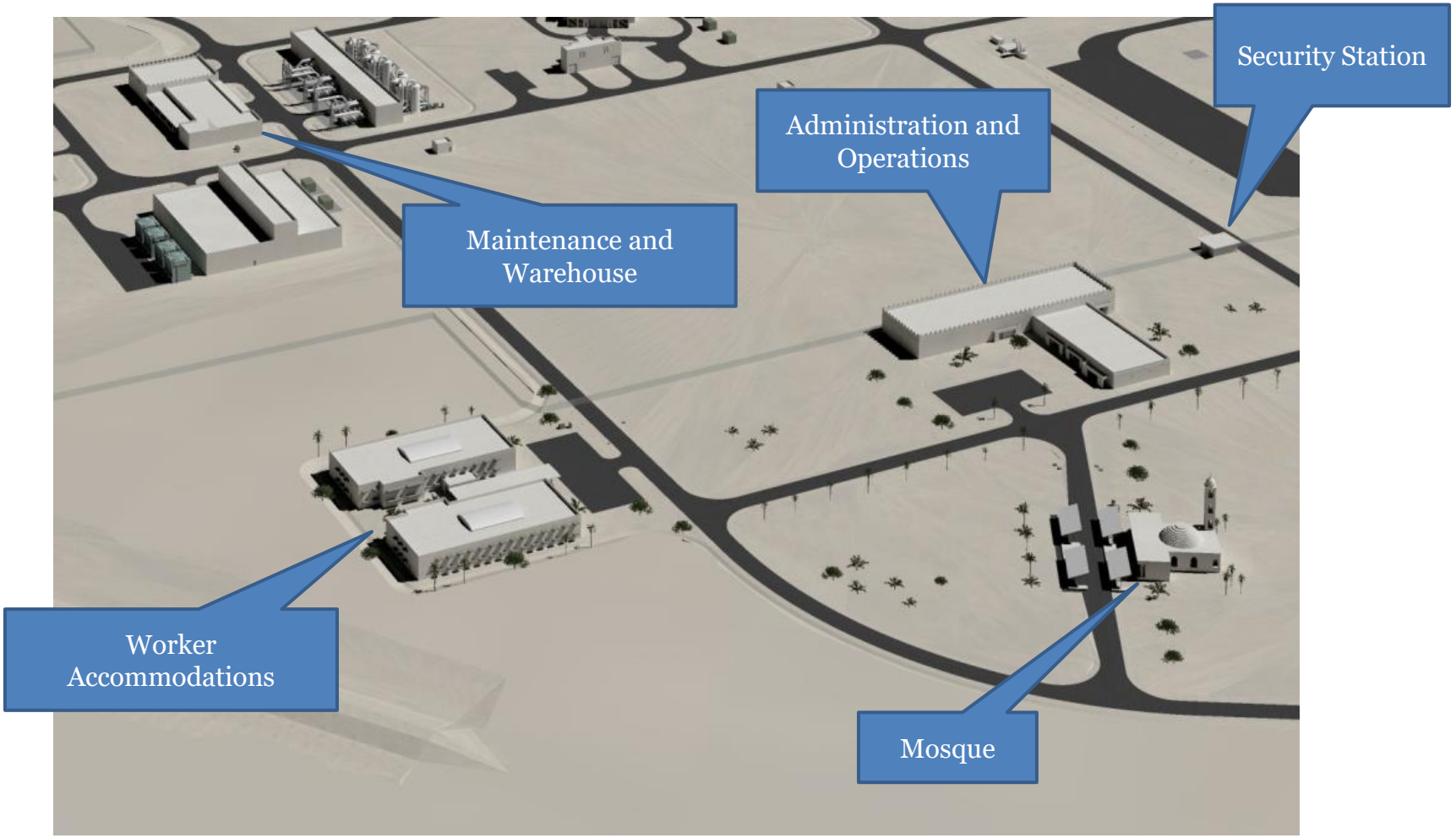
Disinfection and TSE Storage and Pumping – Water Reuse



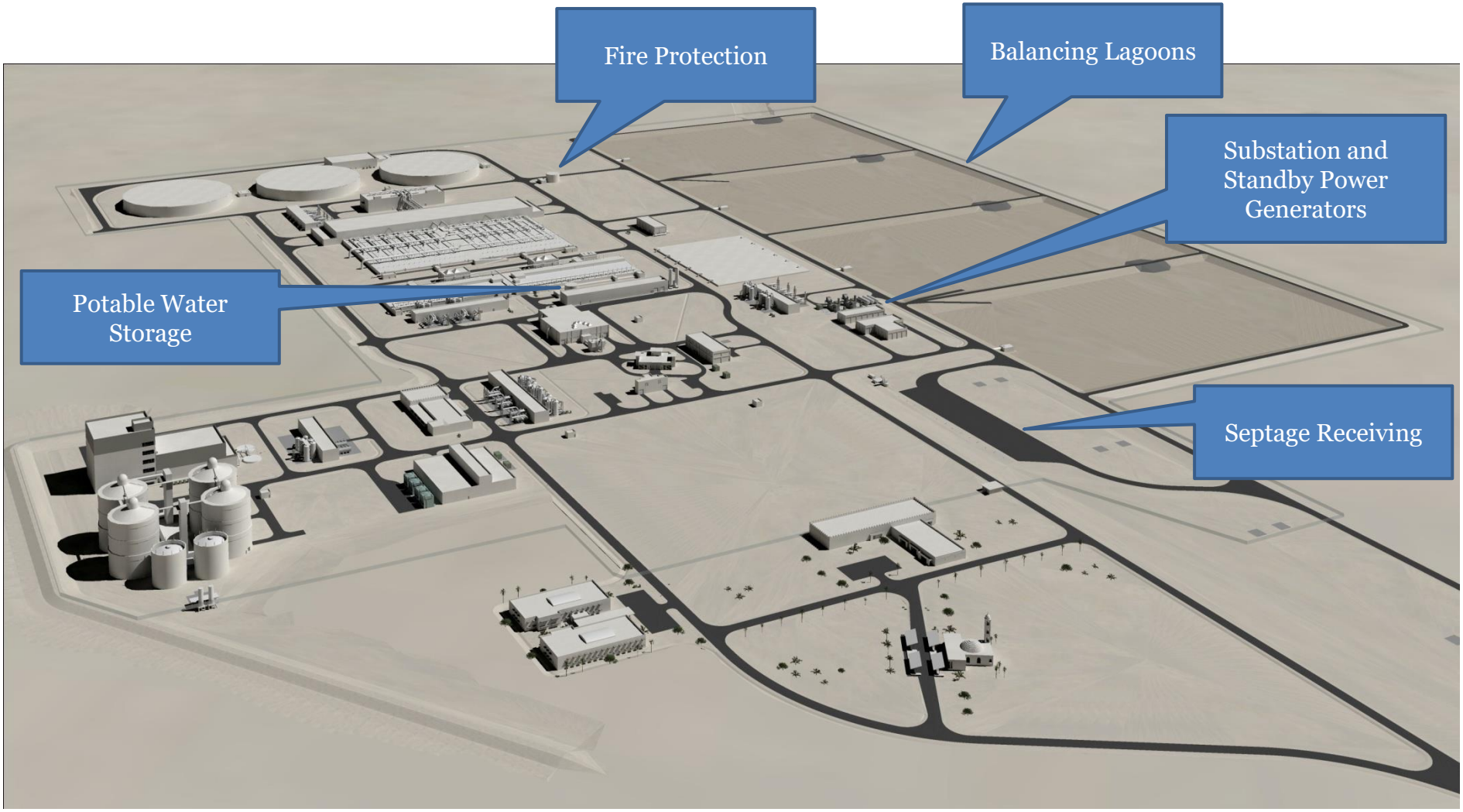
Sludge Treatment



Non-process Buildings



Other Facilities



Discussion Timeline

October 2012

Gateway 2: Approval of CDR; included MBR as recommended reference design

April 2013

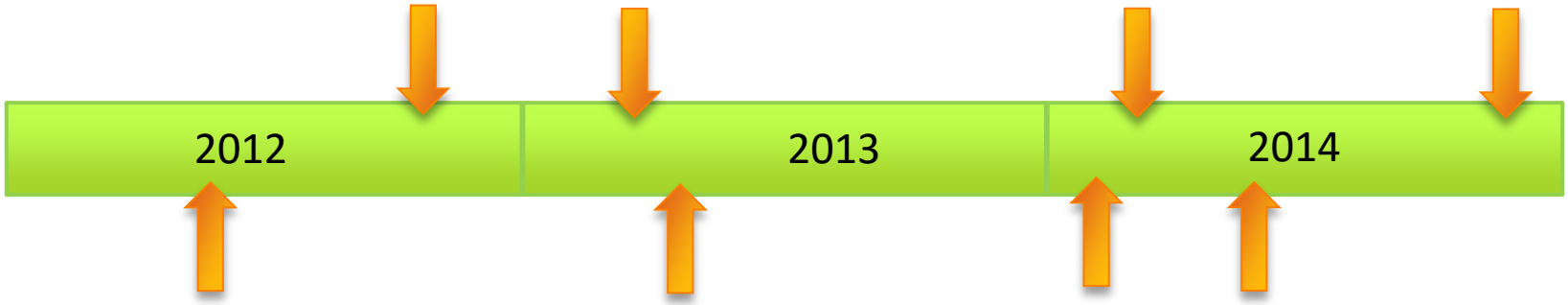
Final Preliminary Design Report submitted; MBR used as reference design

February 2014

Draft Final Contract TPS/STW-01 Tender Documents submitted; included both CAS & MBR options

November 2014

IA Director confirmed encouragement of alternatives that meet Guaranted Performance Levels



June 2012

Meeting of Ashghal Senior Management; approved overall conceptual plan for IDRIS; noted that MBR to be used as reference design

May 2013

Decision by IA Director to allow both CAS & MBR as acceptable technologies in Tender Documents confirmed

January 2014

Gateway 3: Approval to Tender TPS/STW; included both CAS and MBR as acceptable options

May 2014

Instruction given to remove MBR as acceptable option for compliant proposal; Contract TPS/STW-01 floated

Viable Tender Alternative - MBR

Key Features

- Proven, modern technology, continuously improving
- Multi-barrier treatment, including ultrafiltration and two-stage disinfection
- Very high water quality, suitable for unrestricted re-use
- Meets the highest international standards for recycled water
- Significantly smaller footprint
- Lower CAPEX, similar OPEX
- Reduced time to construct
- Highly resilient: 2 treatment trains, 12 bioreactors, 24 MBR tanks, 528 MBR skids

The Largest MBR Plants Worldwide

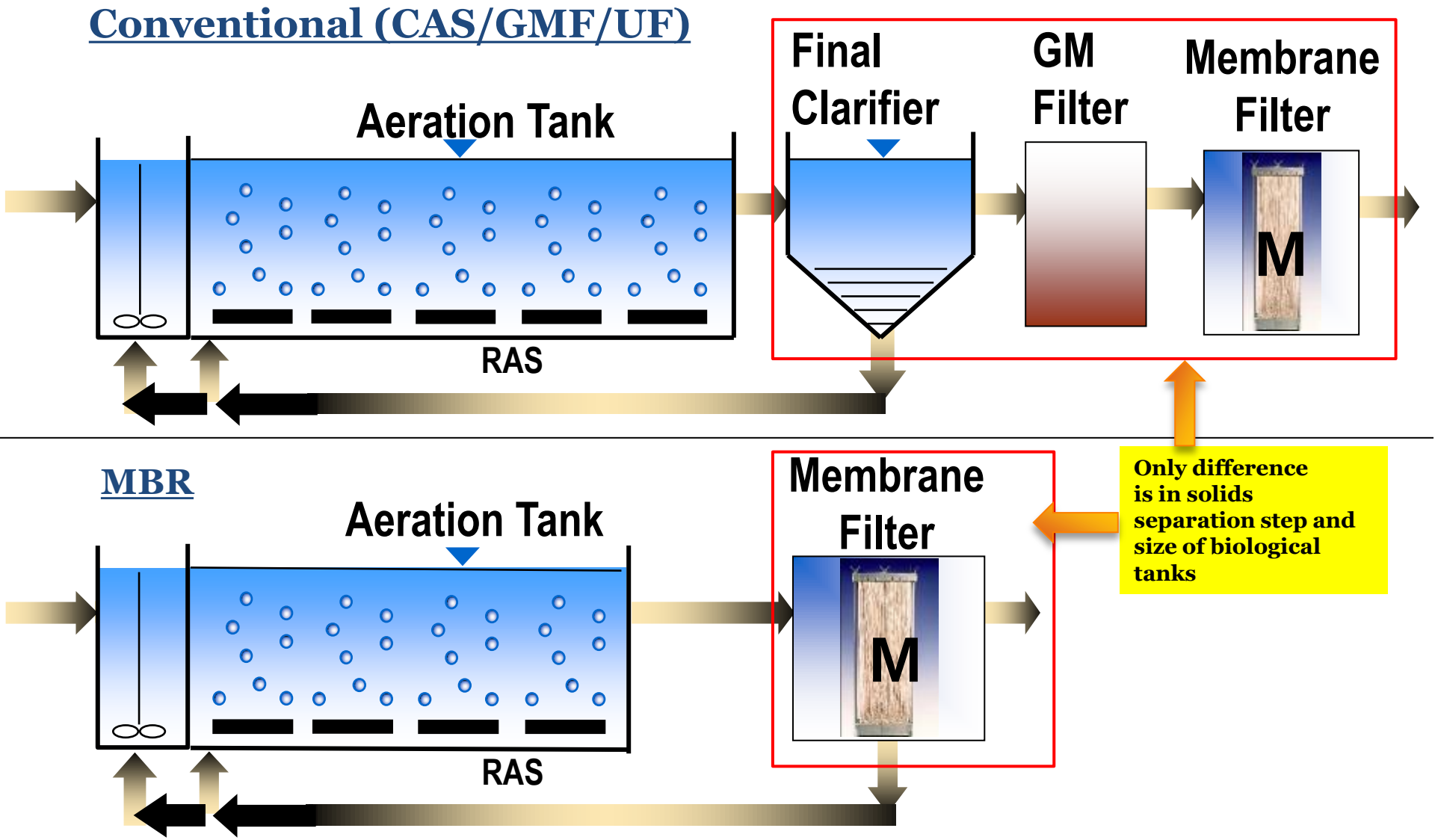
Updated: March 2015

Installations	Location	Technology Provider	(Expected) date of commissioning	PDF (MLD)	ADF (MLD)
Henriksdal, Sweden	nr Stockholm, Sweden	GEWPT	2016-2019	864	536
Seine Aval	Acheres, France	GEWPT	2016	357	224
Canton WWTP	Ohio, USA	Ovivo USA/Kubota	2015-2017	333	159
Euclid, OH, USA	Ohio, USA	GEWPT	2018	250	83
Shunyi	Beijing, China	GEWPT	2016	234	180
Macau	Macau Special Administrative Region, China	GEWPT	2017	210	210
Wuhan Sanjintang WWTP	Hubei Province, China	OW	2015	200	
Jilin WWTP (Phase 1, upgrade)	Jilin Province, China	OW	2015	200	
Brussels Sud	Brussels, Belgium	GEWPT	2017	190	86
Macau	China	GEWPT	2014	189	137
Riverside	California, USA	GEWPT	2014	186	124
Brightwater	Washington, USA	GEWPT	2011	175	122
Visalia	California, USA	GEWPT	2014	171	85
Qinghe WRP (Phase 2)	Beijing, China	OW	2011	150	
Kunming 10th WWTP	Yunnan Province, China	OW	2013	150	
Nanjing East WWTP (Phase 3)	Jiangsu Province, China	OW	2014	150	
Yantai TaoziWan WWTP	Shandong Province, China	OW	2014	150	
Jilin WWPT (Phase 2)	Jilin Province, China	OW	2014	150	
Qinghe	China	OW/MRC	2011	150	150
Changsha 2nd WWTP	Hunan Province, China	OW	2014	140	
North Las Vegas	Nevada, USA	GEWPT	2011	136	97
Ballenger McKinney ENR WWTP	Maryland, USA	GEWPT	2013	135	58
Assago	Milan, Italy	GEWPT	2016	125	55
Daxing Huangcun WRP	Beijing, China	OW	2012	120	
Jinyang WWTP (Phase 1)	Shanxi Province, China	OW	2015	120	
Cox Creek WRF	Maryland, USA	GEWPT	2015	116	58
Yellow River	Georgia, USA	GEWPT	2011	114	71
Shiyan Shendinghe	China	OW/MRC	2009	110	110
Aquaviva	Cannes, France	GEWPT	2013	108	60
Urumqi Ganquanpu WRP	Xinjiang Uygur Autonomous Region, China	OW	2014	105	
Busan City	Korea	GEWPT	2012	102	102
Wenyuhe River Water Treatment (Phase 2)	Beijing, China	OW-MRC	2010	100	
Kunming 9th WWTP	Yunnan Province, China	OW	2013	100	
Hebei Zhengdi WWTP	Hubei Province, China	OW	2014	100	
ZhuHai Qianshan WWTP	Guangdong Province, China	OW	2016	100	
Guangzhou	China	Memstar	2010	100	
Wenyuhe	Beijing, China				

Representative MBR Installations

Location/Facility	Average Flow (MLD)	Status/Comments
Singapore – Tuas WRP	800 (600 domestic + 200 industrial)	Preliminary design (MBR selected for 600 MLD domestic; 200 MLD industrial yet to be determine)
Florida (USA) – Miami OOL Program	380	Planning
Singapore – Changi WRP	320	120 MLD currently being retrofit into existing WRP; design of new 200 MLD expansion
Acheres, France – Seine Aval	224	Commissioning in 2016
Ohio USA – Canton WWTP	159	Commissioning in 2017
China - Qinghe	150	Commissioned 2011
China - Macau	137	Commissioning in 2014
California USA - Riverside	124	Commissioning in 2014
Washington USA - Brightwater	122	Commissioned 2011
China – Shiyan Shendinghe	110	Commissioned 2010
Korea – Busan City	102	Commissioned 2012
China – Wenyuhe (Beijing)	100	Commissioned 2007
Nevada USA – North Las Vegas	97	Commissioned 2011

Process Comparison – CAS vs. MBR



Tender Alternative Layout (cont.)

12 Bioreactor Tanks

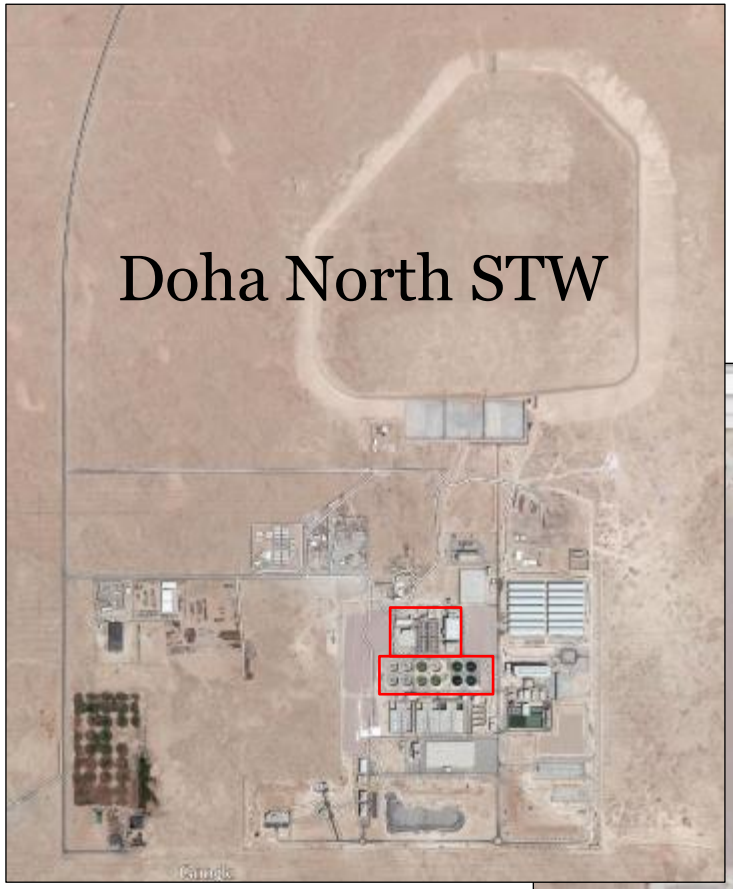
Two Process Trains

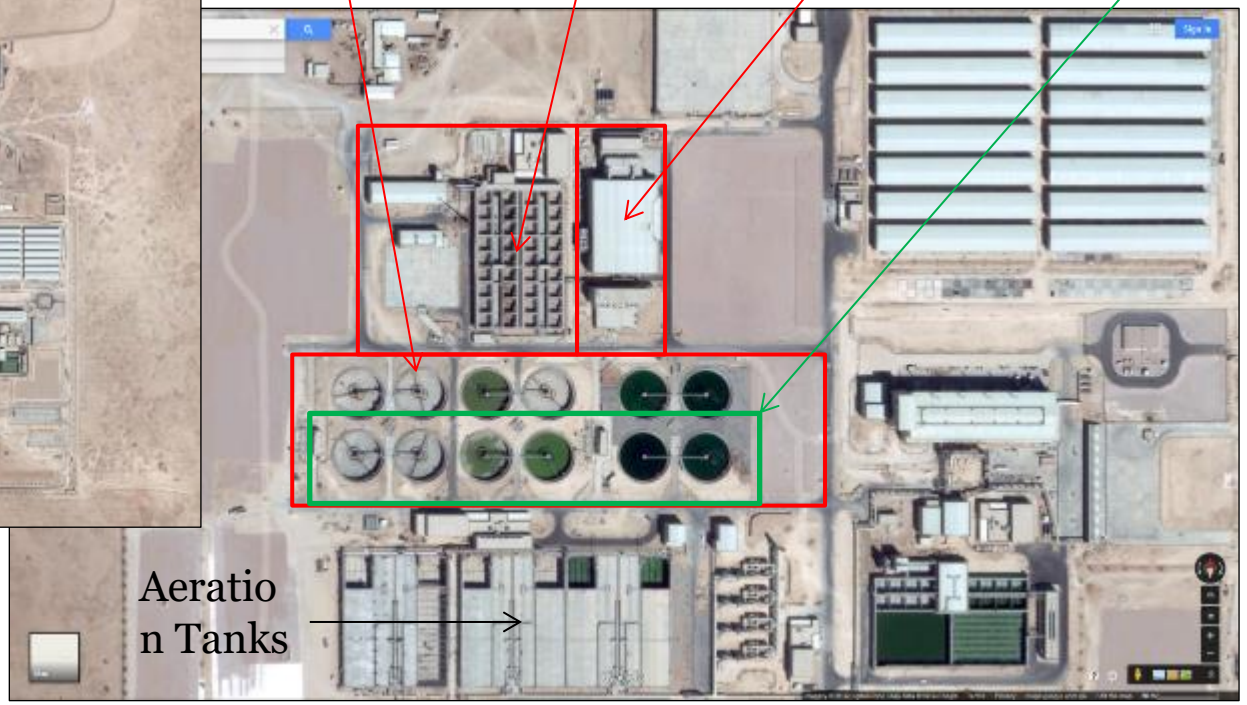
24 MBR Tanks

From Preliminary Design Report (May 2013)

528 MBR Skids

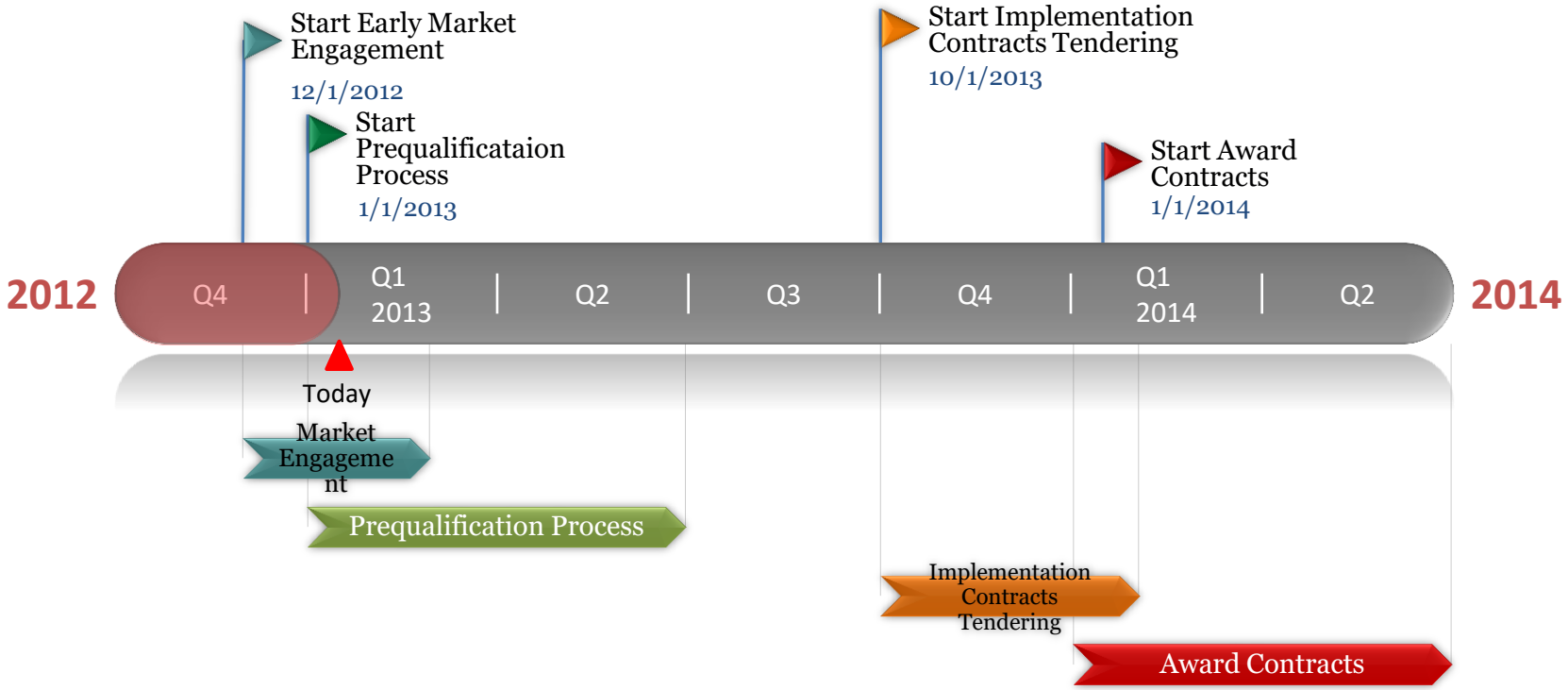
Comparison at Doha North STW

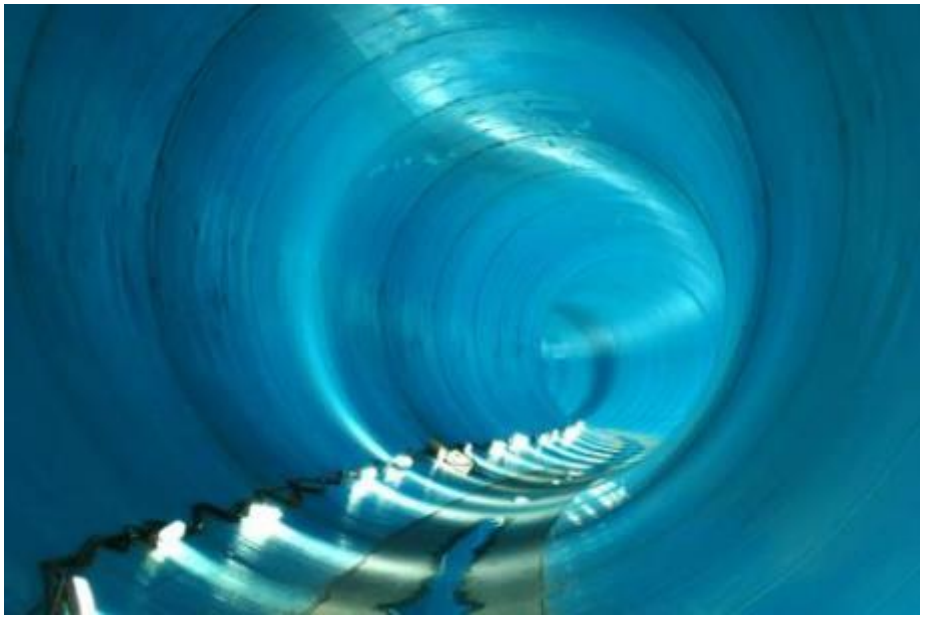


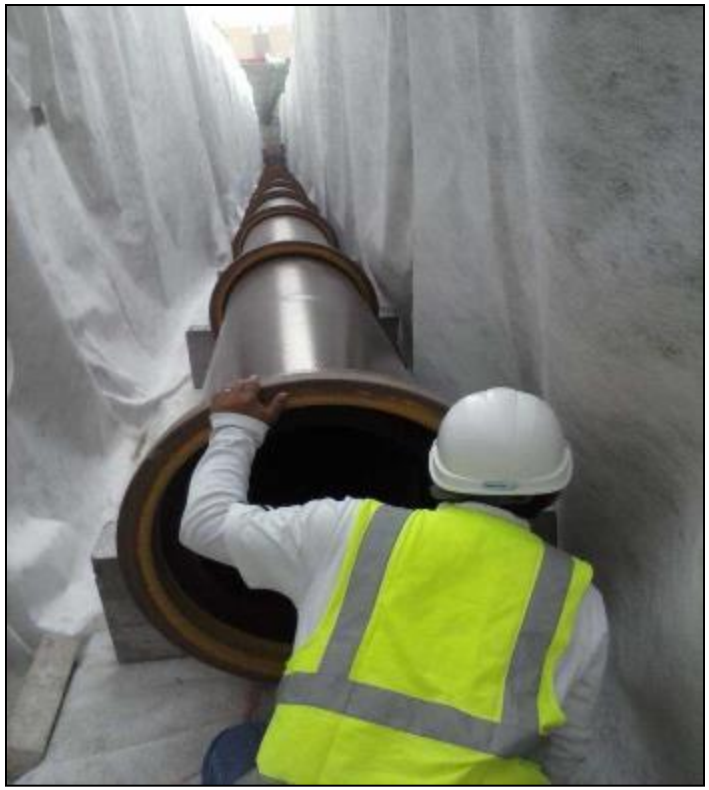


Overall Procurement Schedule

- Early market engagement activities – December 2013-February 2013
- Pre-qualification – 1st & 2nd quarters of 2013
- Start implementation contracts tendering – 4th quarter 2013
- Award first contracts – 1st quarter 2014





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