EVALUATION TOOLKIT – WATER SENSITIVE COMPLIANCE CRITERIA

Hildegard Edith Rohr

WATER RESEARCH COMMISSION

TT 923/2/23

Evaluation Toolkit – Water Sensitive Compliance Criteria

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Report to the

Water Research Commission

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The publication of this report emanates from a project entitled “Water Sensitive Design and Planning solutions for Gauteng MEGA Human Settlements” (WRC Project No. K5/2587).

This report forms part of a series of two reports. The supporting report is titled ‘Evaluating MEGA Human Settlements from a water sensitive planning perspective’ (WRC Report no. TT 923/1/23).

The toolkit, Water sensitive self-evaluation criteria scoring, has been added to this report as an attachment.

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EXECUTIVE SUMMARY

How can Gauteng MEGA Human Settlements incorporate Water Sensitive Design and Planning solutions?

Household Growth

Gauteng Province is facing a housing backlog of around a million units caused by amongst others an influx of c. 300,000 people each year. This roughly translates to an increased demand for housing of more than 50,000 units each year (GDHS, 2020). The Gauteng Department of Human Settlements classified the housing crisis as both a historical and systematic challenge that could not be resolved timeously and had created issues such as the accumulation of accruals, illegal occupations, and housing projects that had been abandoned, mainly as a result of failed management.

Water Security

Gauteng has limited natural water resources and therefore relies on a very large and highly engineered system called the Integrated Vaal River System (IVRS) which draws water from five different river basins across six provinces. The Gauteng Water Security Perspective (GCRO, 2019) calls for five interventions: (1) reduce water demand; (2) manage variability to prepare for drought and/or water scarcity; (3) invest in alternative water sources and tools for conservation; (4) manage water quality and limit pollution and achieve environmental goals, and (5) establish effective institutions for water security.

MEGA Human Settlements

In 2015 GDHS announced its MEGA Human Settlement incentive, defining it as a radical human settlements delivery mechanism that seeks to yield between 5,000 and 20,000 housing units per project. Approximately 300,000 new housing units, together with a selection of land-use mixes, are planned to be developed as part of the MEGA Human Settlement Initiative. Evidently, these planned settlements are mostly located in areas with limited to no bulk water and wastewater treatment works.

Water Sensitivity

Land use change decisions taken by government officials, developers and other stakeholders carry both a water resource quality and quantity impact. South Africa's roadmap to water sensitivity is reaching its first decade since its introduction. Research institutions such as the Water Research Commission (WRC) and the University of Cape Town (UCT), together with the private sector, have provided a sound foundation for practitioners to give effect to water sensitive practices. This study aims to put water sensitive theory into practice by adapting the business-as-usual approach of the land development process to incorporate water sensitive design and planning practices within each stage of the land development process. This report puts forward a framework and guidelines together with a Water Sensitive Compliance/Criteria Assessment Toolkit that will assist developers, government officials and other professional practitioners to secure ecosystem sustainability and water resilience throughout the land development process of MEGA Human Settlements and other developments.

Research Project Outlook

A critical evaluation of existing criteria for the planning and design, and project approval processes set out for MEGA projects will lead to the identification of gaps and opportunities for water sensitive design solutions. While most MEGA projects are still in the planning phase, the research findings led to the development of a Framework and Guideline document (informed by existing WRC studies) specifically for the planning, design and implementation of Water Sensitive MEGA Human Settlements.

This framework and guideline document is supported by a Water Sensitive Compliance/Criteria Assessment Toolkit that will assist developers, government officials and other professional practitioners with how to plan, design and maintain water sensitive solutions within a MEGA human settlement. It is anticipated that this research project will facilitate cross-sectoral and inter-disciplinary collaboration of various sectors within the built and natural environment.

Outlook and Opportunities for Water Sensitive MEGA Human Settlements

Critique 	Most of the planned Gauteng MEGA Human settlements are located within areas with limited to no bulk water and wastewater treatment work. To date, no evidence could be found that developers, professional practitioners or government aim to develop these MEGA human settlements in a water sensitive manner. Or that the water crisis and sustained capacity of existing infrastructure is taken into consideration at all.
Gaps 	The reality is that South Africa's water crisis cannot be fixed by research only. There is a need to give effect to theory. The most evident gap in achieving water sensitivity in development is the fact that no one really knows whose responsibility it is to implement these practices. As a result, water sensitive design is brought in as an after-thought or reactive measure.
Opportunities 	Water Sensitive Design and Planning have been proven to improve water quality and water security. MEGA Human Settlements offer Gauteng a unique opportunity to put this to the test within the South African context. The opportunity to give effect to water sensitive design and planning lies within the land development processes. Professional practitioners can take proactive measures to include water sensitive design if they re-think the way in which the land development process is undertaken.

Water Sensitive Land Development Process

The diagram below (Figure 1) illustrates a typical, almost generic, land development process through which a proposed development will transpire. The diagram forms the basis of the framework for Water Sensitive MEGA Human Settlements. The framework is also applicable to other proposed developments – however, not one land development application is likely to be the same and professional practitioners should use this

framework at their own discretion and adapt where needed. Although the diagram might seem basic, opportunities for water sensitive design have been identified within each stage (where possible) to assist developers, professional practitioners and government officials in changing the business-as-usual approach of planning and development and reviewing applications to one which is water sensitive

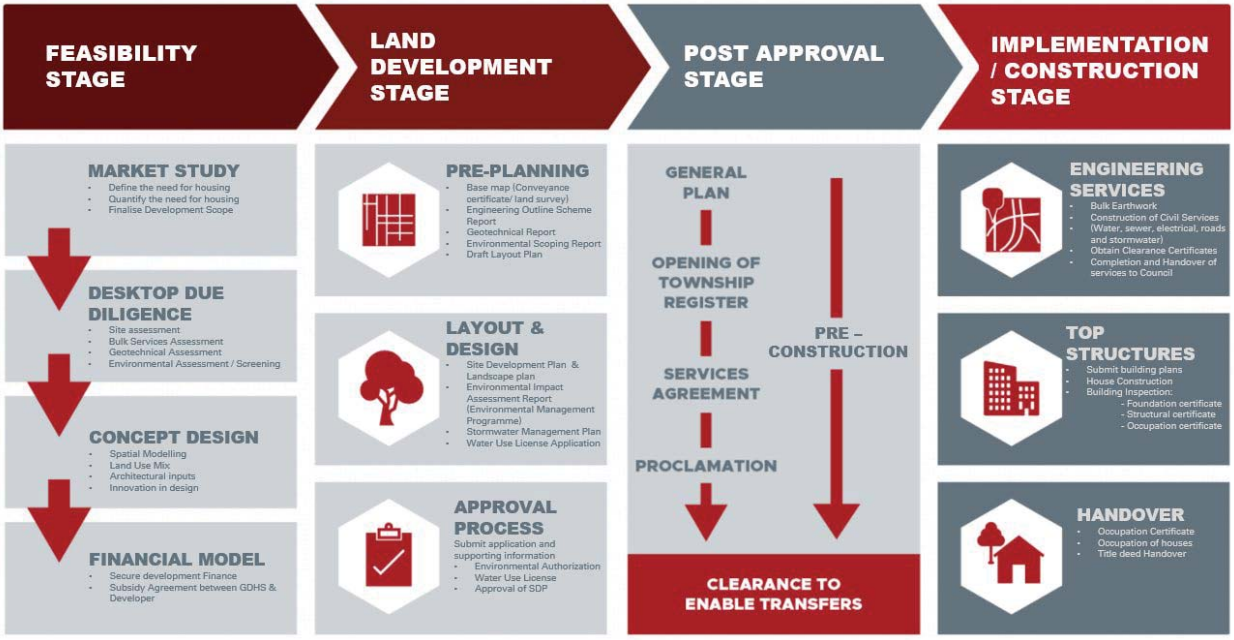

Figure 1: Water Sensitive Land Development Process

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Mr Jay Bhagwan	Water Research Commission (Chair)
Mr Nkateko Kubayi	Water Research Commission (Project Manager)
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Rutz Marx	Jones Lang Lasalle
Bernice Swanepoel	Jones Lang Lasalle
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The financing of the project by the WRC and the contributions of the members of the reference group are gratefully acknowledged.

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LIST OF ACRONYMS

CMA	Catchment Management Agency
CoJ	City of Johannesburg
CoT	City of Tshwane
CRCWSC	Cooperative Research Centre for Water Sensitive Cities
EISD	Environment and Infrastructure Services Department
EIAR	Environmental Impact Assessment Report
GCRO	Gauteng City Region Observatory
GCTWF	Greater Cape Town Water Fund
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
GDS 2040	Growth and Development Strategy 2040
GIS	Geographical Information System
IUWM	Integrated Urban Water Management
IVRS	Integrated Vaal River System
IWA	International Water Association
IWRM	Integrated Water Resources Management
JRA	Johannesburg Roads Agency
JW	Johannesburg Water
LUS	Land Use Scheme
NRW	Non-Revenue Water
RSA	Republic of South Africa
RW	Rand Water
SDF	Spatial Development Framework
SDP	Site Development Plan
SWMP	Stormwater Management Plan
SuDS	Sustainable Drainage Systems
SIUWM	Sustainability Index for Urban Water Management
UCT	University of Cape Town
UWCS	Urban Water Cycle Services

UWMTF	Urban Water Management Transitions Framework
UWTF	Urban Water Transitions Framework
WCWDM	Water Conservation & Water Demand Management
WRC	Water Research Commission
WSC	Water Sensitive City
WSCI	Water Sensitive Cities Index
WSUD	Water Sensitive Urban Design
WULA	Water Use License Application

CHAPTER 1

1. Water Sensitive Compliance Criteria Toolkit Overview

1.1. Toolkit Background

The Research Proposal (2021/2022-00589) set out to design a Water Sensitive Compliance Criteria/Assessment toolkit to establish a benchmark for planning and designing Water Sensitive MEGA Human Settlements. The following key documents were used to design and inform the Toolkit –

- The South African Guidelines for Sustainable Urban Drainage Systems;
- Water Sensitive Urban Design for South Africa: Framework and Guideline;
- Framework towards water sensitive spatial planning and land use management;
- Guideline on compiling water-sensitive Spatial Plans; and,
- GDARD Decision Support Tool for Sustainable Drainage Systems

The motive behind the self-evaluation assessment of water sensitive compliance criteria is to build a comprehensive understanding of MEGA Human Settlements land development process to identify gaps and opportunities for the implementation of water sensitive design and planning solutions from the project initiation and feasibility phase up to construction and handover phase. Even though the Water Sensitive Compliance Criteria/Assessment toolkit is intended for MEGA Human Settlements, it is designed to be applicable to all land development scenarios.

The following methodology was adopted to design the Water Sensitive Compliance Criteria/Assessment toolkit for MEGA Human Settlements:

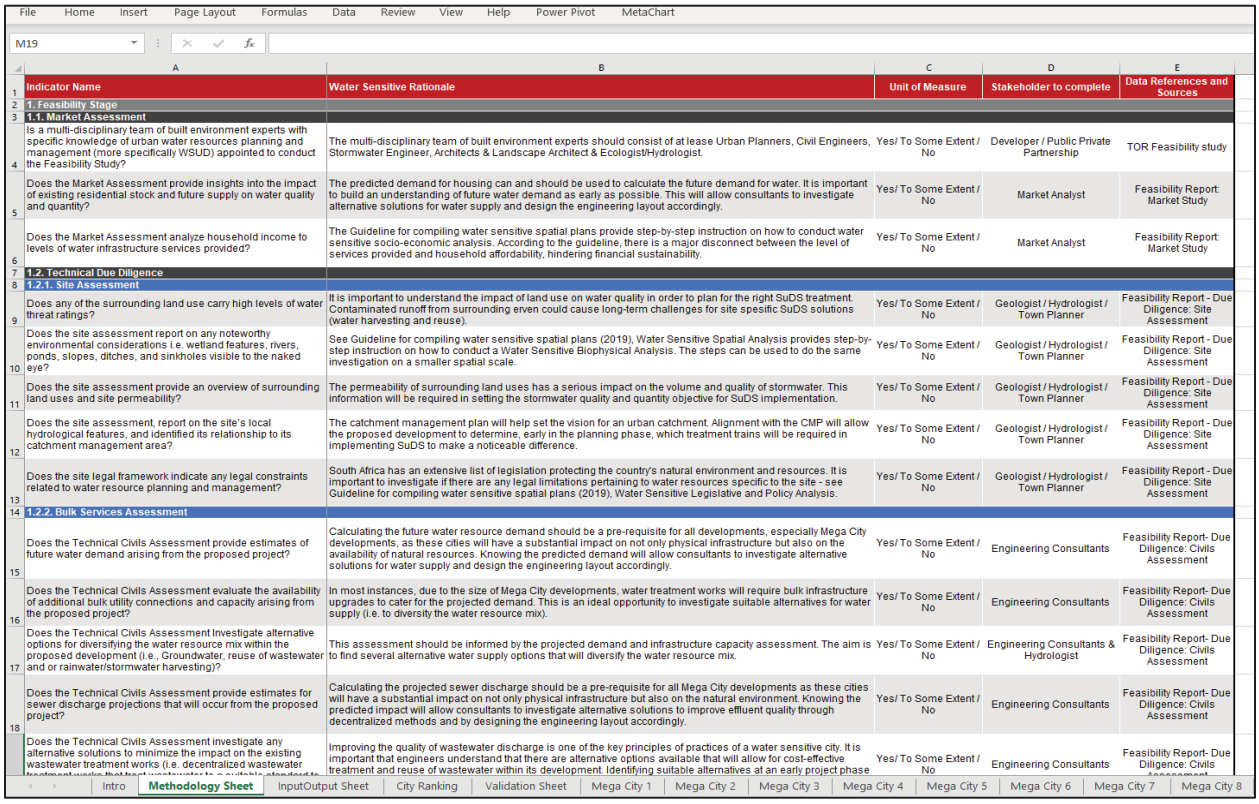
- Based on the literature review and the availability of data pertaining to the planning and development of MEGA Human Settlements, the research team developed a Multi-Criteria Analysis (MCA) Matrix which scores and ranks each planning phase and actions in relation to water sensitive outcomes.

- Indicators pertaining to the opportunities for water sensitive outcomes were identified for each of the following land development stages:
    - Feasibility stage
    - Land Development Stage
    - Post Approval Stage
    - Construction Stage
- The intention is that each MEGA Human Settlements is scored and ranked using these indicators to establish gaps and opportunities to give effect to water sensitive planning practices within the various land development stages.
- Using multiple indicators allows for choosing and prioritizing between the interests of different groups by comparing options with slightly different outputs. These differences (in this instance indicators), are typically weighted based on the desired analyses and outcome of the assessment.
- The weight for each indicator was based on its perceived relative importance/impact on possible water sensitive outcomes in a specific MEGA Human Settlement. The weighting of indicators is done on a range of 1 to 10, with 10 indicating an indicator that holds a very high relevance to water sensitivity and a score of 1 for an indicator with little relevance.
- The research team compiled a Multi-Criteria Analysis (MCA) Matrix in which all relevant MEGA City Developments can be scored and compared cohesively. Subsequently, MEGA Human Settlements can be ranked accordingly to provide a hierarchical list of potential interventions and or opportunities for water sensitive outcomes.
- The ranking can be done on development stages considerations to provide a holistic, although high-level, assessment of the potential for water sensitive practices roll-out.

1.2. Toolkit Overview

Figure 2 showcases the Methodology Sheet which sets out the Indicator (Colum A) in the form of a water/development-related question, followed by the Water Sensitive rationale (Colum B), the unit of measurements (Colum C) in this case Yes/To Some Extent/No.

Colum D indicates which stakeholder is the recommended custodian of the section followed by a Data Reference Source in Colum E.

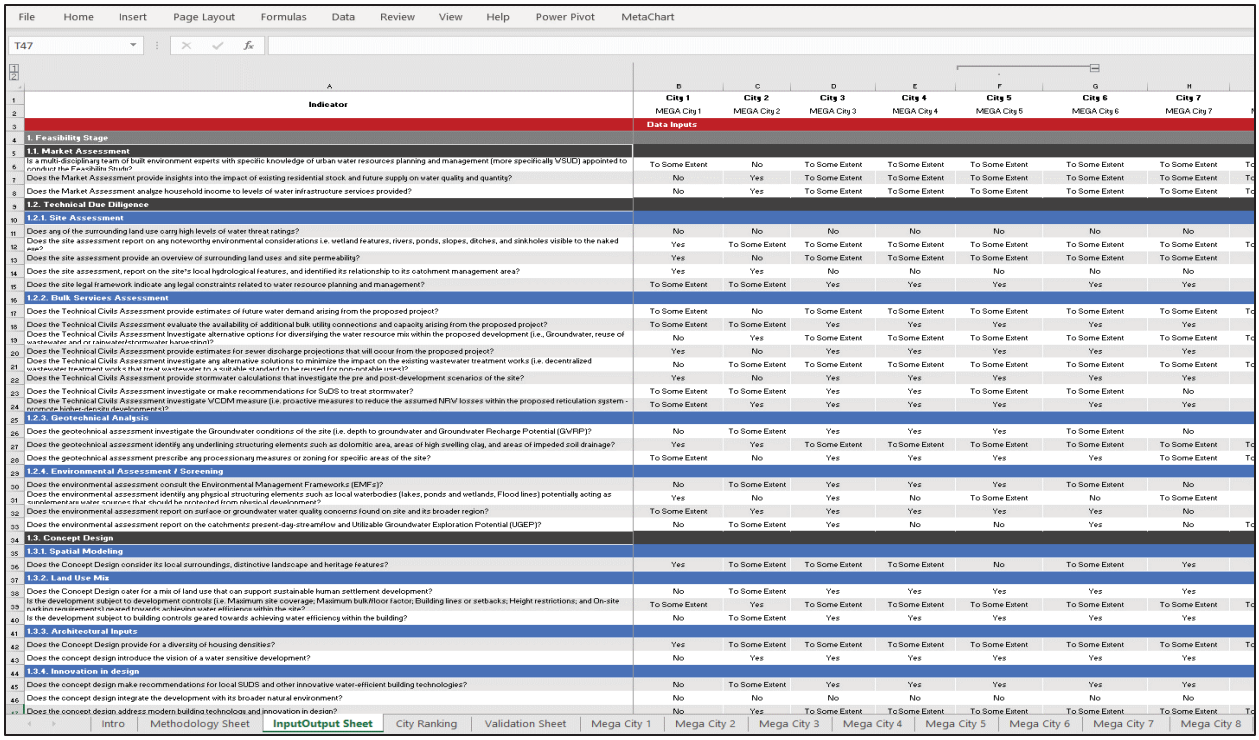


Indicator Name	Water Sensitive Rationale	Unit of Measure	Stakeholder to complete	Data References and Sources
1. Feasibility Stage				
1.1. Market Assessment				
Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management (more specifically WSUD) appointed to conduct the Feasibility Study?	The multi-disciplinary team of built environment experts should consist of at lease Urban Planners, Civil Engineers, Stormwater Engineer, Architects & Landscape Architect & Ecologist/Hydrologist.	Yes/ To Some Extent / No	Developer / Public Private Partnership	TOR Feasibility study
Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	The predicted demand for housing can and should be used to calculate the future demand for water. It is important to build an understanding of future water demand as early as possible. This will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.	Yes/ To Some Extent / No	Market Analyst	Feasibility Report: Market Study
Does the Market Assessment analyze household income to levels of water infrastructure services provided?	The Guideline for compiling water sensitive spatial plans provide step-by-step instruction on how to conduct water sensitive socio-economic analysis. According to the guideline, there is a major disconnect between the level of services provided and household affordability, hindering financial sustainability.	Yes/ To Some Extent / No	Market Analyst	Feasibility Report: Market Study
1.2. Technical Due Diligence				
1.2.1. Site Assessment				
Does any of the surrounding land use carry high levels of water threat ratings?	It is important to understand the impact of land use on water quality in order to plan for the right SuDS treatment. Contaminated runoff from surrounding erven could cause long-term challenges for site spesific SuDS solutions (water harvesting and reuse).	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye?	See Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Spatial Analysis provides step-by-step instruction on how to conduct a Water Sensitive Biophysical Analysis. The steps can be used to do the same investigation on a smaller spatial scale.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
Does the site assessment provide an overview of surrounding land uses and site permeability?	The permeability of surrounding land uses has a serious impact on the volume and quality of stormwater. This information will be required in setting the stormwater quality and quantity objective for SuDS implementation.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area?	The catchment management plan will help set the vision for an urban catchment. Alignment with the CMP will allow the proposed development to determine, early in the planning phase, which treatment trains will be required in implementing SuDS to make a noticeable difference.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
Does the site legal framework indicate any legal constraints related to water resource planning and management?	South Africa has an extensive list of legislation protecting the country's natural environment and resources. It is important to investigate if there are any legal limitations pertaining to water resources specific to the site - see Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Legislative and Policy Analysis.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
1.2.2. Bulk Services Assessment				
Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	Calculating the future water resource demand should be a pre-requisite for all developments, especially Mega City developments, as these cities will have a substantial impact on not only physical infrastructure but also on the availability of natural resources. Knowing the predicted demand will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project?	In most instances, due to the size of Mega City developments, water treatment works will require bulk infrastructure upgrades to cater for the projected demand. This is an ideal opportunity to investigate suitable alternatives for water supply (i.e. to diversity the water resource mix).	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
Does the Technical Civils Assessment Investigate alternative options for diversifying the water resource mix within the proposed development (i.e., Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)?	This assessment should be informed by the projected demand and infrastructure capacity assessment. The aim is to find several alternative water supply options that will diversify the water resource mix.	Yes/ To Some Extent / No	Engineering Consultants & Hydrologist	Feasibility Report- Due Diligence: Civils Assessment
Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	Calculating the projected sewer discharge should be a pre-requisite for all Mega City developments as these cities will have a substantial impact on not only physical infrastructure but also on the natural environment. Knowing the predicted impact will allow consultants to investigate alternative solutions to improve effluent quality through decentralized methods and by designing the engineering layout accordingly.	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment works (i.e. decentralized wastewater	Improving the quality of wastewater discharge is one of the key principles of practices of a water sensitive city. It is important that engineers understand that there are alternative options available that will allow for cost-effective treatment and reuse of wastewater within its development. Identifying suitable alternatives at an early project phase	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils

Figure 2: Methodology Sheet

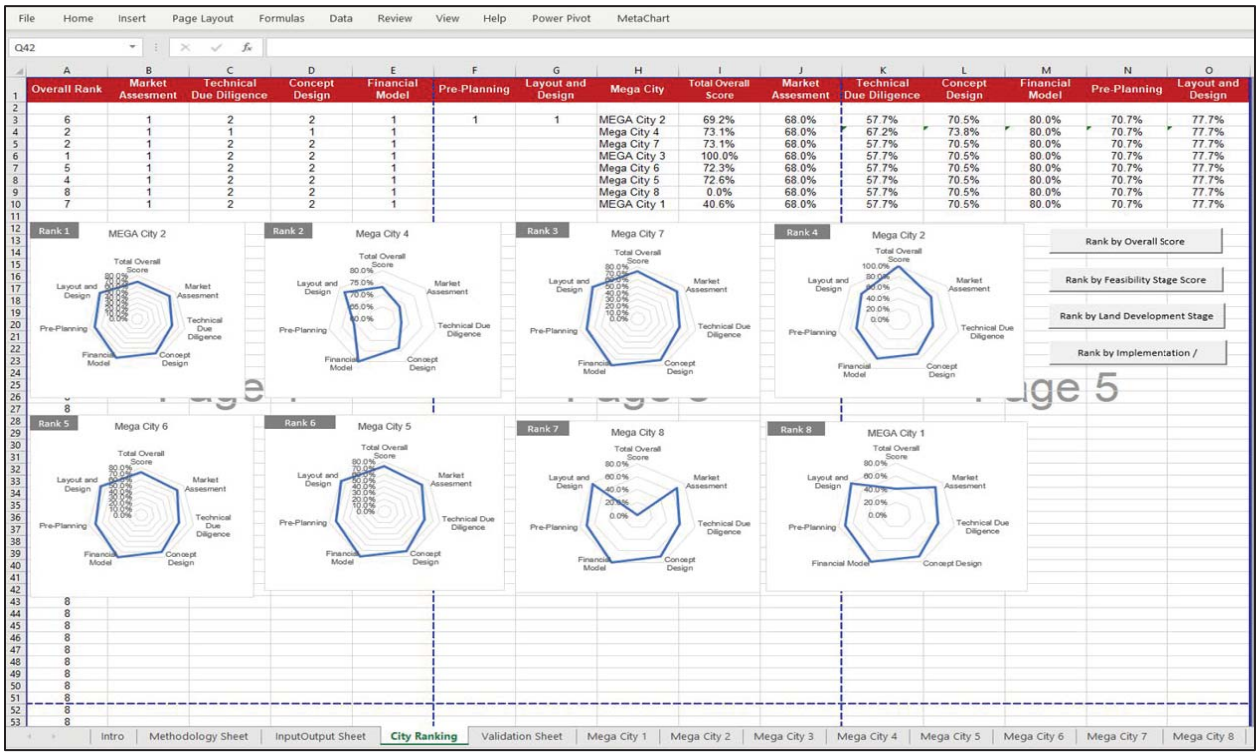
Figure 3 illustrates the layout of the Input/output sheet which is also the main toolkit sheet where stakeholders are required to select one of the Data Input options (Colum B-G) to answer the Water Sensitive Indicator (Colum A). Each of the Data Input options has a numeric value/score as per the Data Validation Sheet:

- Yes = 5
- To some extent = 3
- No = 1



Indicator	City 1 MEGA City 1	City 2 MEGA City 2	City 3 MEGA City 3	City 4 MEGA City 4	City 5 MEGA City 5	City 6 MEGA City 6	City 7 MEGA City 7
Data Inputs							
1. Feasibility Stage							
1.1. Market Assessment							
Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management (more specifically WSUD) appointed to conduct the Feasibility Study?	To Some Extent	No	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	No	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the Market Assessment analyze household income to levels of water infrastructure services provided?	No	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
1.2. Technical Due Diligence							
1.2.1. Site Assessment							
Does any of the surrounding land use carry high levels of water threat ratings?	No	No	No	No	No	No	No
Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye?	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the site assessment provide an overview of surrounding land uses and site permeability?	Yes	No	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area?	Yes	Yes	No	No	No	No	No
Does the site legal framework indicate any legal constraints related to water resource planning and management?	To Some Extent	To Some Extent	Yes	Yes	Yes	Yes	Yes
1.2.2. Bulk Services Assessment							
Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	To Some Extent	No	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project?	To Some Extent	To Some Extent	Yes	Yes	Yes	Yes	Yes
Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed development (i.e., Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)?	No	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	Yes	No	Yes	Yes	Yes	Yes	Yes
Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment works (i.e. decentralized wastewater treatment work that treat wastewater to a suitable standard to be reused for non-potable uses)?	No	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the Technical Civils Assessment provide stormwater calculations that investigate the pre and post-development scenarios of the site?	Yes	No	Yes	Yes	Yes	Yes	Yes
Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater?	To Some Extent	To Some Extent	Yes	Yes	To Some Extent	To Some Extent	No
Does the Technical Civils Assessment investigate WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within the proposed reticulation system - promote higher-density development)?	To Some Extent	Yes	Yes	Yes	Yes	Yes	Yes
1.2.3. Geotechnical Analysis							
Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater Recharge Potential (GVRP))?	No	To Some Extent	Yes	Yes	Yes	To Some Extent	No
Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and areas of impeded soil drainage?	Yes	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site?	To Some Extent	No	Yes	Yes	Yes	Yes	To Some Extent
1.2.4. Environmental Assessment / Screening							
Does the environmental assessment consult the Environmental Management Frameworks (EMFs)?	No	To Some Extent	Yes	Yes	Yes	To Some Extent	No
Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands, Flood lines) potentially acting as supplementary water sources that should be protected from physical development?	Yes	No	Yes	No	To Some Extent	No	To Some Extent
Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region?	To Some Extent	Yes	Yes	Yes	Yes	Yes	No
Does the environmental assessment report on the catchments present-day-stream/low and Utilizable Groundwater Exploration Potential (UGEP)?	No	To Some Extent	Yes	No	No	Yes	No
1.3. Concept Design							
1.3.1. Spatial Modeling							
Does the Concept Design consider its local surroundings, distinctive landscape and heritage features?	Yes	To Some Extent	To Some Extent	To Some Extent	No	To Some Extent	Yes
1.3.2. Land Use Mix							
Does the Concept Design cater for a mix of land use that can support sustainable human settlement development?	No	To Some Extent	Yes	Yes	Yes	Yes	Yes
Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks; Height restrictions; and On-site parking requirements) geared towards achieving water efficiency within the site?	To Some Extent	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Is the development subject to building controls geared towards achieving water efficiency within the building?	No	To Some Extent	Yes	Yes	Yes	Yes	Yes
1.3.3. Architectural Inputs							
Does the Concept Design provide for a diversity of housing densities?	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent
Does the concept design introduce the vision of a water sensitive development?	No	Yes	Yes	Yes	Yes	Yes	Yes
1.3.4. Innovation in design							
Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies?	No	To Some Extent	Yes	Yes	Yes	Yes	Yes
Does the concept design integrate the development with its broader natural environment?	No	No	No	No	No	No	No
Does the concept design address modern building technology and innovation in design?	No	Yes	To Some Extent	To Some Extent	To Some Extent	To Some Extent	To Some Extent

Figure 3: Input/output sheet



Overall Rank	Market Assesment	Technical Due Diligence	Concept Design	Financial Model	Pre-Planning	Layout and Design	Mega City	Total Overall Score	Market Assesment	Technical Due Diligence	Concept Design	Financial Model	Pre-Planning	Layout and Design
6	1	2	2	1	1	1	MEGA City 2	69.2%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
2	1	1	1	1			Mega City 4	73.1%	68.0%	67.2%	73.8%	80.0%	70.7%	77.7%
2	1	2	2	1			Mega City 7	73.1%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
1	1	2	2	1			MEGA City 3	100.0%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
5	1	2	2	1			Mega City 6	72.3%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
4	1	2	2	1			Mega City 5	72.6%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
8	1	2	2	1			Mega City 8	0.0%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%
7	1	2	2	1			MEGA City 1	40.6%	68.0%	57.7%	70.5%	80.0%	70.7%	77.7%

Rank 1 MEGA City 2 | Rank 2 Mega City 4 | Rank 3 Mega City 7 | Rank 4 Mega City 2

Rank 5 Mega City 6 | Rank 6 Mega City 5 | Rank 7 Mega City 8 | Rank 8 MEGA City 1

Rank by Overall Score

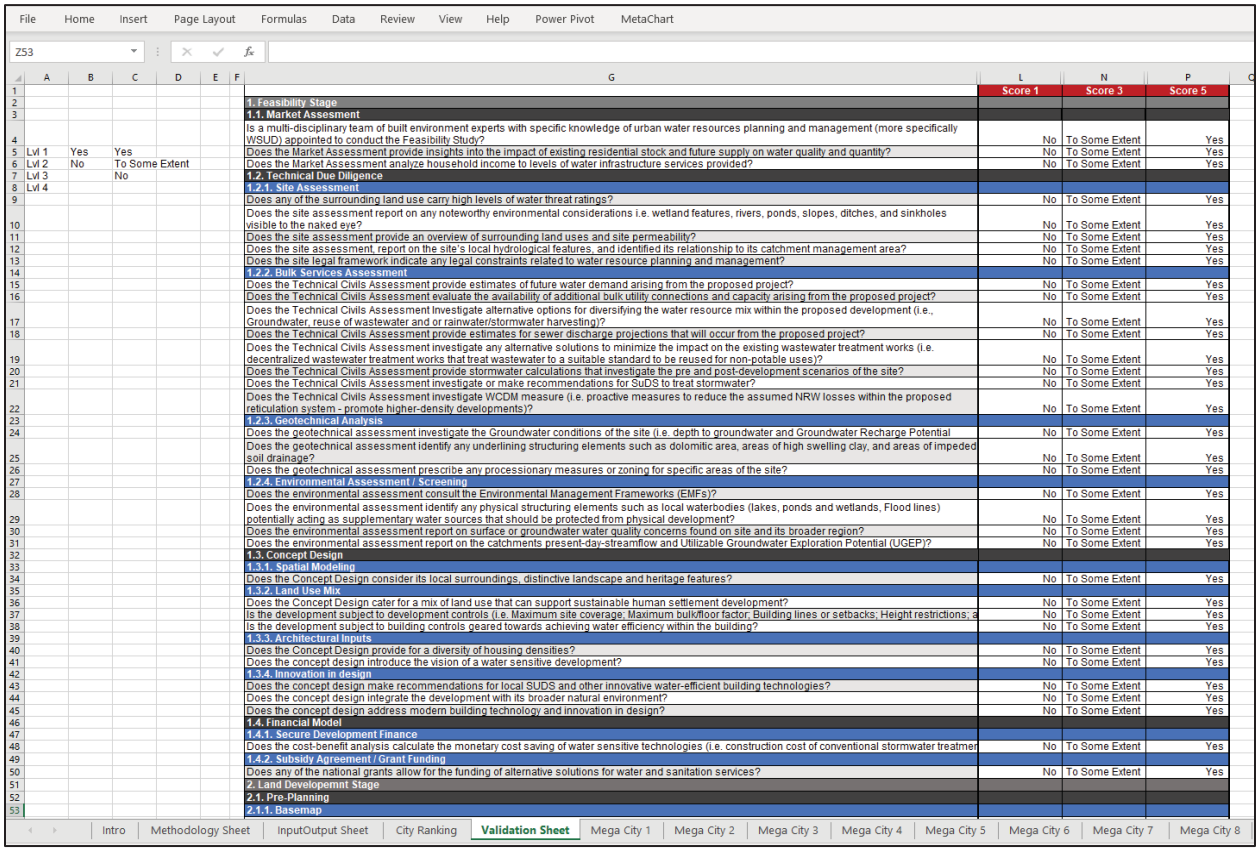
Rank by Feasibility Stage Score

Rank by Land Development Stage

Rank by Implementation /

Figure 4: City Ranking

Figure 4 ranks the various Mega City development according to their level of water sensitivity given the various indicators. The sheet offers the user the option to rank the developments according to Overall Score, Feasibility Stage, Land Development State and Implementation.



	A	B	C	D	E	F	G	L	N	P
1								Score 1	Score 3	Score 5
2							1. Feasibility Stage			
3							1.1. Market Assesment			
4							Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management (more specifically WSUD) appointed to conduct the Feasibility Study?	No	To Some Extent	Yes
5	Lvl 1	Yes	Yes				Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	No	To Some Extent	Yes
6	Lvl 2	No	To Some Extent				Does the Market Assessment analyze household income to levels of water infrastructure services provided?	No	To Some Extent	Yes
7	Lvl 3		No				1.2. Technical Due Diligence			
8	Lvl 4						1.2.1. Site Assessment			
9							Does any of the surrounding land use carry high levels of water threat ratings?	No	To Some Extent	Yes
10							Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye?	No	To Some Extent	Yes
11							Does the site assessment provide an overview of surrounding land uses and site permeability?	No	To Some Extent	Yes
12							Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area?	No	To Some Extent	Yes
13							Does the site legal framework indicate any legal constraints related to water resource planning and management?	No	To Some Extent	Yes
14							1.2.2. Bulk Services Assessment			
15							Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	No	To Some Extent	Yes
16							Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project?	No	To Some Extent	Yes
17							Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed development (i.e., Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)?	No	To Some Extent	Yes
18							Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	No	To Some Extent	Yes
19							Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment works (i.e. decentralized wastewater treatment works that treat wastewater to a suitable standard to be reused for non-potable uses)?	No	To Some Extent	Yes
20							Does the Technical Civils Assessment provide stormwater calculations that investigate the pre and post-development scenarios of the site?	No	To Some Extent	Yes
21							Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater?	No	To Some Extent	Yes
22							Does the Technical Civils Assessment investigate WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within the proposed reticulation system - promote higher-density developments)?	No	To Some Extent	Yes
23							1.2.3. Geotechnical Analysis			
24							Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater Recharge Potential	No	To Some Extent	Yes
25							Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and areas of impeded soil drainage?	No	To Some Extent	Yes
26							Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site?	No	To Some Extent	Yes
27							1.2.4. Environmental Assessment / Screening			
28							Does the environmental assessment consult the Environmental Management Frameworks (EMFs)?	No	To Some Extent	Yes
29							Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands, Flood lines) potentially acting as supplementary water sources that should be protected from physical development?	No	To Some Extent	Yes
30							Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region?	No	To Some Extent	Yes
31							Does the environmental assessment report on the catchments present-day-streamflow and Utilizable Groundwater Exploration Potential (UGEP)?	No	To Some Extent	Yes
32							1.3. Concept Design			
33							1.3.1. Spatial Modeling			
34							Does the Concept Design consider its local surroundings, distinctive landscape and heritage features?	No	To Some Extent	Yes
35							1.3.2. Land Use Mix			
36							Does the Concept Design cater for a mix of land use that can support sustainable human settlement development?	No	To Some Extent	Yes
37							Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks; Height restrictions; a	No	To Some Extent	Yes
38							Is the development subject to building controls geared towards achieving water efficiency within the building?	No	To Some Extent	Yes
39							1.3.3. Architectural Inputs			
40							Does the Concept Design provide for a diversity of housing densities?	No	To Some Extent	Yes
41							Does the concept design introduce the vision of a water sensitive development?	No	To Some Extent	Yes
42							1.3.4. Innovation in design			
43							Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies?	No	To Some Extent	Yes
44							Does the concept design integrate the development with its broader natural environment?	No	To Some Extent	Yes
45							Does the concept design address modern building technology and innovation in design?	No	To Some Extent	Yes
46							1.4. Financial Model			
47							1.4.1. Secure Development Finance			
48							Does the cost-benefit analysis calculate the monetary cost saving of water sensitive technologies (i.e. construction cost of conventional stormwater treatmer	No	To Some Extent	Yes
49							1.4.2. Subsidy Agreement / Grant Funding			
50							Does any of the national grants allow for the funding of alternative solutions for water and sanitation services?	No	To Some Extent	Yes
51							2. Land Developomnt Stage			
52							2.1. Pre-Planning			
53							2.1.1. Basemap			

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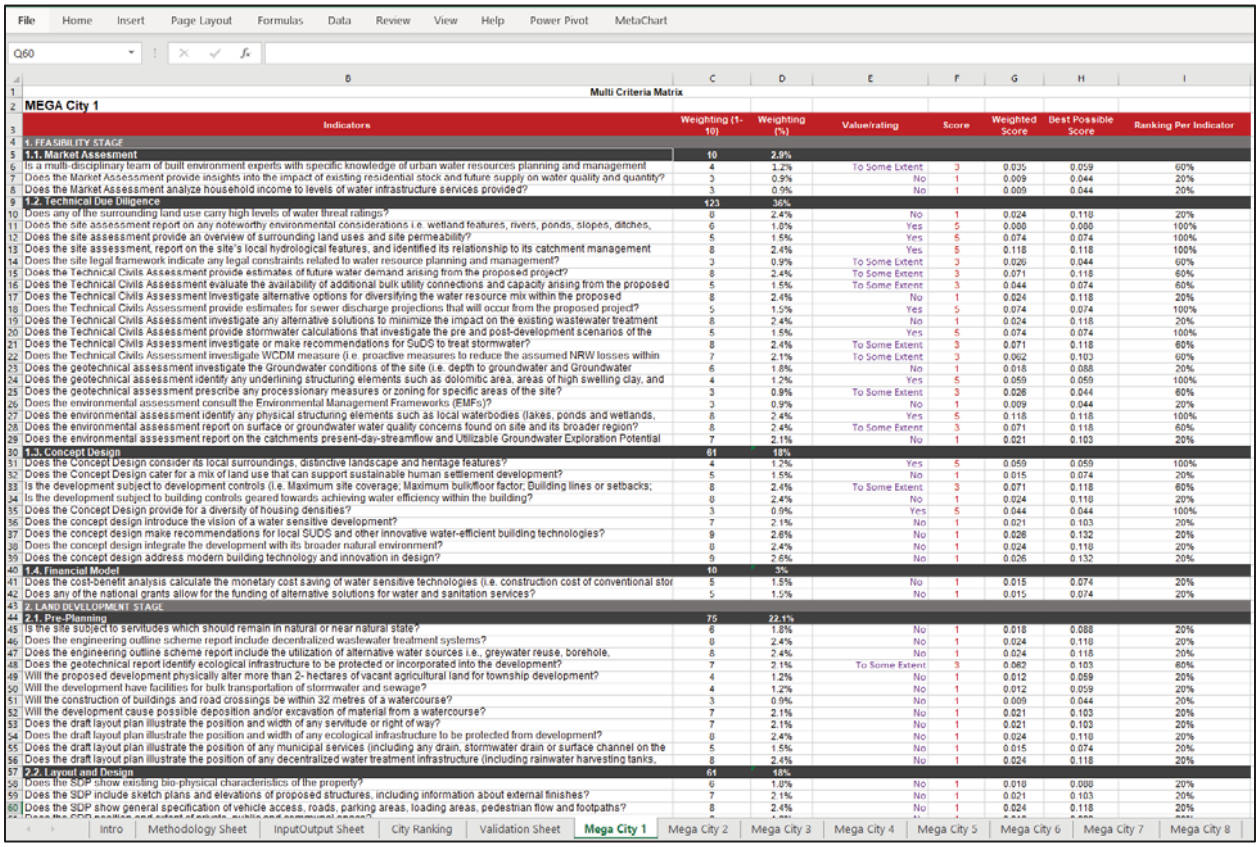
Figure 5: Validation Sheet

Figure 5 represents the Validation Sheet. The Validation Sheet is functioning background information linked to the Input/output sheet of the toolkit.

Figure 6, Mega City 1 contains functioning background information which links to both the Methodology Sheet, Input Output sheet and city ranking sheet. This sheet contains the Indicator Weightings (Colom C) which can be adjusted or customised to suit the development needs.



Multi Criteria Matrix

MEGA City 1

Indicators	Weighting (1-10)	Weighting (%)	Value/rating	Score	Weighted Score	Best Possible Score	Ranking Per Indicator
1. FEASIBILITY STAGE							
1.1. Market Assesment	10	2.9%					
Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management	4	1.2%	To Some Extent	3	0.035	0.059	60%
Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	3	0.9%	No	1	0.009	0.044	20%
Does the Market Assessment analyze household income to levels of water infrastructure services provided?	3	0.9%	No	1	0.009	0.044	20%
1.2. Technical Due Diligence	123	36%					
Does any of the surrounding land use carry high levels of water threat ratings?	8	2.4%	No	1	0.024	0.118	20%
Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches,	6	1.8%	Yes	5	0.088	0.088	100%
Does the site assessment provide an overview of surrounding land uses and site permeability?	5	1.5%	Yes	5	0.074	0.074	100%
Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management	8	2.4%	Yes	5	0.118	0.118	100%
Does the site legal framework indicate any legal constraints related to water resource planning and management?	3	0.9%	To Some Extent	3	0.026	0.044	60%
Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed	5	1.5%	To Some Extent	3	0.044	0.074	60%
Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed	8	2.4%	No	1	0.024	0.118	20%
Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	5	1.5%	Yes	5	0.074	0.074	100%
Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment	8	2.4%	No	1	0.024	0.118	20%
Does the Technical Civils Assessment provide stormwater calculations that investigate the pre and post-development scenarios of the	5	1.5%	Yes	5	0.074	0.074	100%
Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the Technical Civils Assessment investigate WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within	7	2.1%	To Some Extent	3	0.062	0.103	60%
Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater	6	1.8%	No	1	0.018	0.088	20%
Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and	4	1.2%	Yes	5	0.059	0.059	100%
Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site?	3	0.9%	To Some Extent	3	0.026	0.044	60%
Does the environmental assessment consult the Environmental Management Frameworks (EMFs)?	3	0.9%	No	1	0.009	0.044	20%
Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands,	8	2.4%	Yes	5	0.118	0.118	100%
Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the environmental assessment report on the catchments present-day-streamflow and Utilizable Groundwater Exploration Potential	7	2.1%	No	1	0.021	0.103	20%
1.3. Concept Design	61	18%					
Does the Concept Design consider its local surroundings, distinctive landscape and heritage features?	4	1.2%	Yes	5	0.059	0.059	100%
Does the Concept Design cater for a mix of land use that can support sustainable human settlement development?	5	1.5%	No	1	0.015	0.074	20%
Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks;	8	2.4%	To Some Extent	3	0.071	0.118	60%
Is the development subject to building controls geared towards achieving water efficiency within the building?	8	2.4%	No	1	0.024	0.118	20%
Does the Concept Design provide for a diversity of housing densities?	3	0.9%	Yes	5	0.044	0.044	100%
Does the concept design introduce the vision of a water sensitive development?	7	2.1%	No	1	0.021	0.103	20%
Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies?	9	2.6%	No	1	0.026	0.132	20%
Does the concept design integrate the development with its broader natural environment?	8	2.4%	No	1	0.024	0.118	20%
Does the concept design address modern building technology and innovation in design?	9	2.6%	No	1	0.026	0.132	20%
1.4. Financial Model	10	3%					
Does the cost-benefit analysis calculate the monetary cost saving of water sensitive technologies (i.e. construction cost of conventional stor	5	1.5%	No	1	0.015	0.074	20%
Does any of the national grants allow for the funding of alternative solutions for water and sanitation services?	5	1.5%	No	1	0.015	0.074	20%
2. LAND DEVELOPMENT STAGE							
2.1. Pre-Planning	75	22.1%					
Is the site subject to servitudes which should remain in natural or near natural state?	6	1.8%	No	1	0.018	0.088	20%
Does the engineering outline scheme report include decentralized wastewater treatment systems?	8	2.4%	No	1	0.024	0.118	20%
Does the engineering outline scheme report include the utilization of alternative water sources i.e., greywater reuse, borehole,	8	2.4%	No	1	0.024	0.118	20%
Does the geotechnical report identify ecological infrastructure to be protected or incorporated into the development?	7	2.1%	To Some Extent	3	0.062	0.103	60%
Will the proposed development physically alter more than 2- hectares of vacant agricultural land for township development?	4	1.2%	No	1	0.012	0.059	20%
Will the development have facilities for bulk transportation of stormwater and sewage?	4	1.2%	No	1	0.012	0.059	20%
Will the construction of buildings and road crossings be within 32 metres of a watercourse?	3	0.9%	No	1	0.009	0.044	20%
Will the development cause possible deposition and/or excavation of material from a watercourse?	7	2.1%	No	1	0.021	0.103	20%
Does the draft layout plan illustrate the position and width of any servitude or right of way?	7	2.1%	No	1	0.021	0.103	20%
Does the draft layout plan illustrate the position and width of any ecological infrastructure to be protected from development?	8	2.4%	No	1	0.024	0.118	20%
Does the draft layout plan illustrate the position of any municipal services (including any drain, stormwater drain or surface channel on the	5	1.5%	No	1	0.015	0.074	20%
Does the draft layout plan illustrate the position of any decentralized water treatment infrastructure (including rainwater harvesting tanks,	8	2.4%	No	1	0.024	0.118	20%
2.2. Layout and Design	61	18%					
Does the SDP show existing bio-physical characteristics of the property?	6	1.8%	No	1	0.018	0.088	20%
Does the SDP include sketch plans and elevations of proposed structures, including information about external finishes?	7	2.1%	No	1	0.021	0.103	20%
Does the SDP show general specification of vehicle access, roads, parking areas, loading areas, pedestrian flow and footpaths?	8	2.4%	No	1	0.024	0.118	20%

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Figure 6: Mega City 1/Development

CHAPTER 2

2. Water Sensitive Compliance Criteria Toolkit

2.1. Introduction

The schematic below illustrates the simplified expression of the land development stages through which the planning and implementation of MEGA Human Settlements undergo. The framework for achieving water sensitive design and planning solutions for MEGA Human Settlements is captured within each of the following land development stages.

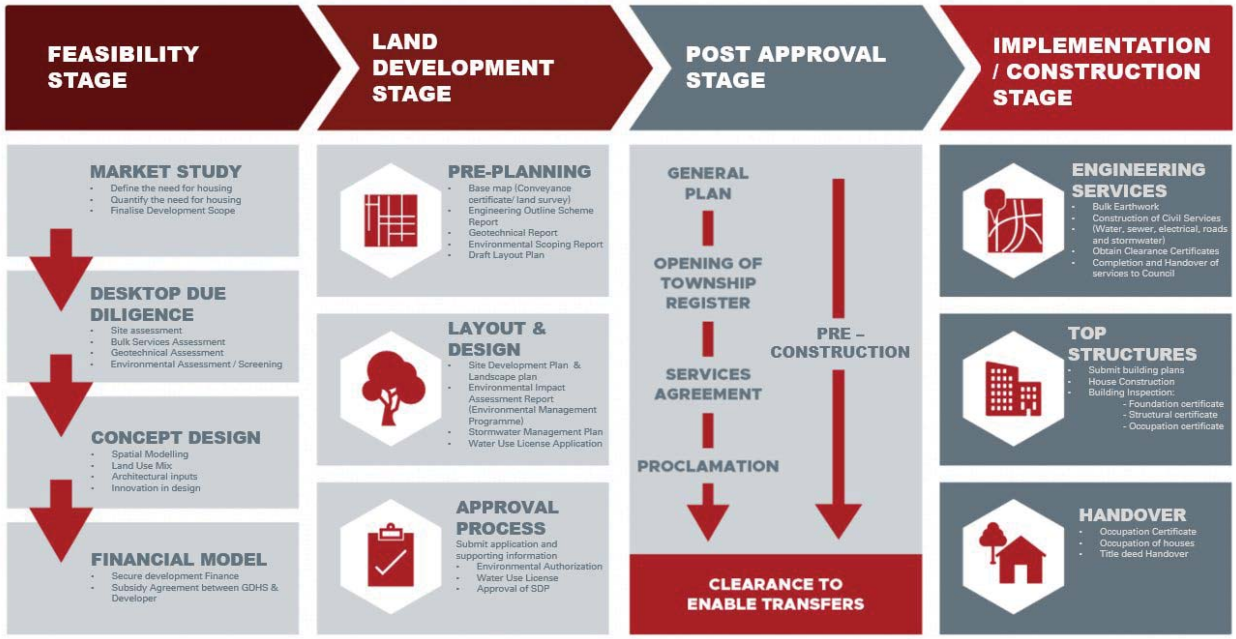


Figure 7: Land Development and Design Process

2.2. Building Development Management

In South Africa, the Constitution assigns this function to local authorities. The specific duties in carrying out this function can be found in the National Building Regulations and Building Standards Act, Act 103 of 1977, which is the primary law that local authorities need to comply with in managing building development in their respective areas.

Who are the role players involved in the development process?

Landowner/ property owner (also called "developer")

The person or institution who:

- comes up with the idea or makes land available for development;
- appoints all necessary consultants to act on his/her/its behalf; and
- oversees the entire development process until complete.

Bank/financial institution/mortgager/investor

May be approached by the landowner/developer to provide the finance for the development, usually in the form of a long-term loan or bond. May need to give consent for an application to be submitted.

Public Private Partnerships

A partnership formed between a role-player from the public sector (government or a government agency) and a role-player from the private sector (a private company or developer) to jointly undertake a specific development in the interest of the broader community, such as building a shopping centre (private) next to a railway station (public). Each partner contributes specific skills or assets.

Town planner/ urban designer

Appointed by the landowner/developer to:

- identify suitable land for development;
- determine the best way to use or develop the land;
- prepare layout plans and proposals for submission to and approval by the City;
- negotiate with all interested and affected parties on the developer's behalf; and
- oversee the planning, pre-application and approval phases.

Architect/draught

Appointed by the landowner/developer to:

- design the proposed buildings/structures that form part of the development;

- obtain building plan approval from the City; and
- (usually) oversee the actual construction.

Consulting engineer

Appointed by the landowner/developer to design the services and infrastructure required for the development (such as roads, water, sewers, stormwater drainage and electricity) as well as any structural elements of the development; and install these (or have them installed).

Stormwater engineer

The stormwater engineer should understand and incorporate the wider water resource objectives into the planning and design of hydrological performance (quality and quantity) of SuDS treatment train to achieve these objectives.

- Hydrology and hydraulics of receiving systems.
- Flood risk management
- SuDS soils specification (in association with the Landscape Architect).

Landscape architect

Appointed by the landowner/developer to design and beautify all open spaces around the newly constructed buildings, using either plants and lawn or hard surfacing materials such as paving. Landscape architect is also responsible for the design and layout of SuDS treatment train as part of the landscape plan. This also includes plant selection, soil specification and maintenance.

Aquatic ecologist /wetland specialist

Particularly important on sites where ecological rehabilitation is required, as well as sites where larger SuDS treatment trains are planned and integrated with conservation plans.

Quantity surveyor

Appointed by the landowner/developer to calculate the cost of the building/development according to specified standards.

Land surveyor

Appointed by the landowner/developer to:

- survey (measure out) the property; and
- prepare survey diagrams or general plans, which are submitted to the Surveyor-General for approval.

Conveyancer/attorney

Appointed by the landowner/seller to:

- prepare and submit transfer documents to the Deeds Office once the City has given approval, in order to register and transfer individual units to new owners; and
- possibly help prepare documents for submission to the City, respond to comments or objections received during public participation, or lodge an appeal.

Contractor/ builder/ developer

Selected and appointed by the landowner/developer to:

- build the development; and
- install the supporting infrastructure;
- usually with the help of subcontractors such as electricians, plumbers, carpenters, landscapers, etc.

Estate Agent

Appointed by the landowner/seller to:

- market the property or development;
- find willing buyers for the development or for units in the development; and
- help conclude the sale

Community/interested and affected part

Members of the public who have an interest in or are affected by a proposed development. By advertising development applications, the City provides interested and affected parties

with an opportunity to have a say in the planning proposal and design, and in monitoring the development during construction and implementation.

Non-governmental organisations

Organisations – often operating on a charitable not-for-profit basis (such as residents' and ratepayers' associations) – that provide assistance and advice to communities and represent them in general planning and development matters.

Various government departments and agencies/parastatals

Includes national and provincial government departments. They comment and provide input on proposed developments when consulted, and sometimes also perform specific functions required by law.

Surveyor-General

A government office that approves survey diagrams or general plans submitted for a new development; and keeps official records of all surveyed properties and their descriptions.

Registrar of Deeds/Deeds Office

A government office that registers the transfer of property into new owners' names; and keeps official records of all registered properties and their details, such as any servitudes, restrictions, bonds, etc.

Local authority/municipality

Municipalities are responsible for:

- providing basic services and infrastructure to communities;
- drawing up long-term development policies and plans for the wider community;
- approving development applications and building plans if they are in line with the City's policies, plans and legislation;
- monitoring the implementation of development projects according to approved standards; and
- investigating and resolving any contraventions or illegal development.

Planning Official

A City employee who is responsible for:

- processing and assessing development applications, which may include public participation;
- ensuring that an applicant is informed of the decision in the shortest possible time;
- monitoring implementation of the project; enforcing all applicable laws; and
- providing developers, consultants and members of the public with general advice on procedures and technical aspects in line with the City's Development Management Scheme throughout the process

Building control Officer

A City employee who is responsible for overseeing:

- the processing and assessment of building plan applications; and
- the recommendation for approval of applications; in accordance with the National Building Regulations and other applicable laws.

Building Inspector

A City employee who is responsible for:

- monitoring and inspecting on-site construction to ensure that it complies with the approved building plans and standards; and
- investigating contraventions and complaints regarding building work.

2.3. MEGA Human Settlements Development Lifecycle

The process starts when the MEC receives a Provincial Housing Subsidy allocation from the National Department of Housing according to the housing needs/projects identified in the Provincial Integrated Development Plan. The Municipality then applies for reservation of project funding in terms of approved IDP and agreed-on project priorities. Usually, this is already where the Developer comes into play, using the municipality as the implementing agent.

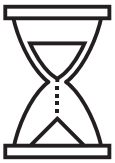
The MEC confirms the reservation of project funding in terms of the relevant housing programme per municipality and requests project descriptions. The Municipality then calls for land availability proposals where required. The Developer would communicate with the Municipality his/her intent to develop a specific piece of land. The municipality together with the developer considers the alignment of the proposal in relation to IDP. If applicable, the Municipality secures the land and undertakes a feasibility study, prepares project descriptions and compiles the acquisition agreement “Land Availability Agreement”.

The MEC then considers the agreement and makes conditional approval of specific project funding against selected land parcels and project descriptions including funds for housing subsidies and facilitates and determines variation amounts.

The municipality must then request project enrollment with the NHBRC, once completed, the NHBRC will issue a Project Enrolment Certificate. The MEC confirms subsidy project approval in the project agreement with Municipality and concludes MOU with relevant parties (i.e. Municipality and Developer). The Developer and Municipality agree on a procurement method, in the case of MEGA Human Settlements, the Turn-key Strategy, where the development is responsible for the entire project (i.e. provides a complete and functional development would be agreed upon) is ideal. A Memorandum of Understanding is signed between the MEC, Municipality, Developer, NHBRC and any other relevant party.

Stage 1

1. Feasibility Stage

Aim / Objective	Water Sensitive Rationale	Who is responsible	Timeline
			
Establish the need, desirability and viability of undertaking the development together with securing the land and rights to undertake such development in accordance with a project initiation program.	Identify opportunities for water sensitive design & planning solutions as early as possible during the land development process.	Town Planners, Real Estate Practitioners, Engineers, Environmental Practitioners, Architects & Real Estate Finance specialists.	Depending on the scale of development between (16-32 weeks).

Each development – whether private or public – starts off with an idea or vision. This is often a response to a specific need or market demand. Construction projects require huge investments, in both time and money, and for this reason, it is important to establish if the project will be feasible at a very early stage.

Feasibility studies are preliminary investigations undertaken in the very early stage of a project to assess whether the project is viable. They tend to be carried out when a project is relatively large or complex (i.e. MEGA Human Settlements), or where there is some doubt or controversy regarding the proposed development.

The feasibility stage is the first official stage where built environment professionals are brought onto the project. The feasibility stage primarily consists of one comprehensive study, referred to as the Feasibility Study which aims to:

- establish if the project is viable,
- identify numerous feasible options,
- assist in the development of business cases and project execution plans.

A detailed feasibility study can take time in accordance with the size of the project. Its purpose is to inform the developer and other interested and affected parties if the project is viable, needs to be adjusted or is unlikely to succeed.

The feasibility study is undertaken by a professional team consisting of Town Planners, Real Estate Practitioners, Engineers, Environmental Practitioners, Architects & Real Estate Finance specialists. The study will assess the general conditions surrounding the intended housing development and identify constraints and risks insofar as they could affect the said development.

Factors affecting water sensitive design and planning should be introduced during this stage as it will form the basis of all decision-making and trains of thought throughout the project life-cycle.

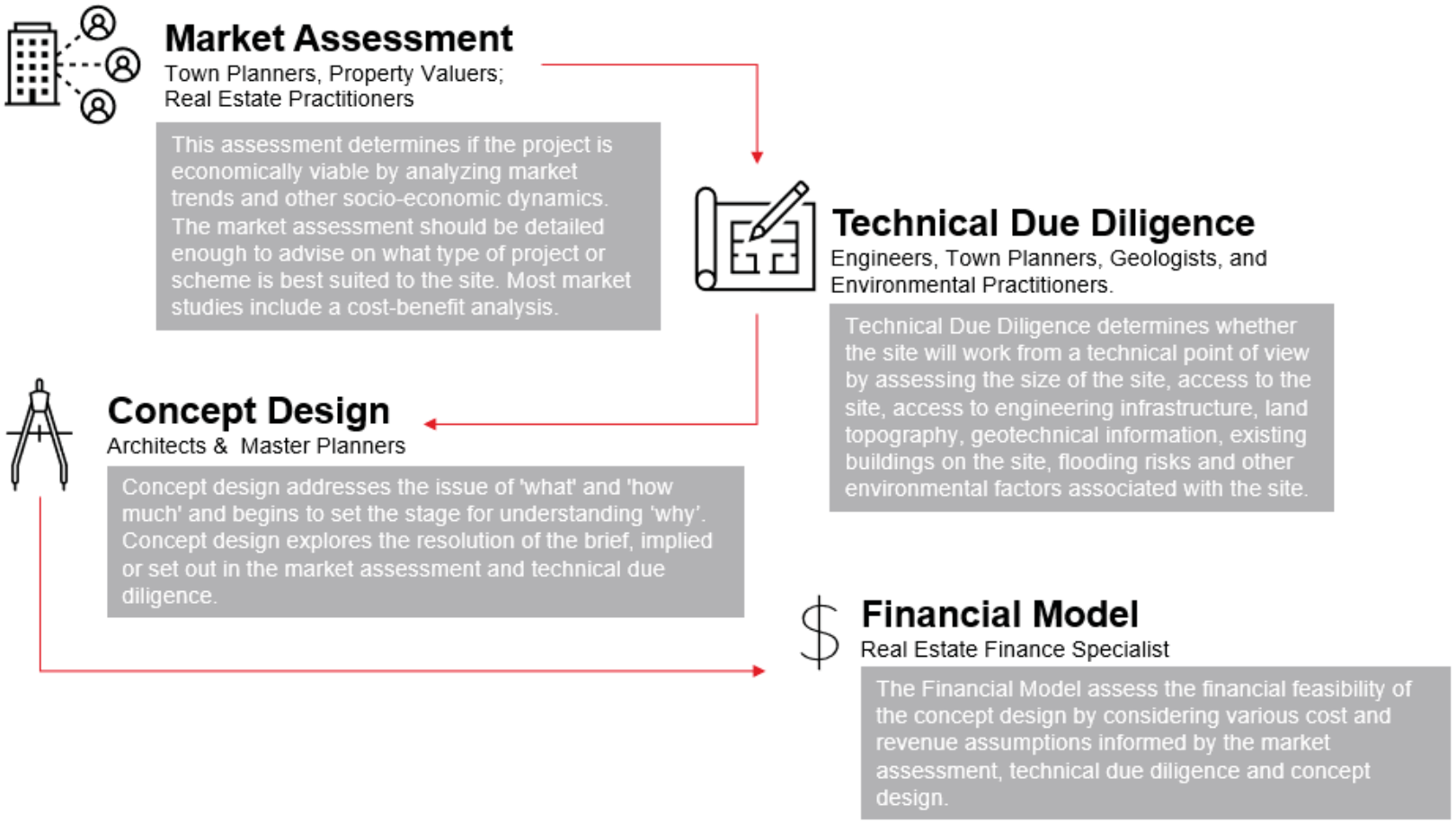


Figure 8: Feasibility study stages

1.1. Market Assessment

Town Planners, Property Valuers; Real Estate Practitioners

Typical Residential Market Assessment will aim to highlight major dynamics influencing the market including the following:

- Existing Stock & Future Supply
- Existing Demand and Future Demand
- Supply & Demand Commentary
- Key Market Indicators (Rental Levels, Sales Prices, Occupancy Rates, etc.)
- Benchmarking Analysis: A maximum of Three Case Studies
- Unique Selling Points & Critical Success Factors

The concept of **Water Sensitive Design and Planning** should be introduced during the **Market Assessment** by asking the right questions, here's how:

Existing stock and future Supply (residential market) – This subsection typically investigates existing residential stock and future supply in terms of typology (single residential, semi-detached, townhouses, walk-ups, flats) and grade (luxury, high-end, mid-end, low-end, affordable housing) and market price. The **water sensitive rationale** is to determine the water quality and water quantity impact associated with the various housing typologies and grades, i.e. a single residential household has a higher water demand compared to a flat or a luxury grade townhouse could potentially have a lower water quality impact compared to an affordable housing unit as the technology for treating wastewater might be better in one compared to the other.

Q: Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity? The predicted demand for housing can and should be used to calculate the future demand for water. It is important to build an understanding of future water demand as early as possible. This

will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.

Existing and Future demand (residential market) – This subsection is typically informed by socioeconomic data trends pertaining to population and household growth, household income and affordability.

Q: Does the Market Assessment analyze household income to levels of water infrastructure services provided? The Guideline for compiling water sensitive spatial plans provide step-by-step instruction on how to conduct water sensitive socio-economic analysis. According to the guideline, there is a major disconnect between the level of services provided and household affordability, hindering financial sustainability.

The Guidelines for Water Sensitive Spatial Planning and Land Use Management suggest that a Water Sensitive Socio-Economic & Built Environment analysis is to be conducted as part of the process of formulating water sensitive Spatial Development Framework. The guideline provides insight into determining:

- Land use water quality impact (existing and future)
- Land use water quantity impact (existing and future)
- Sustainable levels of services – affordability assessment (existing and future)
- Innovative building technologies for water harvesting and water re-use.

1.2. Technical Due Diligence

Engineers, Town Planners, Geologists, and Environmental Practitioners.

Technical Due Diligence determines whether the site will work from a technical point of view by assessing the size of the site, access to the site, access to engineering infrastructure, land topography, geotechnical information, existing buildings on the site, flooding risks and other environmental factors associated with the site.

Typical Technical Due Diligence aims to highlight major dynamics influencing the market including the following:

- Site Assessment
- Bulk services Assessment
- Geotechnical Assessment
- Environmental Assessment / Screening

The purpose of the professional team appointed to compile the Due Diligence is to assess the general conditions surrounding the intended development and identify constraints and risks insofar as they could affect the said development. The concept of **Water Sensitive Design and Planning** should be introduced during the **Technical Due Diligence** by asking the right questions, here is how:

1.2.1 Site assessment

The purpose of this step is to evaluate the development potential of the site by collecting and reviewing information related to the site's legal status and characteristics. The site assessment, therefore, sets out the legal framework as it relates to the current legal status of the land and the opportunities or constraints for obtaining the proposed land use rights as stipulated in the title deed restrictions and municipal land use scheme. A site assessment report would therefore typically report on information related to the site's Zoning; Size/Extent; SG Ref No.; Ownership; Land Claim Status; Mineral Rights Holder's

Consent and Land Valuation; boundaries and servitudes usually informed by a Land Surveyor Report.

The site assessment should also provide noteworthy commentary on site characteristics including topography, site orientation and points of access as well as report on surrounding land use, and adjacent developments, and indicate how the site will be affected by the Municipal development vision. Some site assessments also provide a high-level overview of climate characteristics and environmental considerations, i.e. visible constraints like wetlands and rivers.

In achieving **Water Sensitive objectives**, it is important for the professional team to build an understanding of how the development (or site) fits within its immediate hydrological surroundings and broader catchment area. It is therefore important to ask the following questions:

Q: Does any of the surrounding land uses carry high levels of water threat ratings? It is important to understand the impact of land use on water quality in order to plan for the right SuDS treatment. Contaminated runoff from surrounding erven could cause long-term challenges for site-specific SuDS solutions (water harvesting and reuse). See Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Spatial Analysis for step-by-step guidance on how to conduct a land use water quality assessment.

Q: Does the site assessment report on any noteworthy environmental considerations, i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye? See Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Spatial Analysis provides step-by-step instruction on how to conduct a Water Sensitive Biophysical Analysis.

Q: Does the site assessment provide an overview of surrounding land uses and site permeability (i.e. this information will be useful for the stormwater management plan)? The permeability of surrounding land uses has a serious impact on the volume and quality of stormwater. This information will be required in setting the stormwater quality and quantity objective for SuDS implementation.

Q: Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area? The catchment management plan will help set the vision for an urban catchment. Alignment with the CMP will allow the proposed development to determine, early in the planning phase, which treatment trains will be required in implementing SuDS to make a noticeable difference.

Q: Does the site's legal framework indicate any legal constraints related to water resource planning and management? South Africa has an extensive list of legislation protecting the country's natural environment and resources. It is important to investigate if there are any legal limitations pertaining to water resources specific to the site – see Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Legislative and Policy Analysis.

1.2.2. Bulk Services Assessment

The scope of bulk services assessment is to determine whether existing infrastructure has sufficient carrying capacity to cater for the proposed developments' water demand; determine the future demand, and asses the design standards of the internal engineering services. This assessment should make recommendations to adopt Water Sensitive Practices such as diversifying the water resource mix and using innovative building technologies to curb the calculated demand. The Bulk Services Assessment has potentially the biggest impact on the future decision-making process as it needs to provide options for bulk service delivery. The concept of **Water Sensitive Design and Planning** should be introduced during the **Technical Due Diligence** by asking the right questions, here's how:

Q: Does the Technical Civils Assessment provide detailed calculations on the future water demand arising from the proposed project? Calculating the future water resource demand should be a pre-requisite for all developments, especially Mega City developments, as these cities will have a substantial impact on not only physical infrastructure but also on the availability of natural resources. Knowing the predicted demand will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.

Q: Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project? In most instances, due to the size of MEGA Human settlement development, water treatment works will require bulk infrastructure upgrades to cater for the projected demand. This is an ideal opportunity to investigate suitable alternatives for water supply (i.e. to diversity the water resource mix).

Q: Does the Technical Civils Assessment investigate the options of diversifying the water resource mix within the proposed development (i.e. Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)? This assessment should be informed by the projected demand and infrastructure capacity assessment. The aim is to find several alternative water supply options that will diversify the water resource mix.

Q: Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project? Calculating the projected sewer discharge should be a pre-requisite for all MEGA Human Settlement developments as they will have a substantial impact on not only physical infrastructure but also on the natural environment. Knowing the predicted impact will allow consultants to investigate alternative solutions to improve effluent quality through decentralised methods.

Q: Does the Technical Civils Assessment investigate any alternative solutions to minimise the impact on the existing wastewater treatment works (i.e. decentralised wastewater treatment works that treat wastewater to a suitable standard to be reused for non-potable uses)? Improving the quality of wastewater discharge is one of the key principles of practices of a water sensitive city. It is important that engineers understand that there are alternative options available that will allow for cost-effective treatment and reuse of wastewater within its development. Identifying suitable alternatives at an early project phase will allow the master planner to allocate sufficient space for treatment solutions.

Q: Does the Technical Civils Assessment provide stormwater calculations that investigate the pre- and post-development scenarios of the site? It is anticipated that the size of the MEGA Human Settlement developments will have a major impact on the broader catchment area. Peak Flow is most likely to increase significantly due to the

uptake of artificial surfaces. Detailed stormwater modelling is required in order to achieve water sensitivity within these developments. Calculating the post-development conditions of the site, it will allow the stormwater engineer together with the master planner to design and allocate sufficient space for SuDS treatment trains.

Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater? The Red Book places emphasis on introducing greener methods to treat stormwater. Recycling and reusing wastewater naturally (low cost/low energy) and not treating it as a liability is key to achieving water sensitivity in MEGA Human Settlements. SuDS functions best when implemented within various treatment trains at various spatial scales – which requires space. Therefore, the stormwater engineer and the master planner must work closely together and consult the Guidelines for SuDS South Africa when preparing the concept design.

Does the technical assessment investigate the WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within the proposed reticulation system – promote higher-density developments)? NRW losses should be kept in mind at all times of the engineering design phase. Proactive measures should be discussed and evaluated that will keep NRW losses to a minimum.

1.2.3 Geotechnical Assessment

This assessment is informed by a desktop review of available geological data, geotechnical investigations and relevant reports from the study area. It provides a description of the topography, regional geology (including rock types and structural aspects, if pertinent), soils and expected geotechnical conditions. It concludes with geotechnical and geological risks and opportunities within the study area. The concept of **Water Sensitive Design and Planning** should be introduced during the Geotechnical Assessment by asking the right questions, here's how:

Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater Recharge Potential (GWRP))? Groundwater is considered an underutilised water resource forming an integral part of a water sensitives city's resource mix. GWRP is determined by its geological permeability.

The issue of whether water can get into the aquifer rapidly enough depends on the permeability of the aquifer. Land use activities in areas with moderate to high GWRP can cause groundwater contamination and should be managed carefully.

Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and areas of impeded soil drainage? Most of these underlining conditions should be avoided by development. They also provide opportunities for SuDS regional treatment trains (i.e. areas with poor or impeded solid drainage commonly support wetlands which could be further explored to accommodate constructed wetlands).

Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site? The Geotechnical assessment must make precautionary construction recommendations for township services to prevent the construction from failing and also to prevent the natural environment to be impacted negatively by the development. SuDS should be considered when recommendations are made – specifically for stormwater management.

1.2.4 Environmental Assessment / Screening

Screening is the first step of the EIA process and must be undertaken during the planning and design stage of the proposed development. The step involves assessing if an EIA (Environmental Impact Assessment) is necessary and determining the level of assessment needed when it is done. During this step, any factor that could hinder the required EIA from being conducted is identified and taken into corrective measures.

Does the environmental assessment consult the Environmental Management Frameworks (EMFs)? The EMF provides information on the biophysical and socio-cultural systems of a specific geographical area which should be used as a guideline on where specific land uses may be best practised and provide performance standards for maintaining the appropriate land use in the area. The EMF will also give a good indication if an EIA will be required.

Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands, Flood lines) potentially

acting as supplementary water sources that should be protected from physical development? Physical structuring elements such as hills, rivers and wetlands provide ecological services and development direction within a site. It is imperative that these structuring elements are kept as close as possible to the natural state to promote a resilient ecological state.

Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region? A Water Sensitive City aims to improve its water quality through water sensitive design practices it is, therefore, important to identify areas affected by poor surface and groundwater quality (i.e. Sediment yield 1,000 t/a & Total Dissolvent Solids (TDS) & Groundwater Electrical Conductivity (EC))

Does the environmental assessment report on the catchment's present-day streamflow and Utilizable Groundwater Exploration Potential (UGEP)? While the Technical Due Diligence is likely to report on infrastructure capacity, it does not necessarily report on water resources available within the broader region. A Water Sensitive City needs to understand where its water resources come from, and the master planner must consider the potential future impact of the city on the natural water resources.

The Guidelines for Water Sensitive Spatial Planning and Land Use Management suggest that a Water Sensitive Socio-Economic & Built Environment analysis is to be conducted as part of the process of formulating water sensitive Spatial Development Framework. The guideline provides insight into determining:

- Land use water quality impact (existing and future)
- Land use water quantity impact (existing and future)
- Sustainable levels of services – affordability assessment (existing and future)
- Innovative building technologies

1.3. Concept Design

Architects, Master Planners & Engineer.

Concept design requires that the architect grapples with the real issues of form and bulk, scale and mass and the generic appearance of a building within its surrounding urban context. Concept design explores the resolution of the brief, implied or set out in the feasibility stage.

The Concept Design represents an initial response to the brief and should address the issue of 'what' and 'how much' and sets the stage for understanding 'how' and is informed by the following:

- Land use mix and regulation
- Architectural inputs
- Innovation in design

The Professional Team appointed to draft the Design Concept is to explore the resolution of the brief, implied or set out in the feasibility and assessment stage. The concept of **Water Sensitive Design and Planning** should be introduced during the **Concept design stage** by asking the right questions, here's how:

1.3.1 Land use mix and regulation

The purpose of this stage is to identify appropriate land uses to accommodate the development. The professional team appointed to compile the Design Concept should consult the technical due diligence report (site assessment) so that the design is informed by the site's legal framework. Development controls include amongst other Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks; Height restrictions; and On-site parking requirements. These controls should be adhered to during the concept design phase.

In addition to the above standard development controls, some municipalities have adopted detailed building control (i.e. City of Cape Town) as municipalities aim to enforce

more energy and water-efficient buildings. The Guideline for compiling Water Sensitive Land Use scheme recommends that a municipality adopts water sensitive scheme clauses that legally enforce development principles geared towards protecting water resources and limiting the water consumption footprint of existing and future developments. Examples of Water Sensitive Management or Development Controls include Examples of Water Sensitive Management or Development Controls include:

1.3.2 Increased or reduced coverage

Increased allowable coverage from 60% to 70% if developers implement rainwater/stormwater harvesting or any other onsite water reuse technologies. The Site Development Plan (SDP) submitted with the application should include rainwater/stormwater harvesting or water reuse technologies to store and reuse 30% of runoff.

1.3.3 Increased permeability

Introducing compulsory development controls or regulations to increase onsite reliability through permeable paving or natural vegetation to reduce the rate and volume of stormwater. Permeability should be illustrated on the stormwater plan or landscape plan submitted to the Municipality as part of the development application.

1.3.4 Water sensitive building controls

Water sensitive building controls refers to a variety of innovative technologies related to water-efficient domestic plumbing, domestic and commercial irrigation, limitation on the size of private and public swimming pools, rainwater/stormwater harvesting tanks, and onsite water reuse technologies.

Q: Does the Concept Design consider its local surroundings, distinctive landscape and heritage features? It is imperative that the Concept Design aligns with the overall spatial development framework and vision of the municipality.

Q: Does the Concept Design cater to a mix of land use that can support sustainable human settlement development? Given the context of a MEGA City, it is important that the land use mix incorporates residential, commercial, educational and healthcare land

uses – all of which have a water resource quality and quantity impact. These land use should be placed carefully in order to maximise natural and near-natural landscape, more specifically creating a free flow of blue-green corridors within the MEGA Human Settlements.

Q: Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks; Height restrictions; and On-site parking requirements) geared towards achieving water efficiency within the site? Although most developers might see this as a development restriction the water sensitive approach would be to utilise these “protected” spaces to treat and harvest stormwater. Similar to coverage, the building line and set-back line should be used for water sensitive design opportunities. To be addressed in the SDP or Landscape plan.

Q: Is the development subject to building controls geared towards achieving water efficiency within the building? *This too is often seen as a development restriction or obstacle associated with increased costs as water-saving products (ultra-low-flow or single flush toilets, aerated taps) tend to be more expensive. Most products and technologies have proven to have long-term financial savings on utility bills. Given the fact that MEGA Human Settlements will be occupied by a variety of income groups, there is a likelihood that some households might not be able to pay for utility services.*

Q: Does the Concept Design provide for a diversity of housing densities? *When developing housing, a variety of housing types, sizes, and tenures must be considered. Development density has a major impact on NRW (unavoidable real loss). Water Sensitive MEGA Human settlements should aim to reduce this NRW loss as far as possible. The concept design should ensure appropriate housing density and design services accordingly.*

1.3.5 Architectural Inputs

Once the land use mix has been decided on and both the development and building controls have been carefully assessed, the lead architect will sketch a concept design of the proposed development. The concept design can be simply a series of sketches, ideas

and explorations, or it can go into considerable depth, including design illustrations, indicative plans, sections and elevations and 3D models of a development approach.

The purpose of the concept design is to provide the developer and professional team with a visual illustration that captures the overall shapes of the buildings and placement, defined by principal aesthetic and technical principles of the overall project within its broader urban context.

The concept design sketch is also supported by a design schedule/table providing detailed floor areas, use types, likely forms of construction, facade treatments, parking, access, building performance criteria and technical systems. It is considered good practice for external site treatments and landscape to also be included.

According to the Gauteng Sustainable Drainage Systems Implementation Manual (2020) considerations for stormwater management should be made early in the land development process. If stormwater processes are not inclusive of SuDS in the beginning, it is likely that space for SuDS will become a contested issue where compromises will have to be made (e.g. between the developer and the municipality). This will usually extend the land development process and timelines. By introducing the SuDS design during the concept design stage improves the chances of synergistic solutions and therefore adoption by the stakeholders. This is particularly important for Greenfields developments, but also for retrofit projects, if Suds are to be appropriately integrated into the design.

The implementation manual recommends that the overall stormwater performance (particularly stormwater quantity and quality) be set at a concept design stage and presented for authority approval as an agreement in principle. The details of the treatment train, network layout and integration with ecological and amenity functions would then be refined in the detailed design stage.

In achieving **water sensitivity** within the development, the lead architect should consider the following guiding questions:

Q: Does the concept design introduce the vision of a water sensitive development?
The Cooperative Research Centre for Water Sensitive Cities defines a Water Sensitive

City as “a city that interacts with the urban hydrological cycle in ways that provide water security essential for economic prosperity by efficiently using a diversity of water resources available; enhances and protects the health of watercourses and wetlands; mitigate flood risk and damage; and create public spaces that harvest, clean and recycle water”. The concept design should be guided by a vision statement similar to the above in order to achieve water sensitive outcomes.

Q: Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies? The concept design is the first stage of the design phase which allocated buildings to space. The water sensitive outcome would be to allocate space for SUDS and other water treatment and harvesting technologies during the initial design phase to that these systems are not included as an afterthought but rather be treated with the same importance as the physical buildings.

Q: Does the concept design integrate the development with its broader natural environment? If the site’s broader natural environment offers ecological infrastructure, It would be imperative that the natural and near-natural landscape interact seamlessly with its broader natural environment to strengthen the ecological integrity of the catchment ecosystem.

Does the concept design address modern building technology and innovation in design? During the concept design phases, it is considered good practice for the technical team to research and identify the latest innovations in construction technologies and materials. The WRC is a good place to start collecting information on innovative water and sanitation solutions.

The Guidelines for Water Sensitive Spatial Planning and Land use Management suggest that Water Sensitive Socio-Economic & Built environment is to be conducted as part of the process of formulating water sensitive Spatial Development Framework. The guideline provides insight into determining:

- Water Sensitive Land Use Scheme Guidelines
- Gauteng Sustainable Drainage Systems Implementation Manual (2020)

1.4. Financial Model

Real Estate Finance Specialist

The Financial Model assess the financial feasibility of the concept design by considering real-time construction cost and revenue assumptions.

The Financial Model is generally informed by the concept design if sufficient information is provided. The financial model typically consists of the following:

- Cost Benefit Analysis
- Secure Development Finance (i.e. Subsidy Agreement between GDHS & Developers

After the concept design has been drafted and assessed internally, the developer will appoint a Real Estate Finance Specialist to run a Financial Model. The purpose of the financial model is to determine whether or not the project makes financial sense. In recent years, there has been a growing interest in non-financial befits, i.e. social and environmental specifically when dealing with government-funded projects. The financial model is often “option based” and depending on the level of detail, modeler could quantify the costs of implementing and operating conventional vs alternative infrastructure solutions.

The concept of **Water Sensitive Design and Planning** should be introduced during the **Financial Model** stage by asking the right questions, here's how:

1.4.1 Cost Benefit Analysis

A cost-benefit analysis (CBA) is a systematic process in which decisions relating to proposals are analysed to determine whether the benefits outweigh the costs, and by what margin. A CBA serves as a basis for comparing alternative proposals and making informed decisions about whether to proceed.

The first step typically involves listing, in as much detail as possible, all the costs and benefits that are associated with the project as defined by the concept design. Once the

list has been made, a common unit of monetary measurement is applied to all the items before quantitatively comparing them to ascertain whether the benefits outweigh the costs.

Costs could include direct and indirect costs, hard and soft costs, opportunity costs and the cost of potential risks. Benefits could include direct and indirect benefits, and intangible benefits (e.g. increased productivity and cost savings). Water sensitive developments can be very complex and multifaceted, but there is nothing about these projects that makes them a special case when it comes to Cost Benefit Analysis. More specific to the water sector is the range of benefit types that projects are like to generate. In achieving **water sensitivity** within the development, the lead Real Estate Finance Specialist should consider the following guiding question:

Q: Does the cost-benefit analysis calculate the monetary cost saving of water sensitive technologies (i.e. construction cost of conventional stormwater treatment systems vs SUDS / long-term cost savings on utility bills)? The Cooperative Research Centre for Water Sensitive Cities published a Cost Benefit Analysis toolkit which covers CBA basics, guidance on strategic issues related to CBAs, and the use of economic information including CBAs, in strategic decision-making. It is recommended that the Real Estate Finance Specialist use this toolkit so that the financial model can account for the direct and indirect benefits of water sensitive design.

1.4.2 Secure Development Finance

Section 3 of Research Report provides an overview of national funding schemes for housing and infrastructure projects. The financial modeler appointed to conduct the financial feasibility should assess whether any of these grants (i.e. Subsidy Agreement between GDHS & Developers) can be accessed for the purpose of implementation of alternative solutions for infrastructure solutions.

Q: Does any of the national grants allow for the funding of alternative solutions for water and sanitation services? Funding for infrastructure and innovative building technologies should be prioritised early in the development stage.

1.4.3 Decision support tools

The Gauteng Department of Agriculture and Rural Development recently published a "Decision support tool for SuDS". For support during the land development process, these evaluation methods can assist in better informed decision-making in achieving water sensitive MEGA Human Settlements. The following methods are considered promising for deciding on the appropriate implementation of SuDS in Gauteng:

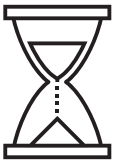
Life-Cycle Analysis: a form of Cost Benefit Analysis particularly suited to evaluating SuDS and to the requirements of the local municipality.

Trade-Off Analysis: a qualitative Multi-Criteria Analysis method, that has been adapted for this research project, from the 'Wet-Services tools for wetlands in South Africa'. This analysis allows for stronger representation of broad economic, ecological and social impacts and benefits

Land value assessment: usually a sub-set of a Cost Benefit Analysis, it can be used as both an economic evaluation and a measure of social (community) support. Community support is identified as a significant success factor for SuDS and is a key outcome of this study.

Stage 2

2. Land Development Stage

Aim / Objective	Water Sensitive Rationale	Who is responsible	Timeline
			
Formulating a detailed development plan to be submitted for approval.	Submit a development application that is water sensitive in every possible way.	Town Planners, Engineers, Geologists, Hydrologist, Architects, Landscape architects, Land Surveyors.	Depending on the scale of development between (12 and 36 months)

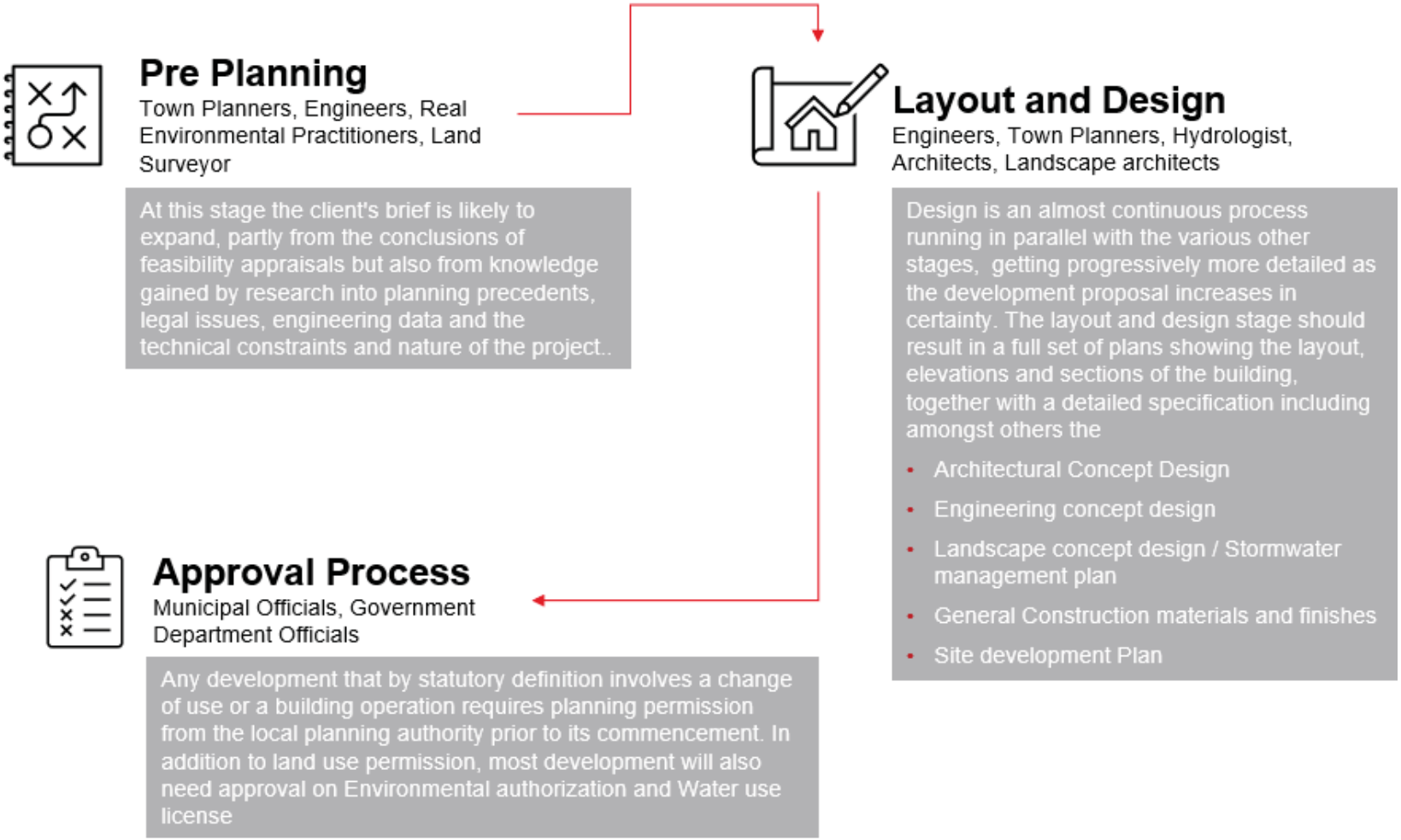
Once the development brief has been found feasible and the developer has stated his intent to proceed with the development, the project will enter the land development stage. The land development stage is primarily concerned with getting all the pre-planning information ready which includes the preparation of a base map, overlayed with an engineering outline Scheme, informed by a detailed Geotechnical report and an environmental scoping report. This information is consolidated into a draft layout plan in most cases prepared by a qualified town planner.

After the Draft Layout Plan has been approved by the professional team, the architect and engineer will refine the initial concept design to align or address any development constraints identified in the pre-planning stage emanating into a final Site Development Plan. The Site Development Plan is typically supported by a set of detailed plans including architectural design, engineering design, and landscape design. During this stage, the finalization of general construction materials and finishes should take place.

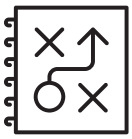
Once the Site Development Plan has been reviewed and finalised the application together with the supporting documentation will be submitted for approval. This includes the approval of a water use license as well as environmental authorization.

The water sensitive objective for this stage is to finalise the options for utilizing alternative water resources, finalise and agree on decentralised wastewater treatment works and agree on stormwater quality objectives and how SuDS design will be incorporated into the site. The section to follow identifies areas within the land development stage where town planners, engineers, geologists, hydrologists, architects, and landscape architects can give effect to water sensitive design objectives.

Figure 9: Land Development Stages



2.1. Pre-planning



Town Planners, Real Estate Practitioners, Environmental Practitioners

The pre-planning phase is typically associated with detailed technical assessments, analysis, surveys and investigations. It forms the basis for the detailed layout and design phases. Its purpose is therefore to provide as much detailed information on the technical aspects of the site as possible to avoid setbacks later in the development cycle.

The Pre-planning phase consists of a combination of detailed technical assessments typically inclusive of:

- Basemap (Conveyance certificate / Land survey)
- Engineering outline scheme Report
- Geotechnical report
- Draft environmental scoping report
- Draft Layout

During the pre-planning stage, the developer appoints professionals to conduct detailed technical assessments necessary for the detailed layout and design phase. The pre-planning phase offers opportunities for specialist practitioners to investigate the probability of tapping into alternative water resources, addressing potential stormwater challenges through SuDS implementation and allocating space for water sensitive design and treatment technologies prior to the final design.

2.1.1. Basemap

The conveyancer checks the records of the Deeds Office to produce a conveyancer's certificate dealing with all the title conditions and servitudes recorded against the title deed for the land. The land surveyor checks the records of the Surveyor-General to produce a servitude certificate dealing with the cadastral information and boundaries of the registered and unregistered servitudes. The information from these two certificates gets integrated into a base plan prepared by the land surveyor, which reflects the

cadastral boundaries, servitudes, contours, a grid, and road proclamations for the raw land.

Q: Is the site subject to servitudes which should remain in natural or near natural state? Servitudes that should remain in natural or near natural state should be utilised for the implementation of SuDS treatment train to treat stormwater runoff before being harvested or deposited to municipal stormwater systems.

2.1.2. Engineering Outline Scheme Report

The Engineers will produce an Engineering Outline Scheme Report which investigates whether the proposed development can be serviced economically with the existing resources and infrastructure based on estimated consumption calculations. The Report should be accompanied by a map illustrating the existing distribution networks in the vicinity of the development.

Q: Does the engineering outline scheme report include decentralised wastewater treatment systems? Water Sensitive Cities Design is based upon the vision of decentralizing the treatment of wastewater and stormwater as close to the source as possible. The Engineering outline scheme should be used to indicate where decentralised treatment systems can be accommodated as well as the volume of treatments it can cater for.

Q: Does the engineering outline scheme report include the utilization of alternative water sources, i.e. greywater reuse, borehole, rainwater/stormwater harvesting? Water Sensitive Cities Design is based upon the vision of accessing alternative or multiple water sources to relieve the pressure on bulk water supply systems. The Engineering outline scheme should be used to indicate how alternative water sources could be accessed, as well as the required volume of potable water.

2.1.3. Geotechnical report

The Geotechnical engineer will produce a Geotechnical report (Geotech Report) that investigates the physical properties of the site which includes, amongst others, the dolomite stability of the site, different soil horizons with their different geotechnical properties, groundwater conditions specifically areas subject to perched water table,

areas of poor drainage, an area underlain by hard rock and its estimated distribution, climate.

Q: Does the geotechnical report identify ecological infrastructure to be protected or incorporated into the development? One of the pillars of the practice of Water Sensitive Cities is to create cities providing ecosystem services. MEGA Human Settlements should be designed in such a way that it allows ecological infrastructure to function as per its natural state.

2.1.4. Draft environmental scoping report

The main aim of NEMA is to provide for cooperative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, 2014 (as amended), the developer is required to appoint an EAP to undertake the EIA, as well as conduct the public participation process. The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the activities that have been identified.

The purpose of these procedures is to provide the competent authority with adequate information to make decisions that ensure that activities that may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised, are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

In accordance with the provisions of Sections 24 (5) and Section 44 of the NEMA the Minister has published EIA Regulations (GN R. 982) pertaining to the required process for conducting EIA's. These Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity. The Regulations differentiate between a simpler Basic Assessment Process (required for activities listed in GN R. 983 – LN1 – and GN R. 985 – LN3) and a more comprehensive EIA process (activities listed in GN R. 984 – LN2). In the case of MEGA Human Settlements, most development will be subject to activities triggered under GN R. 984 and as such a Scoping and EIA process is necessary.

A Scoping and EIA process is reserved for activities which have the potential to result in significant impacts which are complex to assess. The Scoping and EIA phases of the EIA process accordingly provide a mechanism for the comprehensive assessment of activities that are likely to have more significant environmental impacts. In achieving Water Sensitive MEGA Human Settlements, the environmental scoping report should answer the following questions:

- **Q: Will the proposed development physically alter more than 2 hectares of vacant agricultural land for township development?**
- **Q: Will the development have facilities for bulk transportation of stormwater and sewage?**
- **Q: Will the construction of buildings and road crossings be within 32 metres of a watercourse?**
- **Q: Will the development cause possible deposition and/or excavation of material from a watercourse?**

If any of the questions were answered “yes”, the development application will be subject to several other detailed assessments and authorizations, including a stormwater management plan and a water use license.

2.1.5. Draft Layout Plan

Based on the information provided by the preceding technical reports, the town planner together with the architect and engineer will draft a Layout Plan. The Draft Layout Plan must show as a minimum requirement the following:

- The erf number
- The north point
- The distance to the nearest named cross street (and the name of that street)
- The name of the street onto which the site fronts
- The dimensions of the site boundaries (where the planned building work is to carried out)
- The position of any building lines

- The position and width of any servitude or right of way
- All new proposed buildings
- All existing buildings
- All existing structures and pools on the site
- Buildings proposed to be demolished
- The distance of all new and existing buildings from the site boundaries
- The site ground level(s)
- The level of the lowest floor in relation to the abutting road
- The position of any municipal services (including any drain, stormwater drain or surface channel on the site) and any connection points to such services.

Given the minimum requirements, water sensitive objectives can be achieved through the following guiding questions:

Q: Does the draft layout plan illustrate the position and width of any servitude or right of way? Servitudes can be registered in favour of the local Authority or any other relevant government department responsible for holding the SuDS-related land use.

Q: Does the draft layout plan illustrate the position and width of any ecological infrastructure to be protected from development? Ecological infrastructure (i.e. dams, wetlands, and areas with high groundwater utilization potential) should be delineated on the draft layout plan to inform the detailed landscape design plan and the stormwater management plan.

Q: Does the draft layout plan illustrate the position of any municipal services (including any drain, stormwater drain or surface channel on the site) and any connection points to such services? A unique opportunity is presented here where the developer together with the municipality can create a series of SuDS treatment trains.

Q: Does the draft layout plan illustrate the position of any decentralised water treatment infrastructure (including rainwater harvesting tanks, greywater recycling plants, and proposed borehole locations) and any connection points to such services? These alternative water and wastewater treatment solutions should be indicated on the draft layout plan to guide the next phase of the design process.

2.2. Layout and Design

Engineers, Town Planners, Hydrologist, Architects & Landscape architects

During the layout and design phase, the professional team will work together in drafting the most optimal layout and design for the site. The stage is where it all comes together. From the base map information down to the selection of the detailed construction material.

The layout and design phase typically consists:

- Drafting the Site Development Plan together with the landscape plan
- Formulating an Environmental Impact assessment report (environmental management program)
- Draft a Stormwater management plan
- Apply for a water use license

2.2.1. Site Development Plan

Following the internal approval of the draft layout plan, the professional team consisting of the Town Planner, Architect and Engineer will prepare a detailed Site Development Plan. For sites larger than 1 ha, it is recommended that the Site Development Plan is prepared by an urban designer or planner.

A site development plan is a plan or set of plans illustrating the detailed aspects of a proposed development. The purpose of a site development plan is to regulate additional matters that have not already been covered in any earlier conditions of approval or the applicable zoning scheme regulations/development parameters. Such matters would typically include the positioning of buildings, architectural details, etc.

It is generally considered after the primary development or land use rights are in place, but before building plans are submitted. Each Municipality has their own minimum requirements for a site development plan.

Depending on the nature of your proposed development, a site development plan should include at least the following components:

- A basic site layout plan with site layout information and details
- An information table/schedule illustrating development details
- Typical architectural drawings
- Schedule of building materials and finishes
- Landscape plan
- Name logos and/or outdoor advertisement arrangements
- A homeowners/property owners' association constitution
- Several of the above-mentioned SDP minimum criteria could be used to address Water Sensitive design objectives, here's how:

The basic site layout plan should address the following questions**:**

Q: Does the SDP show existing bio-physical characteristics of the property? Opportunity to create cities providing ecosystem services.

Q: Does the SDP include sketch plans and elevations of proposed structures, including information about external finishes? Opportunity to create cities as water catchment areas. All surfaces could potentially be utilised for rainwater harvesting. The roof design could have a significant impact on the volume of rainwater to be harvested.

Q: Does the SDP show general specifications of vehicle access, roads, parking areas, loading areas, pedestrian flow and footpaths? Opportunity to create cities as water catchment areas. Similar to the above, parking areas and sidewalks could be used to reduce the runoff volume protecting grey infrastructure from overloading. Permeable paving has been a sought-after solution for reducing runoff volume.

Q: Does the SDP position and extent of private, public and communal space? Opportunity to create cities proving ecosystem services and water sensitive communities. These spaces should be utilised to provide ecosystem services as well as social amenities.

Q: Does the SDP make provision for alternative means of water supply, sustainable means of stormwater management (SuDS), and disposal of sewage? Sourcing and treating water and wastewater by means of decentralised systems should be illustrated in the SDP.

Q: Does the schedule of building materials and finishes make specifications for external walls and roofs of all structures? The type of roof material and the pitch of the roof determines the volume of water that can be harvested. Modern corrugated steel roofs are ideal for rainwater harvesting systems.

2.2.2. Landscape plan

An important component of a site development plan is the landscaping of the remaining open space on the development site. This can consist of either hard (construction) or soft (vegetation) elements, or both, which are usually depicted on a landscape plan.

A landscape plan is a plan (or set of plans) with supporting drawings that shows how the proposed development will interact and affect the sites' existing natural features (such as a tree or a steep slope), built structures (such as a home or outbuilding) and infrastructure services (such as water mains and electricity cables). Landscape plans usually deal with the finer details of site layout and design.

For larger or more complex developments, like Gauteng MEGA Human Settlements, the municipality may require this to be done by a qualified, professional landscape architect registered with the South African Council for the Landscape Architectural Profession (SACLAP) in terms of the Landscape Architectural Professional Act, Act 45 of 2000. Depending on the nature of your proposed development, a landscape plan may include the following basic information:

Q: Does the development try to maintain the natural water flow system of the site? This means that run-off volumes after development should be kept as close as possible to run-off volumes prior to development. This can be achieved through absorption and attenuation. In addition, the quality of stormwater released into receiving waters should be managed to prevent further degradation and any negative impact on river systems.

Stormwater quality and quantity can be managed through a range of sustainable urban drainage system (SUDS) controls.

Q: Does the landscape plan include a schematic indication of stormwater flow paths, detention (holding) and treatment facilities: The landscape plans should introduce a detailed schematic of the SuDs treatment train design for the site and the broader region.

If the Site Development plan or Landscape plan indicates that the proposed development will have a significant impact on stormwater, the development may be subject to attaining three separate licenses from three different public institutions, and inconsistencies between the application processes can impact the land development timelines.

2.2.3. Environmental authorization

Environmental authorization (or BAR) will usually consider stormwater as part of its larger report. Ideally, a specialist report will be included addressing the anticipated impacts of the proposed stormwater scheme on the receiving drainage environment. The EA is approved by the Gauteng Department of agriculture and rural development.

2.2.4. Stormwater Permit

Signoff of a Stormwater Permit may be required as part of the approval of the Site Development Plan. This is an official permit for proposed stormwater works. It usually requires the submission of some form of Stormwater Management Plan (SWMP) with layout plans, design calculations and intended performance including flood lines where necessary. The permit is authorised by the Roads and stormwater department in conjunction with the environmental department.

2.2.5. Water Use license

Water Use license although not directly addressing stormwater design, a water use license will have an important bearing on how stormwater is released into the watercourse(rivers, wetlands and groundwater). The National Water Act, 1998 (Act 36 of 1998 – NWA) makes provision for two types of applications for water use licences, namely individual applications and compulsory applications. The NWA also provides that the

responsible authority may require an assessment by the applicant of the likely effect of the proposed licence on the resource quality, and that such assessment be subject to the EIA Regulations.

The NWA defines 11 water uses. A water use may only be undertaken if authorised by the Department of Water and Sanitation (DWS). Water users are required to register certain water uses that actually took place on the date of registration, irrespective of whether the use was lawful or not.

The water uses for which an authorisation/license can be issued includes:

- taking water from a water resource;
- storing water;
- impeding or diverting the flow of water in a watercourse;
- engaging in a stream flow reduction activity contemplated in section 36;
- engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduits;
- disposing of waste in a manner which may detrimentally impact on a water resource;
- disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
- altering the bed, banks, course or characteristics of a watercourse;
- removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
- using water for recreational purposes.

If the proposed development is subject to any of the above-mentioned water uses, the developer must apply for a water use license.

2.3. Approval Process

Municipal Planners

Construction works require planning permission before they begin. This is the granting of permission to proceed with a proposed development. Responsibility for granting permission generally lies with local planning authorities (usually the planning department of the district or local municipality). Planning conditions or planning obligations can be imposed on planning permissions, and these may need to be discharged before construction works begin. If outline permission is granted, then reserve matters approvals may be required.

The approval process is required for any developer to process with

- Submit application and supporting information
- Environmental authorization
- Water use license
- Approval of the Site Development Plan

At this point, the developer will appoint a suitably qualified and competent person to prepare the site development plan (which may include a landscape plan) in accordance with the relevant conditions of approval and the municipalities site development plan submission requirements.

When the site development plan application with all supporting documents has been submitted, the application is subject to public consultation and advertising to affected parties and internal circulation to the relevant line departments for comment. After it has been circulated to the line departments, environmental authorization is likely to be granted and a water use license will be issued.

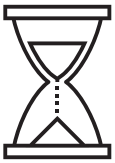
Once the comments have been addressed, the developer will receive written notice of site development plan approval. If no appeals are received, building plans may be submitted at this stage.

During this stage, there is limited action to be taken by the developer and the professional team. Determining the water sensitive outcomes of the development application now lies within the municipal decision-making process.

If/when approved, a site development plan and authorisations become an annexure to the original development approval, which means it becomes a legal obligation with which the developer must fully comply. Therefore, the proposed development must be undertaken, completed and maintained in accordance with the details of the approved site development plan.

Stage 3

3. Post Approval Stage

Aim / Objective	Water Sensitive Rationale	Who is responsible	Timeline
			
The development application is approved by the municipal official..	The municipality approves a development with is underwritten by water sensitive design and planning solutions.	Municipal officials .	Depending on the scale of development between (5-8 months)

Once the pre-planning phase has been completed, the application is submitted to the municipality and processed according to prescribed procedures, which include obtaining all required permissions and approvals. At this stage, detailed consultations with local authorities and statutory authorities will be carried out.

The post-approval stage deals with the statutory planning application process which ensures that all application requirements are met and that all relevant departments are satisfied with the proposed development. This is achieved by circulating the application internally among Building Development Management and other relevant departments for their comments. Any required corrections or changes are then referred back to the applicant, who needs to apply the changes and resubmit to Building Development Management for final consideration.

The planning approval gives the Developer certainty and captures real development value, allowing them to raise capital against the approved scheme. The planning approval allows the project team to proceed with the delivery of the scheme as a physical reality.

Once the application has been approved, the details contained in the application become a binding legal document to which the client, the architect and the construction team must adhere.

Achieving water sensitive objectives during this stage of the land development process lies within the hands of the municipality. If, and when, municipalities amend their Spatial Development Frameworks and Land use scheme documents to incorporate the recommendations made by the Framework and Guideline for Water Sensitive Spatial Planning, the decision-making process within the post-approval stage will be geared towards achieving water sensitive outcomes.

The schematic illustrates the general statutory planning process through which a land development application will go. In many cases, the municipality will grant the right to the developer to start with the pre-construction phase. This is, however, subject to the “agreement in principle” that work will be carried out to the specification as stipulated in the SDP and environmental management plan.

A commencement notice must be submitted at least one day before the works begin, and the local authority will then issue a demand notice which will set out the payments required.

General Plan
Surveyor-General

Opening of the Township Register
Conveyancer/attorney

Services Agreement
Sector departments

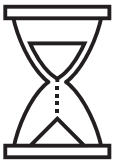
Proclamation
Municipal Planners

Clearance to enable transfer

Pre-construction Phase
Building contractors

Stage 4

4. Construction Stage

Aim / Objective	Water Sensitive Rationale	Who is responsible	Timeline
			
To physically construct the development as per the approved development application.	Give effect to water sensitive design solutions as per the planning. .	Building Contractors, Civil Engineers, Architects and Landscape Architect	Depending on the scale of development between (24 and 48 months)

With all relevant permits in hand, the next stage in the land development process is construction. During this phase, developers work with a construction company to diligently track the progress of each phase to ensure the project is completed according to plan.

The construction stage typically commences with bulk earthworks, followed by the construction of civil services (bulk infrastructure). Once the bulk earthworks and civil services have been completed, the developer will need to obtain a Clearance Certificate. On completion, the bulk services are handed over to the municipality making the municipality the key custodian or owner for operating and maintaining the bulk infrastructure.

At this stage, the building plans will be submitted to the municipality for approval. Once approved the building contractors will proceed with constructing the top structure according to the architect's and engineers' specifications. Once completed, the building inspector will need to approve the completed work and hand over the occupation certificate.

At this point, the new residents will take ownership of the residential units.

Throughout the construction phase, the water sensitive objective will be to implement water conservation and demand management strategies that will aim to limit water usage

during the physical construction period. Qualitative research has proven that when construction companies are liable for the water bill, they tend to be more conservative in water usage. The Environmental Management Plan will play a critical role in protecting the site and its surroundings from pollution, specifically stormwater contamination.

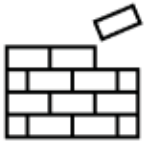
The construction stage is the culmination of all water sensitive endeavors that preceded it. Therefore, no additional water sensitive objectives have been set for the construction stage. The scope of this study does not extend to water sensitive rationale for activities that occur post-approval.

Engineering services

Civil Engineers & Building Contractors

Any greenfield development will start off with bulk earthworks, followed by the construction of civil services.

- Linking the existing bulk infrastructure services to decentralized water and wastewater treatment works.
- Construction of decentralized water and wastewater treatment works.
- Protect ecological infrastructure form demolition.



Top Structures

Building Contractors, Civil Engineers, Architects, Land Scape Architects

The stage deals with the physical construction of the buildings. From the foundation, the walls, the roof and all required finishes as per the Building Plan application.

- Ensure water conservation and demand management strategies are in place and adhered to
- Construction activities should adhere to the Environmental Management Plan rules and regulations.
- Construction of decentralized water and wastewater treatment works

Handover

Developers

At this stage, the development must be occupational. Handover is the final stage of the land development process.

- Custodians for water conservation and demand management