OPERATIONALIZING COMMUNITY-LED WATER SERVICES FOR MULTIPLE USES IN SOUTH AFRICA

Barbara van Koppen, Kenny Phasha, Thando Bophela, Itumeleng Modiba, Malcolm White, Manuel Magombeyi and Inga Jacobs

WATER RESEARCH COMMISSION

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Report to the

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by

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This report stems from two WRC projects, namely K5/2607 and K5/2609.

Executive Summary

Rationale and project design

In spite of considerable government investments in water services provision in rural South Africa, service levels are declining. High rates of dysfunctional municipal boreholes, a maintenance backlog, and communities' neglect, illegal connections, if not vandalism, underscore the need for complementary water services models that can restore the dwindling trust in municipalities. The project 'Operationalizing community-led multiple use water services (MUS) in South Africa' (or MUS project) aims to fill this gap by generating evidence whether and how communities' active participation in planning, design and construction can cost-effectively mobilize local knowledge and innovation, resulting in more and more sustainable livelihoods at scale. In such model, government and communities co-manage water services.

Funded by the African Water Facility of the African Development Bank, the project is designed as an evidence-based change process, managed by the Water Research Commission (WRC). The NGO Tsogang Water and Sanitation (or 'Tsogang') demonstrates the step-wise participatory planning, design and construction processes at community-level as a socio-technical facilitator providing technical and institutional support. The International Water Management Institute (IWMI) compiles the evidence of the change processes at community, district, provincial and national levels. State and non-state actors at all levels join in learning alliances and policy dialogues, in particular the District and Local Municipalities, the Departments of Water and Sanitation; Agriculture, Land Reform and Rural Development; and Cooperative Government and Traditional Affairs. Focusing on two of the country's poorest districts Sekhukhune District Municipality (SDM) and Vhembe District Municipality (VDM) in Limpopo Province, these government partners advised on the selection of six demonstration communities that represent a wide diversity in population sizes, geo-hydrology of both surface and groundwater sources, socio-economic conditions, types of water infrastructure and service levels. This resulted in the selection of Ga-Mokgotho, Ga Moela and Phiring in SDM and Tshakhuma, Khalavha and Ha Gumbu in VDM.

The MUS project team defines community-led multiple use water services (MUS) as:

> A holistic participatory approach to planning and providing water services that support people's self-supply and their multiple water needs as identified by communities; and coordinates across government departments as needed.

The present report covers the period from the end of 2016 to early 2020, during which most of the works were finalized. A project extension will enable finalizing some last works delayed by the COVID 19 crisis and handing over, assessing longer-term sustainability and further upscaling elsewhere. In the following, salient citations by community members or officials are indicated in 'quotation marks'.

Mobilizing local innovation: self-supply and IWRM

The 2017 base line assessment among 645 households in the six communities confirmed the same local innovation as found in rural areas elsewhere across the globe where it also underpins the emergence of complementary and alternative water services models. Individual and organized water users are found to invest in water infrastructure for self-supply to meet their multiple water needs from multiple sources as the building blocks of holistic integrated water resource management (IWRM). Local self-supply and IWRM has existed since time immemorial and is like 'the blinking of an eye' for communities. Self-supply is growing as a result of expanding populations, the availability of affordable water diversion, lifting, conveyance and storage technologies, electrification or solar energy sources, markets for irrigated produce, aspirations for service levels that are higher than basic subsidized provisions, and, last but not least, by the need for back-up supplies when public water services are interrupted or fail completely.

The same was found in the six communities. Most households had two or more sources of water to their homesteads as a vital buffer to irregular supplies and droughts. Water from any infrastructure to homesteads was used and re-used for domestic purposes, livestock and, for many households, irrigation for consumption and sale. This was also the case when average water quantities were less than South Africa's Free Basic Water norm of 25 litres per capita per day. Collective public infrastructure to irrigate fields in a distant irrigation scheme was also used for livestock and domestic purposes. Other sites of use, such as dams or streams were multipurpose, or just for cattle. Individual point sources to irrigate distant fields were single-purpose.

Focusing on water to homesteads, in only one community (Phiring) was government's water supply to homesteads the most important source. Another community self operated and maintained an NGO constructed scheme (Ga Mokgotho). In the remaining four communities the most important source was self-supply. These were piped gravity systems in mountainous areas (Tshakhuma, Khalavha), household boreholes with electric pumps (Ha Gumbu, a community with ample shallow groundwater resources, new electricity connections, and good markets) or low-service hand-dug shallow wells (Ga Moela).

Self supply tends to be taken up by those who can afford, but they share water with neighbours, either for free or for a fee to cover operational costs. This is well illustrated in an in-depth study among 26 household borehole owners and 26 households without an own borehole in Ha Gumbu, during a period in which the municipal borehole was dysfunctional. Intra-community inequalities and water sharing were conceptualized as a water ladder of four categories from lowest to highest service levels: non-borehole owners who paid the borehole owner and fetched water by foot; paying, non-borehole owners with a piped connection from their neighbour's borehole; borehole owners still aspiring to increase their household storage and, at the highest service level, those satisfied with current storage.

The MUS project aimed at mobilizing and supporting communities' innovative water wisdom of managing multiple water sources and public and private infrastructure for self-supply to meet domestic and productive needs, through community-led water services planning, design and construction.

Project Implementation

Conceptualizing step-wise planning and co-management

The MUS project conceptualized the planning, design and construction, repair or rehabilitation of water infrastructure as recurring rounds of six steps: initiating, diagnosing, visioning of the range of solutions, prioritizing and fitting the financial framework including the formalization of implementation arrangements, implementing the plans (procuring materials, organizing works and constructing), and, finally, using the water infrastructure. The steps are not rigid at all, but indicate that any next step requires actions and decisions of an earlier step. One may well go back to an earlier step. For example, during construction of a certain design (step 5), new opportunities and obstacles come up so designs are adjusted (step 3), which requires flexible funding and timeframes (step 4).

Commonly, external agencies (funders, government officials, engineers and technical experts) conduct the diagnostic and solution-oriented pre-feasibility and feasibility studies and final designs. Once the plans fit financial frameworks and contracts, external officials and contractors lead the procurement of materials, recruitment of workers, and construction. Only then, in step 6, is the new or upgraded infrastructure handed over to communities for their use and, possibly, tasks in operation and maintenance.

In contrast, in the MUS project's community-led planning and implementation, communities are in the driver's seat of all steps – except step 4 of fitting of the financial framework. External support consists of socio-technical facilitation, technical and institutional capacity development, advice, supervision and technical quality control (as provided by Tsogang), besides financial support for materials and labour (for which the African Water Facility provided €200,000 to WRC). Community decision-making and external support remain two sides of the coin in forms of 'co-management', in which government and communities each have well defined roles and responsibilities. As duty bearer to ensure Free Basic Water for all, South Africa's government remains key. Communities see their own initiatives, in particular self supply, as being done 'on behalf of government'. After all, 'we as the people ARE the government'. 'We are together'. 'We first did our own thing and now invite government for further support'. 'We are ready'.

The diversity of the selected communities allowed testing whether and how the *process* of community-led planning and implementation is generally applicable so generic, although the *substance* of the participation and co-management differs. This diversity is reflected in the infrastructure and incremental improvements as the communities prioritized under the MUS project (see table below). This illustrates differences between, at the one end, affordable communal piped gravity systems with storage ('jojo') tanks constructed, owned, operated and maintained by communities as self-supply. At the other end is the complex mechanized infrastructure of municipal boreholes. This (or other government bulk supplies, large storage construction and major maintenance and repair) requires higher levels of engineering expertise. In such cases, participatory planning and co-management are still important, but confined to, for example, the storage and reticulation systems connected to the borehole, monitoring and possibly operation of the pump.

Overview of existing and project works (in italics) in the MUS project

	Main types of existing infrastructure	
	Existing infrastructure Communal Piped Gravity System	Existing infrastructure Municipal borehole systems
Community with sections and number of households	*MUS project works* Source development; filter box; repair main line; storage development; (protection of) valve boxes; reticulation repair and extension	*MUS project works* Pump house refurbishment; main line construction or repair; storage development; new, repair or extension of reticulation
Ga Mokgotho SDM 800 households	NGO funded gravity supply from spring, self o&m: *augmentation of supply, upgrades, repairs and extension of reticulation*	-
Ga Moela SDM 118 households	-	• Tawaneng/Letlabela borehole: *new storage and reticulation* • Mabusa/Moela borehole: *new storage and reticulation*
Phiring SDM 420 households	Dam and gravity pipeline for irrigation and other uses: *augmenting water supply to dam and repair leaks; extension to cattle dam*	• Municipal borehole system Phiring: *refurbishing storage, repair reticulation*. • Municipal borehole system Vrystad section – *no works*
Ha Gumbu VDM 1652 households (total for 3 sections)	-	Municipal borehole system: *repair pumphouse; augmentation storage; extension of reticulation; repair cattle trough*
Khalavha Thondoni section VDM 163 households	1 self-supply gravity system: *source development, new storage*	-
Tshakhuma 9 sections VDM 2360 households	11 self-supply gravity systems: *source development, augmentation storage, one new system*	Borehole Maswie: *connecting to new storage*

	Main types of existing infrastructure	
	Existing infrastructure Communal Piped Gravity System	Existing infrastructure Municipal borehole systems
Other	*Household 2500 litres jojo tanks: to 80 indigent households in six communities* *Repairs communal hand pumps (Ga Moela and Ha Gumbu)* *Animal drinking troughs (Ga Mokgotho, Ga Moela, Ha Gumbu, Khalavha, Tshakhuma).*	

Evaluation of the steps and likely sustainability

In addition to Tsogang's experiences and reports on the implementation of the community-led step-wise process, representatives of the MUS Forums of the three demonstration communities in SDM and the three in VDM met six times in district-level innovation forum meetings. All six communities met once. They exchanged experiences and shared advice. Further, IWMI held interviews, transect walks, focus group discussions in all communities, and a quantitative base line (645 households) and user-satisfaction surveys among randomly selected samples in Ga Mokgotho (59 households), Ga Moela (42 households) and Ha Gumbu (52 households). Evidence from these sources confirmed how each step mobilized communities' knowledge, skills and assets and rendered the resulting improvements in access to water and livelihood benefits more sustainable, as follows.

Step 1 – initiating collaboration. After community selection, all community members were invited to one or two meetings to initiate collaboration and agree on shared goals. In smaller sections or communities most community members attended the open meetings. In the large community of Tshakhuma with 11 communal self supply systems, their representatives engaged. The community nominated or elected a local leadership structure, called MUS Forum. Government officials and Tsogang managed expectations by emphasizing voluntary contributions, 'meeting each other half-way', and 'being equal partners'.

Communities fully endorsed the process: 'nothing about us without us'. Managing expectations and keeping promises appeared crucial. Communities' most frequent evaluation of Tsogang was: 'Tsogang kept its promises'. The participatory process was new and only became clear in the course of the steps: 'Now our eyes are opened'. The leadership structures of the MUS Forums were pivotal during the process and will continue to be that in the use phase. This institution means that water users 'now have someone to go to with complaints'. Women water users actively participated throughout the process, but youth was somewhat under-represented. Local artisans or 'loccal engineers' in self supply schemes were mainly elder men.

Step 2 – diagnosing. Community members and Tsogang developed a shared understanding about the community, its water sources, infrastructure and management through focus group discussions, transect walks, interviews and measurements of flows and GIS. Participatory resource mapping appeared particularly informative. The smaller group of more specialized 'local engineers' shared their knowledge with other community members. Looking 'at the community from the sky' made people realize: 'if we do things together as a community instead of criticizing each other, we will achieve more'. This diagnosis mobilized indigenous knowledge and did justice to local specificities. It allowed to 'start with what is there, what we have and what we know, and move from there' (two government officials).

Step 3 – envisioning solutions. In this step, communities and Tsogang further identified, scrutinized, systematized and ranked the range of solutions and translated those into designs of new (parts of) infrastructure, repairs, upgrades or extensions and related institutional requirements. Communities had many ideas for solutions, often since long, as expressed from the first contacts onwards. In step 3, Tsogang provided further engineering expertise to check and give advice; to translate ideas into technical designs; and to compile the bills of quantities and costs. Respondents found that 'Tsogang really listened to us'. 'They discussed what I was thinking'. Following communities' priorities and aspirations created robust commitment and ownership of further actions.

Step 4 – fitting the financial framework and formalizing. The financiers, in this case the WRC and African Water Facility, finalized the prioritization of proposed solutions, approved and reworked this into a budget- and time-specific work plan, complying with due diligence. Legally binding contracts among all partners stipulated the modalities for procurement of materials, labour, construction and quality control. WRC procured materials. For the works, all communities were adamant: skilled and semi-skilled works should be done locally, and not by external contractors 'who come and go'. All partners agreed to remunerate works in line with South Africa's employment generation programs, so ZAR95 per day. Payment would be upon completion and approval of works. As part of the new contractual arrangements, MUS Forums formalized, in this case into Primary Cooperatives.

Step 5 – implementing.

As government agency, WRC procured the materials according to the centralized procurement procedures. MUS Forum members felt somewhat side-lined, also pointing out that local procurement would have better aligned with local conditions, been cheaper, and strengthened knowledge and contacts with local suppliers for future maintenance. Calculations confirmed that local procurement at off-the-shelve prices would have saved the mark-ups charged by the suppliers that won the WRC tender. Their mark-ups varied from minus 3% to plus 39%, with an average of 22% of the prices of the same materials and transport from the local warehouses.

The MUS Forums decided about the procedures to recruit semi-skilled workers (as a lottery) and local skilled works (based on past performance). Tsogang sub-divided all works into daily 'tasks', and trained MUS Forums. Together, they trained and supervised semi-skilled workers in the factual construction, and signed off. Emphasis continued to be on voluntary aspects of semi-skilled works, highlighting the ultimate common good of improved access to water. Tsogang also clarified budgets. Growing transparency on budgets not only mitigated the inevitable rumours but also enabled comparison with other projects. Invariably, community members expressed how the MUS project's budgets created more value than other projects. 'Comparing to Ma-Chupi I wish they had given that ZAR 5.5 million project money to Tsogang; then there would be water everywhere and money would be saved to do other betterment'.

Community-led construction was highly appreciated. This generated a total of 3550 person-days of semi-skilled employment in the six communities, which is 72% of the total labour costs. The lucky ones that won the lottery appreciated the new skills learnt, which stay in the community for sustainable operation, maintenance, (emergency) repair, and future upgrades. Work performance was good, because ‘workers themselves, their families and neighbours benefit from the result’. It triggered continuous care, preventive maintenance and protection against vandalism. ‘We worked hard for it, so we will maintain well’.

The only disadvantage of steps 1 to 5 that emerged in all four communities with street taps was that households still lacked yard connections. Sharing of street taps, on average with about four households, creates tensions. In Ga Mokgotho and Khalavha where water users had promised to self-organize yard connections, this still had failed to materialize by early 2020.

Step 6 – hand over and use. Tsogang trained the communities for this phase, among other on practical measures to ensure that the 3 to 5 litres per person for day for drinking was safe. By early 2020, hand-over to communities and municipalities was still ongoing. Asked about their expected operation and maintenance, respondents in communities with municipal boreholes already performed or expressed willingness to take up semi-skilled tasks, such as small repairs of reticulation and taps, or, in some cases, provision of fuel and voluntary pump operation. This would avoid the usually long periods of waiting until municipalities implement the promised support. Promises paralyze communities to organize and take action, and everyone loses. Clear (temporary or longer-term) co-management arrangements are the lowest hanging fruit to improve service delivery.

Hand-over and the real-life testing of the expected sustainability will be addressed in the project extension.

Time and cost advantages

A comparison of time requirements of community-led design, planning and implementation and more conventional approaches of outsourcing to external consultants and contractors showed that communities do need time to ensure all stakeholders are involved, discuss and build consensus on issues (‘be patient’; ‘tell the leaders again and again, and finally they will support’). Overall, steps 1, 2 and 3 took some eight months in each community. This is to be compared with the time requirements in conventional approaches so: task formulation, tendering, selection, and implementation of pre-feasibility studies and often a similar process for feasibility studies; and for the final technical designs.

Step 4 (approval of proposed designs and signing implementation contracts) lasted some four months, from December 2017 to April 2018. This is to be compared with the time for approval of designs, allocation of funding, tendering and contracting of winning contractors.

In step 5, the central procurement of materials less than ZAR50,000 took four to five months. However, this was eight months for the costlier materials in Tshakhuma. If procurement had been decentralized, it might well have been quicker.

Communities' recruitment and the bulk of construction works were finished within three to four months. However, some unexpected problems gave delays of part of the MUS project's works in Ga Moela (need for booster pump connected to one of the two municipal boreholes), Phiring (relocation of additional intake to pipe water to the dam), Tshakhuma (protection of very distant springs) and Khalavha (lack of promised community organization to connect the new storage to yards). In the case of municipal borehole systems, the community-led upgrades and extensions were also swift. However, interruptions in the functioning of municipal pumps gave long delays (Ga Moela Tawaneng 6 months; Ha Gumbu 11 months; Maswie/Tshakhuma one year).

In sum, community-led planning and implementation is relatively swift, while still ensuring sufficient time for communities to forge internal agreement. Communities have a direct interest in the resulting improvements in access to water. Modest remuneration of works also accelerated implementation. However, flexibility is needed to accommodate few last, unexpected hurdles.

A financial comparison showed that costs of the community-led MUS are lower than conventional water services models, and likely sustainability higher, in the following five ways. First, community-led MUS mobilizes local innovation, and welcomes and supports the knowledge, skills and investments in cash and kind for self-supply. This contributes to achieving government's mandates and constitutional commitments at no or low costs to government.

Second, it supports multi-purpose infrastructure, which is a cost-effective technical design to meet people's priority water needs.

Third, from delivery in the communities onwards, the MUS Forums took charge of storing the materials of pipes, cement and the jojo tanks in a safe space of the chief or school. This saved the costs that contractors would have incurred by establishing a plant and guarding against vandalism.

Fourth, communities seek to reduce costs. Communities and Tsogang had some freedom to spend the fixed amounts set for the labour cost (stipends) in each community. Using this freedom, they reduced payments to skilled and semi-skilled workers in order to save money and, instead, spend on unforeseen but prioritized expenditures, including transport or new materials. These reductions were on average 20% of the fixed amounts, and varied between 5 and 35% across the six communities. Contractors who are only accountable upwards to implement fixed designs have no incentive at all to reduce implementation costs, even if they had the flexibility.

Fifth, work is also done voluntarily, with the reward of improved access to water.

Lastly, the costs made by Tsogang (staff time, travel, overhead) were compared with the service provision fees indicated in the 2016 'Cost benchmarking guide for water infrastructure' of the Department of Water and Sanitation. This calculation uses the capital costs as the basis for calculating service fees. Capital costs are the sum of material plus labour costs; contractor costs are probably included under labour as well. The MUS project's total capital costs for all six communities was ZAR 3 153 746. For steps 1, 2 and 3 the costs that Tsogang made for its services in the communities were 13% of total capital costs. The national Cost Benchmarking Guide indicates planning and design fees between 12,5 and 22,5%, depending on the project's total size and capital costs. So, community-led planning and design compares well.

The costs of Tsogang's own contractor role, plus its advice, classroom and on-the-job training, supervision and quality control of the recruitment of workers and construction, amounted to 36% of total capital costs. In the national cost benchmarking guide the costs of secure storing, construction supervision fees and training and capacity building fees range from 10 to 22%, depending on the size of the project. As it is unclear how local contractor costs are calculated in the cost benchmarking guide, it is impossible to compare. Further research is recommended on costing modalities, including costing of supervision of contractors, size of projects, and required levels of engineering expertise for the infrastructure at stake.

In sum, evidence showed that community-led planning, design and construction can be quicker and is more cost-effective than conventional water service models for small-scale infrastructure. As communities say: community-led MUS enables 'communities to do whatever they can do, and which is often easiest and simplest for government anyhow'.

More and more sustainable benefits

The outcomes of improved access to water and livelihood benefits were assessed in Ga Mokgotho and Ga Moela, two communities that had moved into step 6 by end 2019, In Ga Mokgotho the average volumes per household per week increased from 733 litres per household per week in 2018 to 1138 litres on average without the project's jojo beneficiaries (55%), and to 1305 litres per household per week (so 78%) if the jojo beneficiaries were also included.

In Ga Moela, with many new taps, the quantities of water used per household per week for all respondents in 2018 was 613 litres, taking 9,5 hours per household per week. Post-construction, the average for respondents, excluding jojo beneficiaries, moved to 965 litres per household per week (so an increase of 57%), taking only 4,1 hours per week. Inclusion of the jojo beneficiaries increased the average of volumes used to 1167 litres per household per week (so 90%). Time requirements were similar: 4.3 hours per week.

These increased quantities served multiple uses; only 10% (Ga Mokgotho) and 5% (Ga Moela) of respondents used water from their infrastructure for domestic uses only, whereas 68% (Ga Mokgotho) and 82% (Ga Moela) gave water to livestock. The majority of respondents (86% in Ga Mokgotho and 54% in Ga Moela) irrigated. Respondents estimated the increases in the yields of fruit trees and vegetables as the result of improved access to water. Some prices would also slightly increase. This would lead to increases in value of irrigation produce (whether sold or consumed). Expected increases in value were extrapolated to all water users benefitting from the improved infrastructure.

Accordingly, the better irrigation of fruit trees in Ga Mokgotho (800 households) was estimated to increase their value from ZAR 2,324,123 before the project to ZAR 3,713,198 post-project. This is an increase of ZAR 1,389,075, or 60%.

For the 108 households of Ga Moela, the improved irrigation of fruit trees was estimated to increase the value produced by 64%, from ZAR 100,778 before the MUS project to ZAR 164,869 after the project. Similarly, for the whole of Ga Moela, irrigated vegetable production was expected to increase the value produced by 95%, from ZAR 63,889 before the project to ZAR 124,268 post-construction. Taken together, irrigation before the project was calculated to have a value of ZAR 124,470. With and additional value of ZAR 164,666 (76%), the estimated total value of irrigated produce increased to ZAR 289,136.

These benefits from homestead irrigation largely accrue to women in both communities. In Ga Mokgotho, women managed homestead irrigation in 68% of those cases. Among 17% of homestead irrigators, women were the main managers; in 9% both women and men managed; and only in 6% of households with homestead cultivation, did men exclusively manage. Women were also involved in Ga Moela. Women managed irrigated cultivation in 60% of the cases; men managed in 25%, and both women and men were managers in 15% of the irrigating households.

These higher livelihood benefits compound the earlier reasons why community-designed and implemented infrastructure improvements are likely to be more sustainable.

Upscaling: accountability to communities

- Learning alliances and policy dialogue

The MUS project facilitated dialogue between MUS Forum members, officials and the project team in order to prepare for hand-over and longer-term co-management in the six communities, which MUS Forum members also welcomed as opportunities to 'market our community'. Moreover, dialogues from local to national level also served to explore pathways for replication of community-led water services in various co-management modalities nation-wide. To that end, the MUS project held five district level learning alliance meetings, four provincial meetings, and four national learning alliance meetings and a national policy dialogue. Participants in the events included Local and District Municipalities; the Limpopo Premier's Office and its Limpopo Research Forum; the district, provincial and national Department of Water and Sanitation (DWS); the national Department of Agriculture, Land Reform and Rural Development (DALRRD) and the Limpopo Department of Agriculture and Rural Development (LDARD); and at various occasions also the Department of Cooperative Governance and Traditional Affairs; other government departments; and representatives of development and employment generation programs, treasury and other financing institutions as well as the corporate sector.

Some of these events were held in the communities, where 'seeing is believing'. At the WRC's international biannual symposium 15-17 September 2019, the MUS project became 'one of the most exposed projects', also in the presence of the Deputy Minister of Water and Sanitation (DWS), the Director of the African Water Facility and MUS experts from Ethiopia and India. The MUS project received the Knowledge Tree Award for Community Empowerment.

Communities' voices, their self-supply and buy-in into community-led processes drew officials' attention and was welcomed. For example, on 18 July 2019, Mandela Day, the mayors of both Vhembe district and Makhado local municipality assisted with the construction of a concrete slab for the filter box in Tshakhuma. At national level, the Minister, Deputy Minister and Policy Division of the Department of Water and Sanitation expressed their support in various ways. This advanced a national recognition of support to self-supply and multiple uses as complementary water service model and opened up the exploration of replication and downstream investments by government and other support agencies. Line agencies, especially DWS and DALRRD soon saw themselves as 'the convinced'. Engagement with (overstretched) municipalities and integration in the Integrated Development Planning processes appeared more complex. These engagements and further policy analysis generated the following insights on the opportunities and obstacles for country-wide replication of community participation from the planning phase onwards.

- High level policies

South Africa's high level policies endorse community participation, as articulated in the constitution and Integrated Development Plans. The Department of Water and Sanitation already recognized people's multiple water needs in the Strategic Framework for Water Services in 2003. In 2011, it issued guidelines in the 'Provision of water for small scale multiple uses systems. A guide for municipalities'. The National Water Resource Strategy – 2nd edition of 2013 (p. 24) endorses multiple use water services by seeking '*to ensure a smooth integration of the provision of water supplies for domestic use and water for other purposes leading to economic production, particularly in rural areas*. The National Policy Review of 2014 specified how planning bulk raw water infrastructure for a single water use is '*inefficient use of financial resources*'; and that a participatory approach is needed '*to avoid conflicts over allocations to different purposes*'.

Support to self-supply is equally endorsed. The National Development Plan Vision 2030 proposes grants for self-supply as an alternative water services model. The 2017 'Draft National Norms and Standards for Domestic Water and Sanitation Services' encourages Water Services Authorities to provide support to investments in infrastructure for self-supply. Similarly, the 2020 Comprehensive Producer Support Development Policy of the Department of Agriculture, Land Reform and Rural Development supports a range of small- and larger-scale water technologies for self-supply by individual or organized farmers and farm workers.

- Overcoming paradoxes in operationalizing policies

The constitution and high-level policies fail to be operationalized. One paradox encountered is the silo-ed set up of the administration. This is logic at central levels: it avoids double financing and it organizes the expertise on health, hygiene, agronomy, or markets that is needed to turn the use of water as just one input into an overall livelihood benefit. However, this logic does not hold for water and technical water infrastructure, where multipurpose infrastructure is most cost-effective. This paradox is overcome by ensuring free basic *volumes* of water for all, leaving the right to the user to decide on how to use these basic volumes. Users or other financiers can add and top up these basic subsidized volumes. For low incremental costs they can generate high incremental benefits. Government's responsibility that water for drinking is safe holds for the 3 to 5 litres per person per day that is consumed through effective treatment measures. There is no *a priori* need for expensive treatment of water for bathing, cleaning of floors, laundry or other domestic uses.

Expectations emerged as a second paradox. A logic reason for external planners and engineers to minimize contacts with communities during planning and design phases (steps 1-3) is that this raises communities' expectations that construction (step 5) will take place, although funding is still to be found (step 4). Transparency, good communication and keeping promises can be met by clear criteria, for example on matching contributions, if not ballpark amounts, and monitoring arrangements, as in the Comprehensive Producer Development Support Policy. Government can also support community-led MUS by developing low-cost affordable technology supply chains;

training in socio-technical facilitation; exchange among local artisans to share technical knowledge; promotion of point of use treatment; gender training to overcome male monopolization of technical expertise; and other, coordinated in national hub on self-supply.

The third paradox is intrinsic wherever accountability relations in bureaucracies are mainly upward to the financiers, and not downward to the end-users. This is, first, the tendency to inflate proposals in step 3 to central financers and, then, to rapid spending of allocated funding in step 5. Outsourcing further contributes to fierce competition, if not corruption, among politicians, consultants, contractors and other ‘tenderpreneurs’, with insufficient influence of technical arms and line agencies. As found in one community, this rush for money can trickle down to communities where local conflicts erode vital social capital for water management. Unfortunately, the external water business may even see communities’ innovation and investments in basic self-supply as competition. This paradox is overcome by strengthening accountability downward to the end-users and strong representation of community voices within municipalities.

Way forward

Government’s interest is growing in community-led MUS as complementary water services model. Instead of assuming that people are passive beneficiaries of basic services and passively paying customers for higher service levels, the evidence of the change processes in the MUS project corroborated the cost- and time-effectiveness of community-led planning, design and implementation of water services, leading to more and more sustainable livelihood benefits. In six diverse communities, the same step-wise process appeared applicable, so it is likely that any state or non-state financier can replicate, possibly also in peri-urban areas.

However, the substance of support and co-management differed because of local differences. At the one end is infrastructure that is owned, operated and maintained by communities for self-supply, At the other end is infrastructure, such as municipal boreholes, that is owned and managed by government and requires professional engineering expertise, but even then, communities can, and are willing, to take up more responsibilities, for example for the reticulation. Nation-wide there will be many more modalities in-between. Prior experience, climate, hydro-geological, social, institutional, and economic conditions will further shape co-management modalities. Further evidence on what works and what doesn’t work, also in the second phase of the MUS project, will further inform government of the power of ‘coming low and rising up together’.

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Contents

List of Figures

List of Tables

1 Project design

1.1 Rationale

1.1.1 The global search for alternative service delivery models

In the global efforts to progressively realize everyone's basic rights to water, it is increasingly recognized that the project approach since the 1970s only partially achieves these goals in low-income rural areas (Moriarty et al., 2013). This project approach of rapid design, financing and construction of new infrastructure by external agencies for first-time access and expected community management thereafter, proved to be too optimistic. Rural communities were not able or willing to do and continued support for operation and maintenance was lacking. Widespread sub-functionality, if not collapse, of such schemes testifies to the maintenance backlog. It is now realized that after construction, forms of external support for operation, maintenance and replacement of assets remain needed (Hutchings et al., 2017). Moreover, once communities have received sustainable first-time basic access, they aspire to higher service levels than basic volumes only. Depending on context, a range of alternative rural water service modalities are being explored, including professionalization of community management, support to community-based service providers and self-supply for multiple uses (Moriarty et al., 2013).

In self-supply, water users initiate, largely or fully finance and construct their own infrastructure. Both the WASH sector (Sutton et al., 2012; Butterworth et al., 2013) and irrigation sector (Giordano et al., 2012; Woodhouse et al., 2017) increasingly recognize how individuals or small self-organized groups install, operate and sustainably maintain smaller scale rainwater harvesting, gravity systems or shallow groundwater wells and lifting technologies. These systems not only provide water for own uses but often also for sharing or informal sale. Self-supply not only provides a back up to interrupted, absent or collapsed public services, but also meets rural people's aspirations for higher service levels than just the basic volumes, supposedly for domestic uses only.

Multiple use water services (MUS) are a second and related alternative. MUS welcomes local innovation of holistic, integrated and people-driven management of multiple water sources, to meet their multiple water needs through multi-purpose infrastructure where possible. Multi-purpose infrastructure is widespread. When people invest in self-supply, they seek to meet the range of their water needs for their multi-faceted livelihoods (Butterworth et al., 2013). Similarly, public schemes designed for a single use are in reality used for non-planned purposes as well (Renwick, 2007; FAO, 2010; Van Koppen et al., 2014). A people-centred consideration of multiple water needs ensures that improvements in one dimension of wellbeing positively affect other dimensions. Improved health resulting from clean drinking water, adequate water quantities for good hygiene practice, and year-round irrigated nutritious food, ensures productive lives. Income gained from irrigation enables spending on health care. Multi-purpose infrastructure is the cost-effective and water-efficient engineering innovation to mutually reinforce livelihood benefits and to generate the income from productive uses to re-invest in infrastructure. Especially around homesteads water concurrently contributes to many dimensions of health, nutrition and food-security: domestic needs, livestock, cultivation of trees and crops, home-based small-scale enterprise, brick making and other uses (Van Koppen et al., 2006; Van Koppen et al., 2014).

Lastly, moving from infrastructure-scale to community-scale, rural people have combined the use and re-use of multiple groundwater, wetlands and surface water sources through multiple sets of infrastructure since time immemorial. This includes the increasingly frequent co-existence of public infrastructure and self-supply. Depending on seasonal and annual water availability, customary arrangements anchored in local institutions govern the sharing of water resources (Van Koppen et al., 2007).

1.1.2 South Africa

The search for alternative models is also taking place in South Africa. In spite of considerable financial and technical efforts and even more promises to fill the services backlog since the dawn of democracy in 1994, results are sub-optimal. For example, the Water Sector Development Plans (2014/15) of Vhembe and Sekhukhune District Municipalities in Limpopo Province confirm that out of the 4960 and 8218 municipal boreholes in Sekhukhune and Vhembe District, only 7% and 17% respectively are operational (WSDPs of SDM and VDM 2017). For any infrastructure in Limpopo Province, Ramugondo (undated) found that only 14% of water infrastructure implemented is fully functional, while 15% is sub-functional and 71% is dysfunctional. Nationally, the reliability of the services that have been provided since 1994, is declining, with only 64% of households having access to a reliable water supply service (Balzer, 2019).

Low-income rural areas in South Africa are increasingly facing a maintenance backlog. The required budget allocations to maintenance of new publicly financed infrastructure are low, and even these proportions are often not met. Another reason for the decline in access is that the assumed 'community ownership' and care for the new infrastructure after hand-over fails to materialize. Or worse, some users, including community leaders themselves, anarchically modify systems by illegal connections from street taps to their own yards (Monyai et al., 2020), or parts are stolen. Water users take to the streets for protests, or, as incidentally reported, communities even lock civil servants in their offices to impose their demands. They accuse municipalities and politicians of corruption when new construction of infrastructure is never finished, or not started at all, and even when promised construction is taking longer than promised.

1.1.3 Self-supply

In this search for alternative models, the South African government also supports self-supply. Self-supply is increasing. As elsewhere, the availability of affordable water diversion, lifting, conveyance and storage technologies, and markets for irrigated produce boost self-supply. Aspirations for higher service levels, and intermittent or failing public services, further drive self-supply at large scale. Remote sensing techniques identified at least 70,000 ha of informal irrigation in Limpopo Province's former homelands alone (Van Koppen et al., 2017). Also, as elaborated below, in the six communities nominated for this project in Vhembe and Sekhukhune District, informal self-supply was the primary water source to homesteads in four of the six communities. These self-supply systems were piped gravity systems in mountainous areas and drilled household boreholes with electric pumps in a community with ample shallow groundwater resources, new electricity connections, and good markets. Expectedly, in those cases, users met their multiple needs by combining multiple sources through multi-purpose infrastructure as the rule, and single use as the exception (Van Koppen et al., 2020).

1.1.4 Multiple use water services (MUS)

The South African Government has been a global leader in recognizing and promoting people's multiple water needs, beginning with the Strategic Framework for Water Services 2003 (DWAF, 2003). This mentions the need to meet people's growing aspirations to 'climb the water ladder'. From 2003 onwards, the project Securing Water to Enhance Local Livelihoods (SWELL) demonstrated the first three steps of community-led planning and prioritization in 11 wards in Bushbuckridge, Mpumalanga, and organized national dialogues (Cousins et al., 2007). South Africa was one of the countries of an eight-country research on multiple use water services (MUS) led by IWMI, in collaboration with 150 institutions world-wide.

In 2011, the government's recognition that access to adequate water is not only a basic constitutional right but often also a prerequisite for the poor for their food security, economic growth and improved livelihoods, was further recognised. The Department of Water and Sanitation issued guidelines in the 'Provision of water for small scale multiple uses systems. A guide for municipalities' (DWS, 2011). This document emphasized the benefits of multi-purpose infrastructure, focusing on smaller-scale infrastructure for water at household level.

The National Water Resource Strategy (NWRS) – 2nd edition (DWA, 2013 p 24) also promotes multiple use water services by seeking '*to ensure a smooth integration of the provision of water supplies for domestic use and water for other purposes leading to economic production, particularly in rural areas*. The Strategy recognized: '*Water for domestic supplies in rural areas is used for various household purposes such as cooking, washing, food gardening, stock watering and small businesses. If water is provided mainly for irrigation, it will also be used for domestic purposes, and if water is provided for domestic purposes, it will also be used for other purposes'*. The strategy envisages '*that all new water infrastructure is planned, developed and used as multi-purpose facilities, especially to meet social needs*'. Therefore, '*A new approach to planning for community water supplies is required; one that considers and provides for the multiple water needs of the community. This may necessitate using water from a range of different sources. Policies are in place to facilitate cooperation between the Department of Water Affairs and local government in planning and developing multi-purpose water supplies for communities*'.

The National Policy Review (DWS, 2014) further supported the NWRS – 2nd edition with a focus on bulk raw water infrastructure. Planning for a single water use is seen as '*inefficient use of financial resources*'. It also emphasized the envisaged adoption of a participatory approach '*to avoid conflicts over allocations to different purposes*'.

1.1.5 Community-led service delivery

Both self-supply and MUS require innovation that has received less international attention: new forms of community participation from the earliest planning phases onwards in forms of co-management between communities and government or other public service providers. Community-led planning of support enables the end-users who are most dependent on the results and who can monitor most closely to hold both external service providers and users accountable for results according to agreed forms of co-management. Women are the majority of end-users, with strong interests in easier access to more and more reliable water supply of at least 25 lpcd (litres per capita per day) preferably with yard connections, also for multiple uses at homesteads and, where possible, to their distant fields for irrigation or other types of use. Community participation echoes the Strategic Framework (DWAF, 2003, p 60): '*A regulatory framework should recognise that consumers are the best placed to monitor the effectiveness of water services provision. Therefore, the most effective monitoring strategy for the sector is strengthening the voice of consumers. It is the responsibility of water service authorities to put in place mechanisms to facilitate, listening and responding to consumer and citizen feedback on the quality of service delivery*'.

In practice, such mobilization and support to communities' innovative labour, monetary, skills and intellectual contributions in new forms of co-management requires communities' involvement from the first planning phases onwards. Hence, unlike common community-participation practice in South Africa and elsewhere, which only starts in the use phase, community involvement to support self supply and multiple uses requires socio-technical facilitation from the first contact onwards. Appropriate support depends on a proper diagnosis of the local situation. Such diagnosis can do justice to local diversity, the co-existence of public infrastructure and self-supply, and the knowledge of communities who manage these local complexities as a matter of daily life. Following people's priorities and aspirations for incremental improvements during the planning and design phases is not only key for sustainability but also anticipates aspirations and mitigates alterations, in particular the notorious 'illegal' household connections, that often happen later anyhow, but then in an anarchic and damaging way.

Hence, policies in South Africa support the search for alternative models. The issue was: how to operationalize and upscale such new services models? Against this background, the African Water Facility of the African Development Bank and the Water Research Commission (WRC) conceptualized the project 'Operationalizing community-driven multiple use services (MUS) in South Africa'. As implementing agent, the Water Research Commission selected the NGO Tsogang Water and Sanitation (or Tsogang) to demonstrate community-led MUS on the ground. Tsogang has long-standing experience in community-led small-scale infrastructure development for domestic uses and gardens. As socio-technical facilitator with formal engineering expertise, Tsogang provided technical and institutional support to communities, developed their capacities and supervised construction activities and ensured quality control. The International Water Management Institute (IWMI) led the research aspects of the project.

1.2 Project goals and design

The project 'Operationalizing community-led multiple use water services (MUS) in South Africa' (or 'the MUS project') was implemented from end 2016 onwards, and was near completion when the Covid-19 crisis hit in early 2020. Its goals were to:

- demonstrate MUS approaches in selected communities
- strengthen the knowledge base on MUS
- develop robust manuals for effective up-scaling of more equitable and sustainable water services delivery

- inform and support the development of downstream investments into improved water use services

The project defined community-led MUS as:

> *''A holistic participatory approach to planning and providing water services that supports people's self-supply and their multiple water needs as identified by communities; and coordinates across government departments as needed.''*

With its focus on the growing maintenance backlog and support to self-supply through 'small investments for high benefits', the project's focused on small-scale technologies. The project did not address the maintenance, major repair or replacement of municipality-owned mechanized boreholes, or other government-owned bulk supplies, requiring highly-capital-intensive inputs. In such cases, the project's focus was on refurbishments and especially storage and reticulation networks. The MUS project had earmarked a total of €200,000 for materials and construction work for communal infrastructure. This was to be divided among the demonstration communities according to their needs and prioritized solutions (in step 4, as below). Further, household self-supply was supported by making 10 or 15 2500 L 'jojo' storage tanks per community available to distribute to selected indigent households. The project did *not* support individual self-supply such as private gravity pipes or private household boreholes.

The project was active from local to international levels, as described in the subsequent chapters of this report. At local level, where 'seeing is believing', the project was conceived as demonstration. These demonstrations also provided the evidence base to derive replicable lessons that government water services providers, agricultural and rural development and other development agencies can apply anywhere where people's livelihoods depend in many ways on water. Chapters 3 to 7 present these local experiences and lessons learnt.

Representatives of the demonstration communities within the same district regularly met to exchange experiences in so-called 'Innovation Forums'. These findings are presented in chapter 9.

At district, provincial, national and international level, the evidence of the demonstration experiences was systematically discussed in regular 'Learning Alliance' meetings and Policy Dialogues. From the community selection phase onwards, the project forged relationships with the District Municipalities, the district, provincial and national Department of Water and Sanitation and the Limpopo provincial and national Department of Agriculture and Rural Development. These departments advised the project on the selection of communities. Representatives of these three departments, but also of other local municipalities, the Department of Cooperative Governance and Traditional Affairs, other government departments, development and employment generation programs, treasury and other financing institutions as well as the corporate sector participated in these events. Participants commented on project progress and findings and suggested pathways for replication at wider scale. Representatives of the six demonstration communities actively participated in these dialogues.

1.3 Conceptualizing replicable community participation

At the start of the MUS project, this participatory process was conceptualized as a step-wise process. Communities participate in all six steps: agreement to collaborate, diagnosis, visioning of the range of solutions, prioritizing and formalizing to fit the financial framework, and implementing the procurement of materials and construction before, ultimately, using the water infrastructure. This is an alternative to the planning approach in which funders, implementers, engineers and technical experts lead the pre-feasibility and feasibility studies, design, and lead the procurement of materials and construction, and only then hand the finalized infrastructure over to communities for their use and, often, partial or full participation in the operation and maintenance. **Figure 1** summarizes these steps. The steps are not rigid at all; they only indicate that any next step requires actions and decisions of an earlier step. One may well go back to an earlier step. For example, diagnostic insights during step 2 inform the initial design but insights continue to deepen throughout all next steps. Similarly, during construction of a certain design (step 5), new opportunities and obstacles come up for design adjustments (step 3) and flexible financing (step 4).

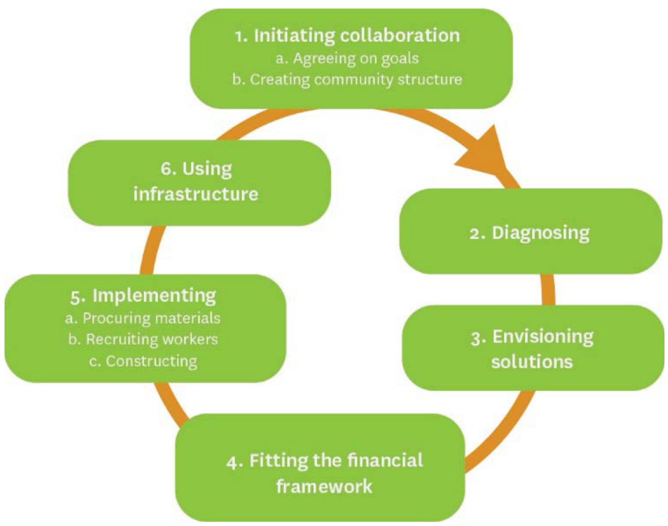

Figure 1 Six steps of community led MUS (adapted from Adank et al., 2012)

1.4 Institutional comparison

In order to unravel the institutional replicability and relative costs of community-led MUS, the project further conceptualized the differences with the more conventional water services approaches in which the overall managers and funders outsource tasks to consultants and contractors. In reality, and depending on the type of infrastructure and required engineering expertise, approaches may well be mixed. Three main parties at three levels in decision-making are distinguished. The detailed activities in the six steps are shown in **Table 1**. The first column is community-led MUS, which is compared with the conventional approach (second column). Green colour indicates the community as main decision-maker; light yellow: the Implementing Agent, as main decision-maker; dark yellow: the overall funder/manager as the main decision-maker

The three main parties are:

- The community as end-users at local level (green when main decision-maker).
- The local Implementing Agent (IA) who directly works with the communities and mediates between communities and the overall funders and managers (light yellow when main decision-maker).
- The higher-level (district, national or international) overall managers of water or development programs who keep the purse and are often accountable for spending to treasury or other central funders (dark yellow when main decision-maker).

  In the MUS project, the Water Research Commission and African Water Facility were the highest-level agencies, so the evidence is based on their experiences. However, community-led MUS can be replicated by any other higher level agency and financer, including Municipalities and government departments of water, agriculture, rural development, climate change adaptation, disaster management programs, public employment generation programs, or non-governmental organizations, development banks, corporates with Corporate Social Responsibility, private consultants and engineering companies, or philanthropic and charity organizations. These highest-level institutions can have their own internal implementing agent (IA) on the ground as 'frontline staff' or they can outsource to an external IA, for example, consultants, contractors or NGOs. In the MUS project, the NGO Tsogang was the IA. Any governmental or non-governmental IA with the required socio-technical expertise can implement community-led MUS. In order to underline this generic role, the generic chapter 2 will refer to an 'IA'. This refers to the actions of Tsogang in the project.

Table 1 Step-wise planning and implementing water services comparing community-led decision-making with top-down approach and total outsourcing

Approach	Community-led MUS facilitated by socio-technical experts	Conventional approach with outsourcing to consultants and contractors
0. Acquiring likely funding	Identifying broad funding frameworks	Identifying broad funding frameworks
0. Appointing the IA	Tendering and appointing socio-technical facilitators for entire project cycle	Tendering and appointing technical consultant for pre-feasibility study
0. Community selection	Selecting according to funder's criteria	Selecting according to funder's criteria
1. Initiating collaboration	Agreeing on goals and mutual contributions; forming committee	Minimal contacts with community
2.Diagnosing	Mobilizing local knowledge through participatory mapping, transect walks, interviews, etc.	Pre-feasibility study
3. Envisioning solutions	Identifying socio-technical solutions that leverage existing public infrastructure and self-supply with technical advice, broad prioritization	Pre-feasibility study Approving pre-feasibility study Tendering and appointing technical consultant for feasibility study

Approach	Community-led MUS facilitated by socio-technical experts	Conventional approach with outsourcing to consultants and contractors
	Technical expert advises, checks, costs designs, further prioritizing	Feasibility study with final costed designs
4.Fitting the financial framework	Final prioritizing, approval and contractual arrangements	Technical check of feasibility study and approving
	Formalizing community structures and agreements	Tendering and appointing contractor for construction phase
5a. Procuring and storing materials	(Potentially) community-led procedures for local purchase, with technical/financial checks; developing capacity and contacts with suppliers	National procedures across all tiers
	Community responsible for storing, safeguarding and transport to site	Site development with security measures, transport to site
5b. Preparing construction and training	Community-led budgeting and recruiting semi-skilled and skilled workers; training	Contractor-led provision of semi-skilled and skilled workers, partial local recruitment
Constructing	Works for stipends and on-the-job training	Works for wages
Adjusting designs	Flexibility	Limited or no flexibility
Testing and signing off	Quality check by IA experts and community	Quality check by experts and hand-over
6. Using, operating and maintaining (hypothesized)	O&M training; experienced committee continues; protection to vandalism; incentive for preventive maintenance; contacts with suppliers; capacity developed; multiple uses for health and wealth. For government owned bulk supplies, e.g. boreholes: community-led responsibilities for reticulation and small repairs	New committee and training needed; no capacity developed; hardly incentive for maintenance; risks of vandalism; unplanned and sub-optimal multiple uses. For government owned bulk supplies, e.g. boreholes: long supply interruptions for even small repairs.

Step ‘zero’ is the broad framework in which the overall manager has (likely) funding and can mobilize expertise to deliver water services and select the community(s). In broad development and employment generation projects, the choice on the type of activities to implement may be left to communities. In such cases, the lessons learnt in the MUS project become relevant once communities prioritize water services. In some settings, funding for all six steps may already be available, or highly likely. This was the case in the MUS project, where funding was available for all six steps in all communities. In other cases, funding for a ‘bankable design’ resulting from the first three steps may still need to be sought.

1.5 Community selection and works till early 2020

The community selection in the MUS project went as follows. The project design focused on two of the poorest districts in South Africa: Sekhukhune District Municipality (SDC) and Vhembe District Municipality (VDM). In each district, three communities were to be selected. In order to corroborate the replicability of the step-wise process, one selection criterion was diversity in geo-hydrological and socio-economic conditions and the type of technologies and service levels. Moreover, in order to explore upscaling through diverse government departments, three different government department were asked for their advice on community selection. In each district, one community was advised by the Department of Water and Sanitation; one by the Department of Agriculture; and one by the District Municipality with the relevant Local Government. Thus, Ga-Mokgotho, Ga Moela and Phiring were eventually selected in the Sekhukhune District Municipality and Tshakhuma, Khalavha and Ha Gumbu in Vhembe District Municipality (See map). Initially, Lambaani was also considered but their key problem was a broken communal pump system. Replacement was too expensive for the available budget. Also, some communities were invited but withdrew. In Tshakhuma, for example, the sections of Luvhalani and Tshitavhadulu were suspicious that the MUS project would take over their self-supply communal gravity systems and preferred continuing on their own, so left the project after the first meeting.

The selected communities differed in population size, level of infrastructure for self-supply and public infrastructure, surface and groundwater resources, and in degree of productive water uses. This underscored the generic relevance of the step-wise *process* of bottom-up participatory planning in any specific local context, highlighting the need for different, tailor-made support instead of any 'one-size-fits-all'.

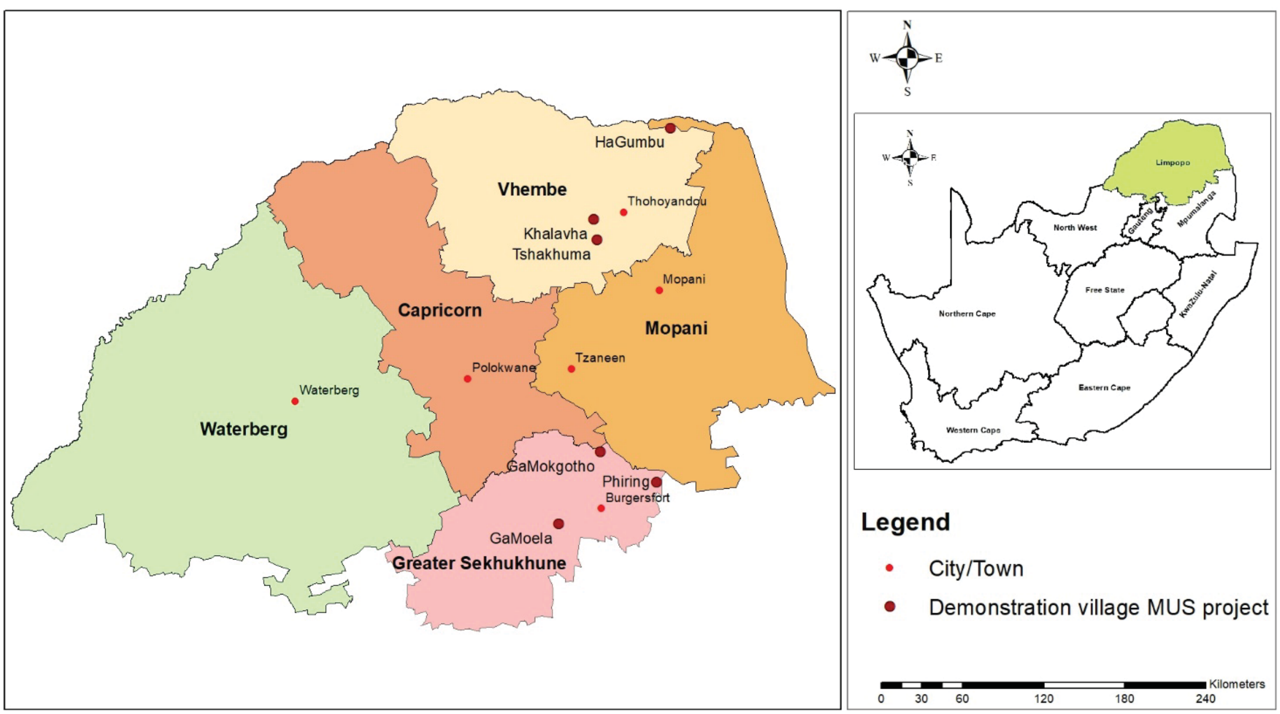

Figure 2 The six demonstration communities in Limpopo Province

Expectedly, these communities practiced local-level Integrated Water Resource Management, as confirmed by the 2017 base line studies of the pre-project situation among 645 households. Distinguishing by the *site* of use: - homesteads, distant fields and other sites of use, most households in these communities were found to have two or more sources of water to their homesteads as a vital buffer to irregular supplies and droughts. Second, infrastructure to homesteads was normally for domestic uses, livestock and, for many households, irrigation for consumption and sale. Public infrastructure to irrigate distant fields was in practice multiple use as well. Exceptionally, self-supply point sources at distant fields were single use. Water bodies providing water to other sites of use were normally multiple use. In only one community (Phiring) was government's water supply to homesteads the most important source. The most important source was self-supply in four communities and the community's own operation and maintenance of an NGO constructed scheme in Ga Mokgotho. In all communities, water provided through self-supply was shared with neighbours, either for free or for a small fee (Magombeyi et al., forthcoming). Hence, overall, self-supply was found to improve access to water faster, more cost-effectively and more sustainably than public services did (Van Koppen et al., 2020).

Table 2 gives the detailed overview of the communities and their different pre-project infrastructure and, in italics, the works that the community prioritized, as will be elaborated in this report. It shows how the process was the same, but how the different local situations led to different works and, hence, different forms of co-management with government.

The two main categories of such co-management, which sometimes co-existed in one community, were:

- Self-supply in three communities: 13 communal piped gravity systems for self-supply (upgrades, e.g. with spring protection and filter boxes, repairs, extensions, and – in one case – new construction).
- Public infrastructure in four communities: six municipal boreholes (extension, repair or rehabilitation in collaboration with the municipalities as owners); and one gravity irrigation system (source augmentation).

Table 2 Overview of existing infrastructure and (in italics) project works in the MUS project

	Main types of existing infrastructure	
	Existing infrastructure Communal Piped Gravity System	Existing infrastructure Municipal borehole systems
Community with sections and number of households	*MUS project works* Source development; filter box; repair main line; storage development; (protection of) valve boxes; reticulation repair and extension	*MUS project works* Pump house refurbishment; main line construction or repair; storage development; new, repair or extension of reticulation
Ga Mokgotho SDM 800 households	NGO funded gravity supply from spring, self o&m: *augmentation of supply, upgrades, repairs and extension of reticulation*	-
Ga Moela SDM 118 households	-	• Tawaneng/Letlabela borehole: *new storage and reticulation* • Mabusa/Moela borehole: *new storage and reticulation*
Phiring SDM 420 households	Dam and gravity pipeline for irrigation and other uses: *augmenting water supply to dam and repair leaks; extension to cattle dam*	• Municipal borehole system Phiring: *refurbishing storage, repair reticulation*. • Municipal borehole system Vrystad section – *no works*
Ha Gumbu VDM 1652 households (total for 3 sections)	-	Municipal borehole system: *repair pumphouse; augmentation storage; extension of reticulation; repair cattle trough*
Khalavha Thondoni section VDM 163 households	1 self-supply gravity system: *source development, new storage*	-
Tshakhuma 9 sections VDM 2360 households	11 self-supply gravity systems: *source development, augmentation storage, one new system*	Borehole Maswie: *connecting to new storage*
Other	*Household 2500 litres jojo tanks: to 80 indigent households in six communities*	

	Main types of existing infrastructure	
	Existing infrastructure Communal Piped Gravity System	Existing infrastructure Municipal borehole systems
	Repairs communal hand pumps (Ga Moela and Ha Gumbu) *Animal drinking troughs (Ga Mokgotho, Ga Moela, Ha Gumbu, Khalavha, Tshakhuma).*	

1.6 Research methods and report structure

1.6.1 Evidence-based change processes

This report covers the period from late 2016 to early 2020 when most works had been finalized. However, the COVID 19 crisis delayed the finalization of some last works in three communities. A project extension up to 2021 aims at enabling these last realizations and assessing the longer-term sustainability of the technical and institutional improvements and their livelihood benefits. The results of this next phase will be reported in the future.

The MUS project generated a new knowledge base to inform change processes through mixed methods. The innovative overall methodology was learning and generating knowledge through evidence-based demonstration. Informed by prior scientific evidence, the hypothesis of the MUS project partners was that community-led multiple use water services is a replicable water service model that performs better than existing models. This hypothesis was tested by implementing this approach on the ground in the diverse local settings and assessing outcomes. The six communities became the 'laboratories' to generate evidence. Accordingly, at local level, Tsogang implemented the step-wise participatory processes with the community structures they helped to create, and compiled community-level diagnostic reports, designs and scope of works. Tsogang further compiled monthly work supervision reports during the construction phase,

At the district and higher levels of water service policies and institutions, learning alliances and policy dialogues were organized not only for information, awareness raising and short-term uptake of aspects of community-led MUS, but they also served as forums to generate knowledge on the assumption that this model and its benefits are potentially replicable at wider scales. At the district level, Tsogang organized and reported on the innovation forums. At the district, provincial, national and international levels Tsogang, WRC, and IWMI organized the learning alliance meetings and policy dialogues, as reported by Tsogang.

IWMI staff and one Ph.D. and two M.Sc. students from Wageningen University, Netherlands, and two M.Sc. students from Cranfield University, United Kingdom, strengthened the knowledge base through rigorous quantitative and qualitative scientific methods. At local level, methods included regular visits to all communities to participate in local events and innovation forums, to interview, make transect walks and observe. Further, surveys were conducted for base line assessments among 645 households. Throughout the project period, each of the steps was documented and published as community reports. This was concluded with in-depth post-construction community reports. In the two communities that had moved into the use phase (step 6) before the COVID 19 crisis hit (Ga Mokgotho and Ga Moela), an extensive impact evaluation was done. For this, qualitative Focus Group Discussions were held with the community structure that participants had nominated to lead the process, the MUS Forum. A quantitative survey among randomly sampled households was conducted to assess and quantify changes in water access and livelihood benefits, end-user satisfaction with process and outcomes. In Ha Gumbu, the municipal borehole broke down when the works had just started. Its replacement by a powerful electric pump was only completed in April 2020, during the COVID 19 crisis. So by end 2019 it was still too early to assess the impacts of the borehole's upgrade and extended reticulation network. However, IWMI conducted a survey to assess the importance of private boreholes for self-supply and sharing with neighbours as back up source for domestic uses and also productive uses, and to assess water users' views on the participatory process. This study also conceptualized intra-community social differentiation by categorizing households at different steps of a water ladder.

Further, in April 2019 IWMI invited and enabled community members to make participatory videos to tell their water stories. Representatives from Tshakhuma and Ga Moela shared their views on the process and outcomes at http://stories.iwmi.org/voicing-water-visions/mus-south-africa/.

IWMI staff and students also participated in the innovation forum meetings and, at the district, provincial, national and international levels in the learning alliance meetings and policy dialogues. Interviews with officials were also held outside these events. For example, as part of his Ph.D., Hofstetter conducted a series of interviews with district officials, especially in Sekhukhune district; attended meetings in which the Integrated Development Plans were presented; and convened a workshop in collaboration with Sekhukhune District Municipality. All of these engagements solicited participants' views on the replicability of community-led multiple use water services. Global literature reviews and presentations at international forums of the MUS project's experiences and findings complemented these insights.

Last but not least, in this mix of methods to generate evidence of change processes, the MUS project team itself continuously exchanged insights, lessons learnt, and findings across all levels for robust triangulation and verification of insights and adjustment of strategies.

1.6.2 Cost and time comparison

The replicability of community-led MUS was informed by a qualitative and quantitative assessment of time and costs. With regard to the duration, community leaders in the MUS project emphasized: community participation requires patience and whatever time may be needed to reach consensus 'till everyone agrees'. Good facilitation and, in the words of Tsogang, creating space to 'sit back and talk' are key. Also, capacity development during construction is needed. However, as in **Table 1** above, these time requirements are to be compared with conventional design and implementation processes. **Table 1** shows how this was compared with the administrative and political decision-making processes required for the prefeasibility and feasibility studies and final approval, the appointment and monitoring of external contractors for construction and the time required for centralized procurement procedures.

The quantitative cost comparison followed South Africa's 'Cost benchmarking guide for water infrastructure' (DWS, 2016). This uses the capital costs (materials plus construction labour, which probably includes contractor costs) as the basis for calculating service fees. Costs made by Tsogang for its facilitation were also calculated as a percentage of the capital costs. Material costs were the sum of the amounts of WRC's purchase orders for the suppliers of the materials, plus the few additional materials bought during the construction process, plus tools bought for the project, to a total of ZAR 2 707 056[1]. The total construction local-labour costs were ZAR 446 690. So total capital costs for the project were ZAR 3 153 746.

Tsogang's costs, expressed as a percentage of the capital costs, included its facilitation, capacity development and supervision costs. These activities implied and went beyond a conventional contractor's job. Staff time and travel costs were based on the following rates:

- a community facilitator (daily rate of ZAR1000; travel 3.47/km),
- a technologist (daily rate of ZAR1547; travel 3.47/km), and
- a senior technician/engineer (daily rate of ZAR3636, travel 4.5/km).

Other costs for Tsogang were: two district offices for field work at ZAR 1 000 per month. For two sets of 4-days classroom training in the communities (preparing for construction and preparing for operation and maintenance, including water quality measures), the costs for lunch at these events amounted to ZAR100 per person. Lastly, for the overhead costs of running Tsogang's overall provincial office, 12% of total costs were calculated. These costs were calculated for the steps 1 to 3; and for step 5, implementation. The cost estimates for community members, Tsogang and the Water Research Commission for step 4 were qualitative. Costs of materials in central procurement were compared with (potential) local procurement. Employment generated was also calculated. Tsogang provided the data for these cost analyses.

1.6.3 Report structure

The structure of the report is bottom-up. We first describe the generic step-wise process and the lessons learnt for the steps 1 to 5, as implemented till early 2020, before the COVID 19 crisis. This evidence underpins the MUS project's recommendations for replication of the process.

After the generic description of the lessons learnt for each of the five steps in chapter 2, the experiences in each of the six communities are presented. This starts with the two communities where the construction had been finalized by end 2019 and where the impact assessment and user satisfaction surveys were conducted: Ga Mokgotho and Ga Moela. Process and outcomes are described together in chapter 3. Next, chapters 4 to 7 present the experiences in Phiring, Tshakhuma, Khalavha and Ha Gumbu respectively. Chapter 8 synthesizes conclusions and lessons learnt at community level. Chapter 9 discusses learning from the innovation forums. This is followed by an analysis of the evolving substantive discussions in the learning alliance events and policy dialogues, and their likely impacts for scaling, in chapter 10.

In all text following, quotation marks indicate 'salient wording' of participants.

[1] 1 USDollar was about ZAR 15 during the project duration

2 Step-wise community-led MUS: generic recommendations and lessons learnt

2.1 Step 1a. Initiating collaboration: agreeing on goals and mutual commitments

2.1.1 Purpose and action

Participatory design for future co-management starts by agreeing on broad goals, stipulating mutual commitments, and ensuring representative communication channels. Following the informal visits to check the eligibility of the community without raising unrealistic expectations, the IA with relevant extension workers of collaborating government departments obtain endorsement from traditional authorities and ward committee members and organizes a mass meeting. Everyone is invited, including women, youth and the most vulnerable who risk being left behind: public water services are for everyone.

In this mass meeting, the IA:

- Provides feedback about earlier informal visits.
- Introduces the implementation team.
- Explains that the project seeks to improve water supply in the community, building on any water infrastructure that already exists for any water use according to communities' priorities.
- Sets the condition that the project should be inclusive and benefit the community as a whole.
- Clarifies the participatory approach and each of the steps to be taken.
- Indicates the expected voluntary contributions, such as attending meetings, and whether food and drinks will be provided.
- Responds to participants' questions, for example, about paid employment or not.

In this way, the IA creates both buy-in and the space to 'sit back and talk'. In this step the community can end collaboration 'without hard feelings'. The IA can also still decide to end the collaboration, or first request solutions for problems that would jeopardize the project.

2.1.2 Lessons learnt

2.1.2.1 Clarifying participatory process

Managing multiple water sources to meet multiple needs through multi-purpose infrastructure is obvious for communities; it is like 'the blinking of an eye'. Yet, community-led infrastructure development was new in the six communities. Communities unanimously felt that, usually, outsiders came, decided, and implemented water or other infrastructure projects. At best, they informed the tribal authorities and recruited some labour. The IA's explanation of the step-wise participatory process clarified the new process somewhat, but it only became tangible and visible in step 5. 'Initially we didn't understand but now our eyes are opened'. Ultimately, though, the community representatives who participated in the district, provincial and national learning events and policy dialogues, advocated community-led MUS as 'nothing about us without us'.

The participatory videos viewable at http://stories.iwmi.org/voicing-water-visions/mus-south-africa/ or exchanges with the six demonstration communities can further clarify community-led MUS in the future.

2.1.2.2 Managing expectations and keeping promises

Confusion, disappointment and frustration about big, unfulfilled promises in earlier interactions with external support agencies were rife, especially in Ga Moela and Vrystad/Phiring. Outside agencies were seen as 'companies' that are only accountable upwards and not downward to communities. 'Companies came and asked many questions, made promises but never came back'. In Ga Moela, for example, they promised a dam of ZAR 2,3 million. Or contractors disappeared without finalizing, without indicating a date of their return, without leaving a mobile number, or even taking the keys of a pump house with them to prevent anyone else to enter and finalize works (Vrystad/Phiring). Unfinished equipment was kept in safety, but more often it was taken out for own collective or individual purposes, or vandalized. In some instances, finalized infrastructure remained unused for years without a clear reason (as in Maswie, Tshakhuma). Operational municipal boreholes lacked fuel so users had to organize and buy fuel themselves (as the Tawaneng section in Ga Moela did), or they just waited (as by the Letlabela section in Ga Moela), or borehole equipment broke down with long interruptions before they were repaired or replaced (Phiring, Ha Gumbu and the Tawaneng and Mabusa boreholes in Ga Moela). These frustrations underscore the need for any infrastructure project to manage expectations and keep promises. 'The IA kept its promise' was communities' most cited appreciation when asked about the performance of the MUS Project's IA (Tsogang).

In these initial introductory phases, it may be tempting for any IA to make promises in order to mobilize buy-in and create legitimacy of what otherwise could be seen as just intangible talk. Similarly, for technicians, it may be tempting to jump to step 3 and already promise solutions: 'we can fix that'. Community members also appeared to have long lists ready of unmet needs and requests for materials. They would like to see 'trucks with loads of material arriving soon' and especially employment opportunities. However, promises backfire when having to return to a community with different solutions, if not empty hands. Communicating the bad news that earlier promises simply cannot be kept because of budget or other constraints 'requires much courage, but is needed' (district official).

The IA, officials, and community leaders alike managed expectations by invoking a spirit of voluntary time and efforts for communal action and self-reliance; by pointing at people's concrete suffering because of water problems; by emphasizing mutual learning as equal partners; 'meeting each other half-way'; emphasizing that there is 'no big money'; and avoiding any upfront reference to paid jobs or hand-outs. Also, community leaders challenged this pervasive 'mine' and 'yours' in South Africa. Instead, they emphasized that 'government and communities are one; in fact, communities ARE the government'. At the same time, they welcomed government representatives' precious guidance.

2.2 Step 1b. Initiating collaboration: creating a community structure

2.2.1 Purpose and action

In this first or second mass meeting, the participants appoint a community structure, called water committee in local language, or (in this project/report) MUS Forum.

For this, the IA explains the purposes of the structure: serving as link for future communication between the IA and community and providing leadership in implementation of the upcoming project. The IA also presents relevant criteria for the selection of members: gender balance, youth involvement, representation of relevant existing water and other community structures, and representation of all relevant community sections. Focus is on voluntary leadership to serve the whole community and an open and transparent nomination process. The IA also repeatedly emphasizes the need to keep minutes of each meeting and to report back to the community.

When participants feel ‘we know each other’, the election or nomination process can be that volunteering candidates raise their hands or participants mention someone’s name, followed by one or two who second. A tribal authority representative and ward committee member of political structures are often automatically ex-officio members of the MUS forum.

In a follow-up meeting of the newly established MUS Forum, the new members internally appoint the chair, vice-chair, secretary, vice-secretary, treasurer (and, as needed, vice-treasurer), and additional members. This appointment is the members’ own responsibility. The IA assesses and addresses their skills and training needs on how to plan, organise, co-ordinate and run effective meetings, financial management, agriculture and health.

2.2.2 Lessons learnt

2.2.2.1 Inclusivity and downward accountability

In the smaller communities, the invitations to the mass meetings reached almost everyone, except some elderly and disabled. Many invitees attended, unless they were not around or unable to come, or – as in some cases – found that attending family members or neighbours would sufficiently inform them. Participation at the mass meetings gave all participants some voice, also in the endorsement of the volunteering candidates. This open nomination process instilled some accountability of the MUS Forum to this constituency. Nevertheless, the IA had to keep emphasizing the need for continuous report back.

In the much larger community of Tshakhuma, with 11 gravity systems serving over 2300 households, the operator and one, two or more others of each system served as representatives.

The persons chosen in the MUS Forums included (aspiring) political leaders, chairs of other committees, the – usually older, male technicians or ‘local engineers’, retired teachers, officials or migrant workers, and a few dynamic young people, for example from within the tribal authority circles. These MUS Forum members brought skills, experience, literacy and some (limited) technical expertise, and significant voluntary effort. Throughout the steps, the actions of the MUS Forum were appreciated: ‘now we have someone to go to with our water problems’. Modest expectations and the continued emphasis on voluntary contributions prevented wealthier elites and those well able ‘to bring the project and its money’ to rush and ‘capture’ the project and become unaccountable gatekeepers between the community and the IA. Nevertheless, a blind election process might well have given participants more power.

Women participated equally in meetings and the MUS Forum. Youth were less represented and often kept silent. Or, when youth participated in the MUS Forums, lack of experience and new outside opportunities for study or work rendered organization difficult, as in Ga Moela and Ha Gumbu. The 'local engineers' or technical system operators, technicians and artisans were middle-aged or older men.

2.2.2.2 Strengthening relations with leadership structures within and outside the community

From the start of the MUS project onwards, the participatory process was embedded in, and depended on wider relationships within the community. Tribal authorities were indispensable to endorse actions. Chiefs' authority to enforce rules and solve disputes in the rare cases that rules were breached encouraged preventive compliance. In only one or two cases, disputes arose that required some mediation. As traditional custodians of land, water and other resources, tribal authorities were also vital to catalyse collective action. In Tshakhuma, the traditional community-wide authority structures ensured cohesion across the nine community sections in which the MUS project was active.

Whereas some political representatives and members of water sub-committees of ward committees were part of the MUS Forums, others merely wanted to be kept informed. When confusion arose, immediate clarification was warranted, for example in Khalavha where the local civic initially confused the MUS project with another project. Here and elsewhere, the advice of a MUS Forum member held: 'Tell the leaders again and again till they get tired. And then they suddenly support'.

Party politics played a lesser role within MUS Forums, also in communities with two or more parties. Various MUS Forum members and leaders were able to profile their – voluntary – political leadership that would also hold during elections. However, the IA's purposive avoidance of politics and the project's independent financing stream minimized influence of political strife.

The risk of intra-community conflicts and jealousies as a result of external projects was clearest in Phiring. This community had seen expensive government projects ever since the 1950s when the community was forcefully removed from 'white' areas to Phiring under Apartheid policies. Strife continued within the post-1994 ward committee and between the community and the ward councillor from another community. At a meeting in which the Integrated Development Plan (IDP) was presented in May 2018, the MUS Forum was surprised to suddenly hear of another water project of ZAR 2,353,179 for Phiring. Yet, IDPs are South Africa's primary tool for bottom-up and inclusive participatory planning. Without transparency, a few individuals had strengthened contacts with government officials to bring and manage such projects locally. They criticized and discouraged the MUS Forum and delayed project implementation.

The MUS project also sought to strengthen the relationships between the community and the collaborating government line agencies and local municipalities at ward, district, provincial, and up to ministerial level. Where municipalities' borehole systems were to be upgraded, the IA ensured pre-project oral permission from municipalities and invited them for monitoring and post-project forms of co-management. In all six communities, community representatives participated in the learning events and policy dialogues. MUS Forum members appreciated being brought in contact with intermediate and higher-level stakeholders as a good option to 'market' their community. In Ga Mokgotho, this helped to mobilize materials from the water services department of the Local Municipality in Tubatse. Khalavha got materials from the corporate Entabeni Forest Plantation.

2.3 Step 2: Diagnosing

2.3.1 Purpose and action

In Step 2, community members and the IA develop a shared understanding about the community, in particular the socio-technical water situation, problems and short- and long-term needs. Publicly available data are often limited to location (including google maps), demography, rainfall, and temperature. At community level, diagnosis starts with participatory resource mapping. In a mass meeting, participants draw maps on the ground indicating community's roads, houses, schools, churches, tribal office or other site marks such as electricity lines; all water resources (streams, springs, surface water bodies); and water infrastructure (pipes, boreholes, intakes, or reservoirs) (**Figure 3**). A few people copy the ground maps on paper to archive for later use, for example, to clarify technical designs (**Figure 4**).

Figure 3 Participatory mapping in Phiring and Ga Mokgotho (Picture credit Barbara van Koppen)

Figure 4 Maps of Ga Moela and Ga Mokgotho

The IA solicits further information in focus group discussions and individual interviews (see the checklist of issues below). This can be in parallel to the resource mapping or at a mass meeting another day. The IA follows up with transect walks with resource persons to further identify, discuss, confirm and complete information. The IA may already start with more precise flow measurements to assess water resource availability, GPS location, and state and performance of the infrastructure. The IA may also already call its professional engineering expertise in – or postpone this to step 3.

After this, at another mass meeting, the IA gives feedback about the paper map and other information collected to check its validity and further probe, for example on the precise technical problems. Thus, in some three to four days, community members share and learn about their current water situation and inform the IA at the same time. This co-created diagnosis that is confirmed at the feedback meeting becomes the basis for step 3.

2.3.1.1 Lessons learnt

2.3.1.1.1 Generating knowledge

Participatory resource mapping united participants in a lively and highly informative manner. Most participants were enthusiastic in contributing to such maps. A few who could not follow would have liked some more explanation but felt shy to ask. The majority identified and discussed problems. When copying the maps on the ground to paper maps, discussions continued to ensure a meticulously accurate map, with, for example, the precise number of inhabited houses. The paper map was also useful in the next step.

Participants were surprised to look at their community 'from the sky' and were interested to learn about other sections and things that they did not know. It helped some participants to realize that 'if we do things together as a community instead of criticizing each other, we will achieve more'. Remarkably, not everyone appeared to be aware of the community's water resources. Few people, typically older men, really knew about the infrastructure and its technical details. During the mapping exercise they shared their knowledge.

Mapping and the transect walks with resource persons also appeared highly effective in informing the IA or other outsiders about the community and its water resources and infrastructure. Listening to the discussions, and sometimes probing, naturally highlighted the histories and problems that users faced and possible solutions.

2.3.1.1.2 Optional: Participatory GIS mapping

Participatory GIS mapping with open access information sources was explored in three communities ('t Hart, 2017). For this, information from the participatory maps was transferred as several layers to a GIS map. Other layers can be added, such as contour lines to calculate water pressures and required gravity pipe sizes and valve locations. The transect walks during some three days enabled checking and detailing information (see **Figure 5** for the 3-dimensional participatory GIS map Phiring).

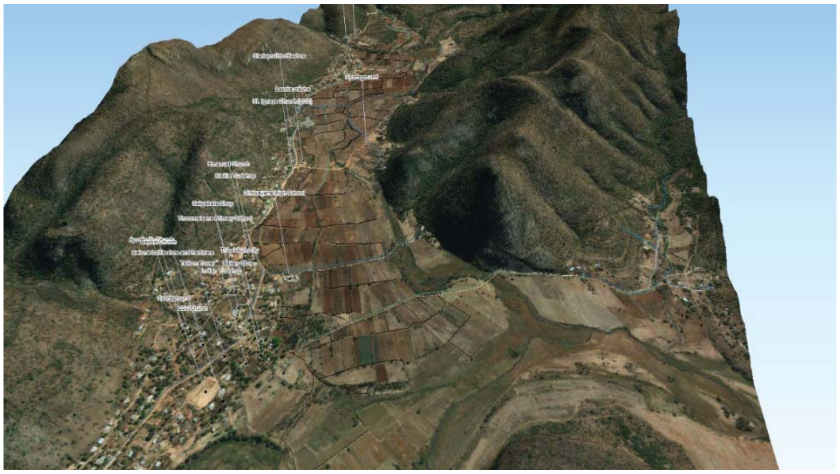

Figure 5 3-dimensional participatory GIS map of Phiring (source 't Hart, 2017)

In Tshakhuma, MUS forum members were well able to interpret the electronic map and to indicate the precise reticulation (see **Figure 6**). They commented, for example, on houses on the downloaded GIS map that, in reality, had been abandoned. Sufficiently large GIS maps enabled all participants to focus attention and create a shared understanding.

Figure 6 Participatory GIS mapping in Tshakhuma (left) and Phiring (right)

However, participatory GIS requires expertise beyond many professionals' capacity. A middle way would be the use of a large print of a Google Map, which has the correct directions and scales. The information of the participatory mapping on the ground and further information from transect walks can then be drawn by hand on the Google Map.

2.3.1.1.3 Examples of diagnostic findings

The diagnosis in step 2 confirmed that water resources were sufficient in the six communities, except in two of the 11 systems in Tshakhuma, which share the same weak source, and the dam in Phiring, which runs dry in the dry season.

The main technical problems identified concerned:

- low-quality LDPE (Low Density Poly Ethylene) pipes;
- leaks and disconnected joints and taps;

- many pipe joints made without proper fittings
- some problems in managing pressure, (which is not surprising given the undulating terrain with distances of up to five kilometres between intake and storage or tap);
- damage to non-buried pipes, by porcupines and other animals, and;
- stolen steel parts.

The top four managerial problems that caused or contributed to the technical problems were:

- free-riding instead of collective contributions;
- illegal household connections;
- unreliable and inequitable water distribution; and
- damage, vandalism and theft.

For municipal boreholes, see the above-described problems. In the irrigation system in Phiring, lack of affordable agricultural inputs, fencing and storage, plant disease and marketing problems also arose.

2.3.2 Diagnosis Checklist

The diagnostic exercise collected information on the following aspects in each of the six villages:

2.3.2.1 Community Features

- History
- Location and sections
- Tribal authorities; local government representatives; other leaders; political parties
- Number of households; demography and migration; expected population growth and water needs
- Poverty profile and health (e.g. asbestos-induced lung disease and tuberculosis in Ga Mokgotho, malaria in Phiring, HIV-AIDS)
- Water-dependent and water-independent livelihood strategies, and social grants
- Electrification; roads; connectivity
- Other public support (schools, healthcare, extension, ongoing projects)
- Other village organizations (committees linked to various departments; informal structures such as burial societies or women's groups)
- Villagers' priority needs for improvement, such as roads, communication, water, clinics, schools
- Other issues, such as crime, public safety, etc.

2.3.2.2 Water Sources

- Rainfall, surface water, groundwater, wetland; location; seasonal availability
- Possible competition during the dry season and drought years; dispute resolution arrangements

2.3.2.3 Water Infrastructure

- Overview of all water infrastructure, including ownership (public; private communal or private individual, vendors; public tankers) and government departments' and users' respective responsibilities, for the following items.
- *Initiation:* Timeline, initiative, design, financing and construction
- *Technical*
    - Intake/abstraction, storage, main flows/canals/pipes (volumes, GPS location, elevation); street taps; yard/house taps; field intakes
    - Technical state
- *Financial:* Labour and monetary costs to collect water; life-cycle costs for operation, maintenance and replacement
- *Managerial: M*anagement structures; rules of operation, e.g. rotations; (preventive) maintenance and compliance; service delivery performance (quantities, quality, reliability)
- *Sites of use with primary and secondary sources and storage:* homesteads and, if available adjacent fields; distant fields; other sites of use (e.g. streams, springs, surface water bodies)
- Abandoned or unfinished infrastructure; reasons

2.3.2.4 Users, uses and re-uses

- Uses at and around homesteads drinking, cooking, cleaning utensils, house cleaning, bathing, laundry, livestock watering, irrigation, brickmaking, crafts, other uses
- Irrigation at homesteads and distant fields: Crops, cropping cycle, use of the crop; fencing/protection to animals; agricultural inputs, skills, marketing
- Other sites of use: ; uses and frequency (year-round or fall-back) of such uses (e.g. livestock, enterprise)

2.3.2.5 Water Quality

Quality of water, especially the 3-5 litres per person per day for drinking and cooking; treatment facilities and point of use treatment; pollution sources including pit latrines; sanitation; hygiene awareness

2.4 Step 3: Envisioning solutions

2.4.1 Purpose and action

Step 3 identifies, systematizes and scrutinizes the range of solutions and translates those into designs of new (parts of) infrastructure, repairs, upgrades or extensions and related institutional changes, and assesses their approximate costs. By forming gender differentiated groups, different solutions and priorities emerge. See **Figure 7**.

Figure 7 Women's and men's groups designing location of new storage and street taps in Ga Moela (photo credit Barbara van Koppen)

If feasible, a common longer-term vision on the community's aspirations for their water situation is articulated. Medium- or long-term and large-scale spatial planning of water infrastructure encourages out-of-the-box thinking in which 'all flowers bloom'. Moreover, it pro-actively identifies multi-purpose infrastructure and integrates public and self-supply infrastructure as being possible. Longer-term visioning at larger scales ensures alignment with changing residential and productive land uses, roads and other infrastructure.

In this identification of the range of solutions, the IA provides engineering expertise to check, advise and develop communities' technical expertise. The IA, including the professional engineer, also conducts technical inspections of water resource availability, assesses the precise problems in existing infrastructure and screens proposed designs, for example with regard to GPS locations and topographies including elevation differences. In collaboration with the few community members who are able to read and interpret designs, the IA also compiles designs and estimates approximate costs as required for final approval and funding. When certain solutions appear to be too costly for the available budget, they are dropped right away. Underlying potential problems, in particular communal management challenges, are also analysed. This is the moment for the IA and MUS Forums to articulate clear conditions, especially managerial conditions that the community should fulfil before proceeding to concrete investments.

The IA sets technical criteria and monitors compliance but leaves decision-making to the MUS Forum, local tribal or political structure. When solutions and conditions have crystallized and tentatively ranked according to their priority, the IA presents the list at a mass meeting for further discussion, feedback, further prioritization and endorsement. The IA reminds the community of the selection criteria set in the introductory meetings, such as inclusion of the marginalized and new community inhabitants. Solutions should also be feasible within the time span of the project's overall time framework.

Once options are endorsed, the IA finalizes the technical designs and compiles Bills of Quantities in continuing discussion with the MUS Forum and finalizes the cost estimates. Labour arrangements and their costs are part of this scope of works, but may warrant further consultation with the financier in step 4. This list stays within, or is slightly more than the likely budget. The IA clarifies to the community that scope of works reports are drafts only – pending further discussion, adjustments and approval by the funder in step 4. Even then, the prioritized solutions will not be cast in stone. During construction in step 5, unforeseen opportunities or obstacles can call for adjustments. Approved and financed designs may well differ from the 'as-built' product.

The IA submits the 'scope of works' reports to the overall manager and funder. In the MUS project this was the Water Research Commission supported by the African Water Facility of the African Development Bank.

2.4.2 Lessons learnt

Solutions already existed before the project and were already proposed in steps 1 and 2. At least some community members had clear and perhaps long-standing solutions to well-known problems. Listening to communities' solutions also overcame the tendency of any 'external specialist with hammers to look especially for nails'. Step 3 provided the space to build on the in-depth problem analysis of step 2 and to identify and agree as community on next incremental improvements.

Accordingly, for both communal gravity systems and municipal borehole systems communities prioritized developing or upgrading the water sources and storage, and extending reticulation to meet increasing demands, as well as repairs of existing reticulation and street taps. The location of new street taps was partly left in women's and men's hands, because they know the neighbours with whom they would best be able to share and maintain the tap. The minimum requirements for basic water supply provision, as legislated, were also maintained.

New yard connections were the aspiration, and were feasible in Ga Mokgotho, Khalavha and Maswie/Tshakhuma. However, the IA left the financing and organization of yard connections to the MUS Forums and communities, but promised to assist technically to avoid damage of the reticulation lines. However, this only materialized in Khalavha and Maswie, where the community also connected the new storage with existing municipal reticulation, in consultation with officials. In three communities, the IA introduced infrastructure that was new to the communities: cattle troughs.

For the upgrades of idle boreholes (Maswie/Tshakhuma) or under-used boreholes and reticulation (Phiring, Ga Moela, Ha Gumbu), the District Municipalities were informed. In Ga Moela the primary school had a borehole, so the idea came up to extend and provide water to ten surrounding households. However, the School Governing Board rejected this.

As part of the MUS project design, distribution of 2500 litres plastic storage tanks to a few vulnerable households was undertaken. In this case, the IA left the selection of these households to the MUS Forum, tribal authorities and local government. Some used the list of indigent households for that purpose. Others proposed a long list to the tribal authority so that the authority could make the final choice. Some tanks ended up among MUS Forum members who were active irrigators and who used for irrigation. They justified this by referring to the project's emphasis on multiple uses.

In some cases, the desired solution had to be amended to fit the budget. In Ga Mokgotho, the community's long-standing vision was to develop a new dam for both domestic uses and irrigation at a spot in the distant Diphalafaleng stream. However, after measuring the distance of five kilometres and making a rough design and costing of the long pipe required, this solution appeared too costly for the available budget, and was dropped.

The MUS Forum in Phiring proposed a similar idea. Here, the water from a dam that feeds by gravity into a central pipe to irrigate a scheme of 300 ha (and to use for other purposes) runs dry in the dry season. The MUS Forum proposed to augment supplies by tapping water from a more distant stream, the Setunyeng, and then connect a two km long pipe from that intake to the start of the central pipe, so just below the dam wall before it runs into the irrigation scheme. This option fitted the available finances, so was included in the proposed list.

Future operation, maintenance and water distribution were also discussed. Gravity systems would remain or become users' full responsibility. Municipal boreholes were to be co-managed. In Ga Mokgotho, the IA set as condition for further support that the managerial problems should be solved first. Here, almost all 800 households shared one communal piped gravity system. Since the system's construction in 2007, the community operated and managed the system. Over the years, the voluntary operator became the only active manager; there was no community authority structure to oversee him. Illegal yard connections became his only source of income. Moreover, taps and steel pipes were stolen and sold at a nearby scrap metal store. Infrastructure deteriorated and most water users were dissatisfied. This not only fostered massive participation in steps 1 and 2, but the IA's condition that these management issues should first be solved also sparked action. Supported by the tribal leadership, MUS Forum members disconnected a few illegal household connections to re-establish communal authority over the system. The active MUS Forum chair, a competent new operator, and representatives of all sections in the new MUS Forum continued taking leadership of the technical aspect and refurbishment of the scheme. They also set clear rules and procedures for operation and maintenance.

Thus, step 3 resulted in the IA's submission of scope of works reports with designs and Bills of Quantities to the Water Research Commission that included High Density Poly Ethylene (HDPE) pipes, control valves, plastic storage tanks of various sizes, cement, 19 mm stones, river sand, building sand, HDPE fittings, galvanised pipes, irrigation hydrants, steel tank stands, stand pipes, taps, re-bar, mesh wire, fence poles, tools and shade netting. See appendices 1-6 for all work design reports.

2.5 Costs steps 1-3

Steps 1, 2 and 3 took place from early 2017 to December 2017 and lasted on average 8 months per community.

Per community, the IA spent the following number of days for staff time, with rates and travel costs by level of expertise (see T**able 3**).

Table 3 IA's staff time for steps 1-3 leading to costed designs per community

	IA staff		
	Facilitator	Technologist	Engineer
Staff time rates and travel costs	ZAR 1,000/day; ZAR 3.87/km)	ZAR 1,527/day; ZAR 3.87/km)	ZAR 3,636/day ZAR 4.5/km
Steps	Number of days for IA staff		
Step 1	3	2	-
Step 2	4	1	1
Step 3	4	5	3
Total	11	8	4

Table 3 shows the total costs for all six communities of the staff time and travel costs, and other facilitation costs. These were 13% of total capital costs (see above in Introduction). So, community-led design compares well with the national Cost Benchmarking Guide, which indicates planning and design fees between 12,5 and 22,5%, depending on the project's total size and capital costs.

Table 4 Total IA facilitation costs of steps 1-3 as percentage of total capital cost

Facilitation costs per community steps 1-3	**Costs ZAR**
Ga-Mokgotho	50 635
Ga-Moela	56 884
Phiring	56 660
Khalavha	61 971
Ha-Gumbu	78 911
Tshakhuma	52 429
Total facilitation costs	357 490
Other costs steps 1-3	
Rental district offices 8 months	16 000
Total IA expenditures	373 490
Overheads IA 12%	44 819
Total costs to IA step 1-3	418 308
Total capital costs	3 153 746
Steps 1-3 as proportion of capital costs	13%

2.6 Step 4 Fitting the financial framework

2.6.1 Purpose and action

In step 4, the technical designs and cost estimates of the range of solutions and their prioritization in step 3 are taken forward for final prioritization, approval and implementation. The final prioritization is reworked into a budget- and time-specific work plan that fits the conditions of funders. The work plan specifies the implementation modalities for procurement of materials, labour, construction and quality control. The respective responsibilities, remuneration and compliance rules are agreed upon, resulting in legally binding contracts among all partners: communities, IA, and overall project managers and funders, as well as municipalities and other relevant government structures.

The highest level overall manager and funder (in this case the WRC, reporting to the African Water Facility) screens the designs and costs; compares the plans of the different communities; agrees on procedures for procuring materials and construction labour, supervision, and quality control; and adjusts solutions as needed to put all together in a final work plan and budget (in this case, a budget for construction materials and labour of €200,000) for signing off. When amounts for materials depend on the outcome of a tendering process, budgets are on the safe side. The budget also includes payment rules and contingencies. In international financing, the contingencies can include currency fluctuations.

Procurement of materials can follow central government procurement procedures (as they were for the Water Research Commission, as a government entity and as endorsed by the African Water Facility) or more localized procedures.

This step also includes the final decision about construction modalities, by the IA, contractors, communities or combinations of these, and their appointment, recruitment and contracting. If communities are taking up formal roles, especially handling of funds, local structures may need to be formalized for contracting. Communities can plan the recruitment of their skilled and semi-skilled workers, and modalities for storage of materials and construction. Inspection of satisfactory completion and payment arrangements, as well as insurance are also to be included in contracts with the IA or others.

Throughout step 4, the IA mediates between the local communities and the higher-level decision-makers. Bottom-up, the IA clarifies needs and proposed solutions in the scope of works with draft designs and costings upwards to the funder. From the top down, the IA communicates the higher-level decisions to the district-level and local stakeholders. The IA's own future contractual commitments with all partners (the overall manager/funder, community, government structures that own bulk infrastructure) are also clarified.

2.6.2 Lessons learnt

2.6.2.1 Finalizing construction labour modalities

All six communities unanimously and adamantly endorsed community-led construction. Citing how 'contractors come and go', many community members pointed at failures of contractor-led construction in their own or a neighbouring community. Only a very few community members commented that 'it does not matter, as long as the contractor does his job'. The MUS project's IA was equally committed to construction by communities instead of hiring contractors. It had the socio-technical capacity to train and supervise as needed, also for specialized installations, and accepted final responsibility for quality control and insurance.

Five arguments favoured community-led recruitment and construction. In principle, these advantages apply for the construction of any design, even where outsiders decide about the designs in steps 1, 2 and 3 without community involvement.

The five advantages are:

- Local workers have a strong incentive to perform well, because they, or their families and neighbours, benefit from the result.
- Some semi-skilled labour may be provided voluntarily to achieve these benefits, especially when quick and off-hours action is required with direct impact on the household's access to water.
- Own efforts trigger continuous care, protection against vandalism, and preventive maintenance.
- Local capacities are developed by on-the-job training, which ensures sustainable operation, maintenance and future upgrades and swift repair in case of breakdown instead of having to wait for outsiders.
- For communities that designed and constructed their communal self-supply systems as in Tshakhuma and Khalavha, there is no reason whatsoever to have external contractors and labourers working on their systems.

The next question was then: voluntary or paid? The five advantages held in both cases. Payment may even erode existing voluntary arrangements and risks strengthening a dependency syndrome of waiting for outsiders instead of acting. However, voluntary works take long. Even a minor reward accelerates implementation. Also, with high unemployment levels, people need paid jobs; employment generation is an important government goal. Moreover, payment is common in national programs and alignment is important. Hence, the MUS project followed existing payment arrangements of the well-known South African employment generation programs: the Community Works Program and Extended Public Works Program. The communities were familiar with these – appreciated programs. The MUS Forums agreed and accepted the daily rates of these programs of ZAR 90. MUS Forums purposively called them 'stipends', and *not* a 'wage' to avoid any potential demand for formal labour conditions. For skilled labour (builders, welders, plumbers) the agreed rate was ZAR 250 per day. The IA left it to the MUS Forums to decide about procedures and implementation of the recruitment of skilled and semi-skilled workers.

The IA split all designs and planned works into daily 'tasks' (ie piece work) for semi-skilled workers of ZAR 90 each, and lump sums for assignments for skilled workers. The main semi-skilled tasks were trench digging (6 metres of 70 cm depth and 50 cm width was ZAR 90; and pipe laying and trench back filling (6 m of 70 cm depth and 50 cm width) was ZAR 30. In all six communities, workers were well able to understand this core task-based payment arrangement. The costs of all tasks to construct the proposed works in the six communities amounted to a total of ZAR 562 600. The Water Research Commission paid this amount to the IA's account, on condition of monthly works supervision reports and transparent recording of all workers and payments.

MUS Forums meticulously remembered any amount mentioned in the scope of works and design books, but knew these were *drafts.* After the overall managers had decided about the final work plan and funding to each community, the IA communicated these final amounts. Communities kept welcoming the support, also when amounts were reduced compared to the drafts. As a MUS Forum chair commented: ‘it does not matter whether it is ZAR 25 or ZAR 5, as long as it is clear’. As outside funding is a sensitive issue in communities, the IA’s transparent explanations of budgets and reasons for any reduction were appreciated. The chair of one MUS Forum added that expectations were more stringent for government projects that came via their political representatives and local government. For the latter, community members would have demanded full transparency in the budget allocation process and criteria for the allocation of both materials and labour.

Even though it gradually became clear for the IA and MUS Forums that there would be stipends for the works, both kept emphasizing voluntary contributions to the ultimate good of improved access to water. This further avoided any expectation of formal wages.

The liability for the quality of works and the required training and supervision and output-based payment remained with the IA. The IA obtained contractors’ risk insurance for a premium of ZAR 4000 per community for construction goods and works losses caused by fire, theft or unforeseen weather conditions like floods, and other risks, including personal injury, for an assumed construction period of 12 months.

2.6.2.2 Formalizing MUS Forums

When it became clear that the communities, in particular the MUS Forums, might have to lead formal tasks, including handling money, a legal structure was needed with a bank account and transparent book-keeping. This structure was needed to avoid the well-known risk of being accused of ‘eating money’ and this structure should also lead into sustainable operation and maintenance. In most communities, this formalization, which was similar across the six communities, took much effort of MUS Forum members and the IA. Total costs were about ZAR 3300 per community, in principle to be paid from the MUS Forum members’ own pockets.

The institution of ‘close cooperatives’ appeared popular amongst the communities. The formal name is a Primary Cooperative under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005). This lean structure is entitled to do business – and, hence, obliged to pay taxes to the South African Revenue Service. It is registered (and certificates are issued) by the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries. The CIPC has decentralized branches in local municipalities. Officials of the local municipality’s branch of the CIPC are easy to access for information and help. They also provide free courses because the Commission realised that most co-operatives collapse after being registered due to lack of information and business management skills. (The IA enabled participation of five MUS Forum members at such training 4-6 December 2018 in Sekhukhune District).

The requirements for registering as Primary Cooperative are:

- Certified copies of Identity Documents for all members.
- All members should be present and be part of the decision making and signing.
- Minutes and attendance register for the meeting held and agreed to registering a Primary Cooperative.

- Four names of the cooperative should be proposed; the CIPC representative chooses one.
- Proof of residence for each member.
- R300 (deposited in the bank)
- A valid constitution that covers: place of the cooperative; application for membership; objectives of the business; membership Terms & Conditions; management of the co-operative; general meetings; finance and amendments.
- Annual renewal through submission of documents and fee payment. Otherwise, they are deregistered.

Moreover, a Primary Cooperative requires annually renewable tax clearance certificates issued by the South African Revenue Service (SARS). If tendering, requirements include a Broad Based Black Economic Empowerment (BBBEE) status, and confirmatory BBBEE certificate. This is also signed by a Commissioner of Oaths, through the CIPC. Level 1 BBBEE means that the business is entirely black owned, with a significant proportion of female members. These certificates also require annual renewal.

The IA determined the precise requirements of the CIPC and bank accounts; held community meetings to explain and motivate about the benefits of Primary Cooperatives; arranged visits to banks, municipality and CIPC; transported community members on some occasions (on other occasions, members had to pay transport and food themselves); helped filling the forms; and collected documents when being near those offices. Some members wrongly copied their identity books or put another part of their name, or they signed with a different signature, so the process had to start all over again. The benefits, progress and challenges of this formalization were also discussed during the innovation forum meetings in which the three communities in each of the two districts shared their experiences. The advanced MUS Forums helped the others.

For the registration as Primary Cooperative, it was agreed that the members of the MUS Forums would continue as members (called 'directors') of the Primary Cooperatives, even though implications were not totally clear at that stage. In Phiring, one MUS Forum member was already chair of another Primary Cooperative but as a result of the above-mentioned tense relations, he had failed to share his experiences.

Accordingly, the MUS Forums compiled constitutions; collected money for transport and food and for the registration fee (ZAR 300) and certificate (ZAR 1500) as 'joining fees'. Obtaining the BBBEE certificate included: visits to the CPIC official in the local municipality's offices; and picking it up afterwards. In Tshakhuma, the chair of the Primary Cooperative already had a tax clearance certificate that met the requirements. Tshakhuma was the first to register as Primary Cooperative in September 2017; Ga-Moela was the last in May 2018. The local branch of the South Africa Revenue Services (SARS) for registration for a tax number and a Tax Clearance Certificate was at such distance from the communities in Sekhukhune District, that this task was outsourced to a consultant for ZAR 400.

For the opening of a bank account, the IA and the MUS Forums' chairs examined the various conditions of banks in terms of waiting time before an account could be opened; identity documents; required presence of members, proof of residence of the Primary Cooperative and its members; and costs, which ranged from ZAR 500 to ZAR1500, plus transport and food of all directors who needed to be present. Different communities opted for different banks.

Another important rationale for the IA and some MUS Forum members to choose for formalization as Primary Cooperative was that Primary Cooperatives are eligible to tender for other business as service provider for government. Government rules do favour local allocation of 30% of the budget. Such business would ensure continuity of the MUS Forums, expectedly also for operation and maintenance of the water systems. For government jobs, Primary Cooperatives should register online with their BBBEE status on the National Data Base of service providers. Accordingly, all Primary Cooperatives had 'multi-purpose' in their name, and some already highlighted their broader goals of construction in water, road projects, recycling (without water pollution), catering, cleaning, or qualifying for the Extended Public Works Program. By March 2020, the MUS Forums in Ga Mokgotho, Khalavha, and Tshakhuma had successfully taken up such opportunities. However, intra-community competition among the growing numbers of Primary Cooperatives also intensified. In this way, South Africa's fierce competition for tenders at intermediate and national levels is trickling down into communities.

The final arrangement in the MUS project was that the IA kept the funds on its account. Upon satisfactory completion of tasks during a certain period of some weeks, the IA was to pay to the Primary Cooperatives' bank account. So, in hindsight, for the water works alone, just a joint bank account by the community structure and IA would have fitted the purpose as well. Or the IA could have directly paid to the workers, either in cash or on their individual bank accounts. Alternative structures could have included all water users as members, instead of the MUS Forum only.

2.6.2.3 Formalizing relations between the IA and Primary Cooperative

The relationships between the IA and the MUS Forum as Primary Cooperative were formalized in a Memorandum of Agreement, signed by the Cooperative chair, witnesses, and the IA. Preceding workshopping and agreement had to prevent a common tendency that one or two people just sign as condition for advancing to the next step, even without much reading.

The Memorandum of Agreement formalized the following points.

- Brief overview of existing infrastructure and description of the agreed infrastructural solutions
- Duties of the IA: technical designs and bills of quantities; support and supervision of construction and of financial management; technical and managerial capacity development; keeping relations with other government entities; quality assurance and completion certification; hand-over; need for as-built drawings; post-construction after care; reporting to Water Research Commission; support to upscaling through local government's Integrated Development Plan processes and otherwise; engineering and technical advice to the Water Research Commission in procurement of materials.
- Duties of the Primary Cooperative: representing the community; providing water for multiple uses; planning project activities; recruiting workers and keeping materials safe; developing dispute resolution processes; recording and weekly reporting; developing a maintenance system with user contributions; receiving capacity development; collaborating with community leadership and with external water support agencies; protecting against vandalism; ensuring

long-term operation and maintenance, including purchasing spares and tools; advocating in Integrated Development Plan processes; and sharing lessons.

- Financial management and reporting, and stipends amounts for each type of works and total amounts, and payment procedures. For this, the IA kept the overall amount of stipends in its account. The MUS Forum kept records of workers and their tasks. The IA paid the total amount to the MUS Forum's bank account in tranches upon satisfactory completion of tasks, as judged and signed by two members of the MUS Forum and the IA facilitator. The MUS Forum either withdrew money and paid workers in cash, or, for workers with a bank account, they paid into that account. Bank payments are quicker and protect against theft. Cheque requisitions, payment vouchers, monthly cash book, bank reconciliation and other supporting documents were filled and kept. The IA reported to the Water Research Commission in monthly works supervision reports and income and expenditure bank statements.
- Duration (the coming year), dispute resolution, confidentiality
- And ultimate hand-over, after which the community owns the infrastructure in co-management with the District (as Water Services Authority). Precise co-management depends on the infrastructure with self-supply on the one hand and municipalities' ownership of boreholes on the other hand.

As for the step-wise participatory process in general, these forms of formalization were new to the six communities and required capacity building. One chair of a Primary Cooperative compared: 'These new arrangements are like getting a car. Then one also needs to learn how to drive and get a license'.

When probing whether MUS Forums would have preferred more say over available funding, some more experienced members thought that this could work for relatively smaller amounts and co-signing by the community structure and financier. However, larger amounts might tempt 'to buy a Mercedes Benz!' Less experienced MUS Forum members preferred the IA to handle budgets, the allocation of money and even the recruitment of workers. This would avoid 'finger pointing' or being bullied by people saying 'I didn't vote for you not to get a job'. Handling money and resources, even smaller amounts or modestly remunerated works, makes MUS Forum members vulnerable. In one community even the risk of being killed was mentioned. Transparency from the IA's side and clear, openly available recording of agreements and budgets is indispensable to prevent or silence rumours that MUS Forum members 'eat' funds.

2.6.2.4 Formalizing upgrades of municipal boreholes

For the proposed upgrades of the municipal boreholes, the IA compiled a draft Memorandum of Agreement with the municipality for signing. This formally included the signing off by the municipality as Water Services Authority on the designs; a joint survey of the site; the establishment of a Project Advisory Committee; a letter of support to the African Water Facility; the arrangement of an independent certifier to issue a completion certificate; and the Water Services Authority's continued ownership and responsibility for operation and maintenance after finalizing the works. The latter would include delivering more fuel or electricity to provide for the higher water volumes to be consumed. In Sekhukhune District, the IA showed the draft agreement to officials who did not object and continued interactions. However, they never signed. In Vhembe, after repeated visits and support from the Department of Water and Sanitation, the District Municipality wrote a letter to permit upgrades to their municipal systems In Maswie/Tshakhuma and Ha Gumbu.

2.7 Step 5a. Implementing: procuring materials

2.7.1 Purpose and action

The first action in implementing approved work plans in step 5 is obtaining the materials. This can be central procurement according to standard national procedures or more decentralized local procurement from local warehouses by an IA or communities or combination. Procurement includes transport and safe storage of materials.

2.7.2 Lessons learnt

2.7.2.1 Central procurement

The Water Research Commission followed South Africa's central government procedures. These allow procurement by 'shopping' when total costs for simple and readily available materials are less than ZAR 500 000 (as was the case for five of the six communities). 'Shopping' means notifying and obtaining quotations from at least three of the suppliers who are registered on the National Data Base. For higher amounts (as for Tshakhuma in this case), nationally advertised tendering processes are to be followed. In both cases, black-owned companies, especially those owned by women, are favoured to achieve BBBEE goals. These procurement procedures were well implemented, but time-consuming. The trajectory for shopping started with Water Research Commission's MUS project's research manager, and moved subsequently to: the Supply Chain Management to prepare two bids, one for the three Sekhukhune communities and one for two Vhembe communities, with the specifications ('specs') of the materials including transport; to the Bid Evaluation Committee for the Request for Quotations (RFQ) with its form of conditions (having a local presence, registration number in the national suppliers data base, a tax clearance certificate, and BBBEE certificate); in writing to local suppliers in both districts that had been identified by the IA to request quotations; back to the Water Research Commission's Supply Chain Management to transparently evaluate the received quotations and write a report; to the Water Research Commission's Bid Adjudication Committee for final judgement; to the Executive to sign off; and then to the winner. The estimated total staff time for the shopping was 15 person days.

In Sekhukhune District, the winner needed a loan, which took more time. He delivered in batches from 19 May to 28 June 2018 as supervised and signed off by the IA. In Vhembe district, the winner, a black woman, had forgotten the 14% VAT in her quotation, so the process had to start again. New bids came in in June. The winner was selected on 6 July and received Water Research Commission's purchase orders mid-July. He delivered all materials between 18-22 July – 'even during the nights', as community members complained. For each batch in both districts, the IA also checked and signed off. The last batch was delivered on 31 July.

For the tendering of materials in Tshakhuma, the additional internal steps in the WRC were that the specifications prepared by Water Research Commission's Supply Chain Management Committee and evaluated by the Bid Evaluation Committee (which found some ambiguity and duplication in the description of materials, which had to be corrected and reduced the amount) were to be approved by the Water Research Commission board at the start of the new financial year of 1 April. Then, it was advertised in the national government gazette, on 20 July. In addition to registration at the National Suppliers Data Base, tax certificate and BBBEE, tenderers also had to submit three reference letters showing that similar tasks were well performed. Further discussions for clarification of costs per material at Water Research Commission took place on 26 November. Total Water Research Commission staff time for Tshakhuma was estimated to be 10 person days. Delivery in batches with repeated checking by IA and the MUS Forum took till 17 January 2019.

In sum, the Water Research Commission diligently implemented the normal government procedures for procurement of materials. This required 25 days of well-paid civil servants' salaries (of Water Research Commission in this case). Delays were mainly due to the market middle men and women 'tenderpreneurs' who comply as black- and women-owned enterprises but have little experience, and, for example, forget VAT, but are attracted by centralized government procurement. Many well-established chains appeared not so interested to directly supply to government; they may also lack registration on the national data base of suppliers, and BBBEE certificates. Although tenderpreneurs claimed to be local, they operated from offices in Gauteng and only bought from their local hardware shops. They were not familiar with local conditions. For example, the supplier to Ga Moela was not familiar with the steep and rocky access road, so the IA and MUS forum had to arrange transport. Moreover, his specification of the rubbers for the hydrants in Phiring appeared so unclear that that whole item was dropped. (Later, the legs of the tank stands for Ga Moela appeared of inferior quality). Especially in Tshakhuma, the process between submission of scope of works and delivery of materials took a year, also because the Bills of Quantities had to be thoroughly checked. Delays were also due to bad weather, the December holidays and electricity outages. This time lapse affected the trust in the project.

2.7.2.2 Comparing with local procurement

These experiences led the MUS Forums and IA to advocate for local procurement of materials by community structures. They cited many advantages over centralized procurement. It would avoid the situation that materials that were locally available, sometimes even freely, such as river sand, had to be bought and transported from afar for high prices. It also saves costs when local stakeholders with a direct interest in high quality material and with some technical advice as needed, ask quotations, adjudicate, and buy in local shops of providers who know the transport requirements. Also, local buyers are able to buy from more than one shop to get the best deal. The option to negotiate discounts because of bulk purchases would still hold. Upon delivery in the community, communities are there to scrutinize the lots provided. Local procurement also increases communities' knowledge on available materials, their quality and prices and contacts with suppliers. This provides a strong basis for future maintenance and extensions.

Last but not least, the purchase price is likely to be lower. **Table 5** (overleaf) compares the final amounts of the purchase orders of the Water Research Commission with the highest of three quotes that the IA asked local shops for their 'on-the-shelves' prices of the same materials, including transport and delivery, plus a margin of 2% for inflation. This comparison shows that local costs are considerably lower in five communities, especially in Vhembe where mark ups in tenders were more than one third. Only in Phiring did the supplier provide at slightly lower costs than the on-the-shelves prices.

Table 5 Comparison of costs for materials in national procurement and prices in local stores. (Source Tsogang)

Community	Amount on Purchase Order (ZAR)	Local price on the shelves, including transport (ZAR)	Price difference amount (ZAR)	Price difference %
Ga Mokgotho	274 626,48	244 880,92	29 745,56	12%
Ga Moela	349 579,47	336 014,00	13 565,47	4%
Phiring	342 923,07	354 138,68	-11 215,61	-3%
Khalavha	400 140,26	287 469,65	112 670,61	39%
Ha Gumbu	339 993,83	252 985,33	87 008,50	34%
Tshakhuma	888 796,96	661 149,62	227 647,34	34%
Total	2 596 060,07	2 136 638,20	459 421,87	22%

Due diligence in local procurement of defined lots remains required. This can be achieved if a legitimate community structure obtains three quotations from local suppliers, selects the best one with transparent criteria and required technical advice, and checks the quality upon delivery to sign off. On that condition, a funder can pay that provider. Or, in more expensive purchases, an IA could receive the funding, list or technically check the specifications, advise on local suppliers to inform and explain as needed, evaluate the bids, check the quality of materials delivered, and sign off for payment, all in consultation with the community structure. In fact, the IA in the MUS project already performed all those local actions, but in the MUS project this was only to inform the higher-level decision-makers. A revival of the government's past service centres stocking spare parts is another option.

2.7.2.3 Community-led storage and safety

Upon delivery in the communities, the MUS Forums took charge of storing the materials of pipes, cement and plastic storage tanks in a safe public space. This saved the costs that contractors would have incurred by establishing a plant and guarding against vandalism. In four communities, tribal chiefs and headmen offered their places. A tribal hall and secondary school were storage elsewhere. MUS Forum members kept their own lists of all materials for stock-checking.

Where construction sites were accessible by car, some suppliers could deliver materials like building and river sands to those sites. However, in most cases, the IA used its pick-up truck or local transporters were mobilized to carry construction materials such as cement, cement blocks, pipes and tools from the storerooms to the site. This was a voluntary in-kind contribution or a small allowance was given. Community members helped in loading and offloading materials in stores and on sites. When sites of construction were inaccessible to cars, such as springs in the mountains, workers took the enormous effort to carry all materials.

The IA provided tools for construction by semi-skilled workers, including picks, spade shovels, nose shovels, wrangles, crowbars, saws, sledges, pliers, spirit level, stamper, rakes, tape measure, hammers and fish line. The IA also moved tools from the more advanced community to the next one. Skilled builders brought their own trowels, spirit level, tape measure and fish lane. Some protective clothing was provided, like dust masks and hand gloves. The IA also kept a first aid kit. The total costs of these tools were ZAR 25000, so on average ZAR 4167 per community.

2.8 Step 5b. Implementing: recruiting workers

2.8.1 Purpose and action

In step 5b, semi-skilled and skilled workers are recruited according to agreed procedures. As employment is a scarce good, competition is likely, so conflicts have to be avoided. Procedures should also ensure equitable representation of women and men and include youth. The rate of payments and conditions, such as protective clothing and first aid, are to be agreed upon. Reduced workers' remuneration can generate flexible funding for more construction, at least if the community has control over those funds. Those who are liable for technical quality, in this case the IA, has to prepare and train the recruited workers.

2.8.2 Lessons learnt

2.8.2.1 Recruiting semi-skilled workers

The MUS Forums held intensive discussions to reach consensus around recruitment. Learning from each other and advised by the IA, all MUS Forums agreed and implemented the following recruitment process for semi-skilled workers. A mass meeting was called where everyone could participate. Papers were written with 'yes' according to the number of tasks for which workers were needed. Other papers got a 'no'. All papers were put in a bowl or hat from which candidates had to blindly pick a paper. To ensure gender equality, some MUS Forums had one bowl for women, and one for men, with equal numbers of tasks. Those with a 'yes' paper got the job. Or identity cards were put in a hat and the chairs took out blindly. The first ones got the jobs (Khalavha). Communities unanimously saw these procedures as fair. Those who lost also accepted, hoping 'that their time was still going to come'.

In most communities, the MUS Forum members who spent considerable voluntary time to bring and implement the project reserved jobs for themselves or received remuneration otherwise for their efforts. While a few community members criticized this, most others accepted, realizing the MUS Forum's efforts for the general good.

The IA and MUS Forum kept calling workers 'volunteers' for the common good of improved access to water. The Sepedi word used was 'baithaupi', meaning a reward one gives to say 'thank you' to somebody after that person helped voluntarily. In some communities, the MUS Forum did not even mention any payment in the first meeting. One community member complained: she had been invited to the mass meeting for recruitment but did not attend because: 'I did not know that recruited people would be paid and I thought they were just volunteers; hence I was confused'. Obviously, after the first round of payments, this truth came out. Only a few workers or others criticized the lower stipend rate as compared with a salary or wage, if not as 'slavery' or 'robbery'. Especially in Phiring, this discouraged others, so the few MUS Forum members had to finalize works.

2.8.2.2 Recruiting skilled workers

Skilled builders (masons, fence installers, welders, plumbers) were required for the fencing of springs and storage and for the building of spring or stream intakes with filter boxes, valve-boxes, tank stands, concrete slabs and tying for 2500, 5000 or 10000 litres plastic reservoirs, and cattle troughs. In the six communities their recruitment started by a meeting of the MUS Forum, the IA and local builders to explain the technical designs, either orally or, if builders understood, with the drawings. Those who were present or were identified later were invited to submit quotations for the overall works. Further, the bidder's previous works were inspected for quality control. The IA and MUS Forum paid skilled builders the agreed lump sum after they had checked and certified satisfactory completion of the works.

Each community had one or more skilled workers, except in Ga-Moela. Here, the builders from Ga-Mokgotho came over to build the cattle troughs and valve boxes and train local people at the same time. All skilled builders were male. The IA continuously exposed this male domination and need for gender equality, so encouraged women to also come forward, if not now, then in the future.

2.8.2.3 Negotiating rates to save money

Once the IA had calculated the overall labour costs for local construction, it communicated those amounts to the MUS Forums. This fixed fund allocation became an incentive to negotiate the lowest possible rates and costs for both semi-skilled and skilled works, also lower than those budgeted to the Water Research Commission. Money saved was used for the common good. It filled gaps in materials, transport of materials from storage site to construction site, or transport costs to withdraw stipend money from the bank. It also enabled adjustments of the designs, either to take advantage of new opportunities that emerged once works started or to accommodate unforeseen obstacles during construction or when testing newly built infrastructure. **Table 6** shows how labour costs reduction varied but was on average 20%.

Table 6 Use of the funds allocated to MUS forums. (Source Tsogang)

Community and total amount of stipends	Workers' compensation	Material and other costs	Total amount allocated for local spending	Materials and other costs as percent of total amount allocated
Ga-Mokgotho	61 500,00	3 122,15	64 622,15	5%
Ga-Moela	123 890,00	48 292,25	172 182,25	28%
Phiring	81 350,00	43 805,16	125 155,16	35%

Community and total amount of stipends	Workers' compensation	Material and other costs	Total amount allocated for local spending	Materials and other costs as percent of total amount allocated
Khalavha	62 500,00	6 573,26	69 073,26	10%
Ha-Gumbu	53 150,00	4 195,01	57 345,01	7%
Tshakhuma	64 300,00	5 008,10	69 308,10	7%
Total	446 690,00	110 995,93	557 685,93	20%

Contractors who are only accountable upwards lack such incentive to reduce labour costs for a transparent common local good. Their incentives for money saving could be business, if not personal gains.

However, it became even more important to keep invoices of purchases and records to silence rumours that money disappeared into pockets. As only few community members mastered book keeping, record keeping was mainly done by the IA. Yet, the growing insight in budgets incited some MUS Forum members and others to compare with other projects. Invariably, they commented how the MUS project created much more value with smaller budgets, and, moreover, finished promised works.

2.8.2.4 Training

Throughout the discussions in steps 3 and 4 on the designs, lots of materials, their costs, and scope of work with drawings in the work design reports, the IA developed local skills. During a classroom session before construction started, the IA provided further technical training to all the MUS Forums. Topics included: occupational health and safety training, working as a team, and the identification of quality material. The IA also demonstrated laying pipes and associated fittings and valves, trench marking, excavating a trench, trench bedding, pipe laying, backfilling, compacting and shoring. This training continued on the job during construction. Significantly, if more funding had been available, the IA would have prioritized further training on technical skills, or hired a local technician for daily supervision, and on book keeping.

2.9 Step 5c. Implementing: constructing

2.9.1 Purpose and action

Finally, 'dust flies' to construct what was designed and, as needed, adjusted to unforeseen obstacles or to new opportunities (see **Figure 8** below). Workers are organized, trained and supervised. Works can be allocated across sections, so without considering whether semi-skilled workers would work on their own (segment of) the system or on others' water supplies. This strengthens community spirit. On the other hand, working on own-infrastructure for direct benefits may be an extra incentive for high quality work.

Selected workers can take up as many tasks as possible and invite family members to help. This enables to do more tasks per day, so earning more. Or workers stick to certain assignments, so once one batch of workers finishes, the next batch gets the opportunity. Selected workers can also choose to group themselves and work independently on the specific task for the total amount of the sum of the stipends.

The IA and skilled MUS Forum members continue workers' on-the-job-training, and regularly come to advise and monitor the quality of the works. They especially supervise key activities, for example junctions of pipes and testing for leaks before backfilling.

All works with related stipends are carefully recorded. Both semi-skilled and skilled workers are only paid once their works are checked as satisfactory. At regular intervals, the total amount of stipends due is drawn from the bank, and paid either in cash or, for ease and safety, in the worker's bank account, if she or he has an account. When construction is ending, the MUS Forum is trained for hand-over.

Figure 8 Semi-skilled workers digging trenches in Maswie/Tshakhuma (photo credit Barbara van Koppen)

2.9.2 Lessons learnt

2.9.2.1 Performance

Construction was fast and smooth. The IA facilitator also worked and explained that this was 'to avoid giving an impression of commanding'. Community members appreciated her hard work to finish even at night 'with the light of the smart phone'. Women and men claimed working equally hard, without difference. Pointing at the hard work done by all also appeared an effective way to silence 'the negative people who are always there' and those 'who talk too much'. They kept quiet when they had to acknowledge the hard work.

In five communities, the semi-skilled workers worked across the community, so also beyond those parts of the system that served their own homes. However, in Tshakhuma, the initial group that represented all sections appeared too large. When they had to share the amount available for the task, stipends became too meagre. After this experience, workers were organized by section.

The bulk of works were swiftly finalized in three to four months, but the last parts or redesigns could take another couple of months or, as in Phiring, up to 12 months. Ga Mokgotho was fastest: it was well organized and the community had experience with their gravity system for over a decade. In Ga Moela, the less experienced (young) workers also finished entirely new works swiftly and enthusiastically. In contrast, in Ha Gumbu, many households have private boreholes. Others buy water from neighbours. This became the only option when the municipal borehole system broke down just before works started. Here, community members were lukewarm about the upgrading and extension of the reticulation of the borehole. Works in Tshakhuma took longest, due to the above-mentioned delays in delivery of materials and the many systems to upgrade and the new construction of one system.

Workers appreciated the skills that they had learnt and the stipends earned. Among the few complaints were late payment in cases in which some still had to finalize their works before the next round of payments were done and, in incidental cases, low amounts of the stipends, lack of protective clothing and hard work. The newly developed local skills and care for the 'infrastructure for which we worked hard' bode well for future sustainability.

2.9.2.2 Flexibility to adjust designs

During construction unforeseen obstacles were encountered that required adjustment. These included rocky soils that needed steel pipes instead of HDPE pipes and, in Ga Moela, an objection by the title holder of a preferred site for storage, so a new site had to be found. New opportunities also came up. Some reticulation lines could be further extended or street taps were added and moved nearer to households. Future users contributed money for such new pipes, or replaced old pipes, and volunteered to excavate the additional trenches. In Ga Mokgotho, a 100 m shorter route was found for the planned 1450 m long pipe line from the source to the reservoir. The big storage tanks were moved closer to the community for security in Khalavha, but it took long before the community members finally connected the reticulation from the communal storage to their yards.

When works were tested, more work appeared needed in three communities. In Ga Mokgotho, the inflows into the reservoir were augmented and water was stored for a more reliable rotation. However, the increased volumes of water in the existing brick reservoir led to a crack. The IA swiftly repaired. In Phiring, workers had quickly installed the two km long pipe from the Setunyeng stream to the spot below the dam where it was to be connected to the big central irrigation pipe that feeds the irrigation scheme. However, the water pressure from the irrigation pipe appeared too high. The next design was to redirect the pipe directly into the dam, and lengthen the pipe for that purpose. However, the difference in elevation between the intake in the Setunyeng and the dam was limited, so water hardly flowed into the dam. The next design was then to move the intake higher up in the Setunyeng river. That worked. A second setback in Phiring was the blocked pipeline from the municipal borehole to houses in the Mohlatswengana section. As people had damaged the main line when they made their own connections to the line, blockages were more severe and over a longer stretch of the pipeline than initially thought.

Lastly, in Ga Moela, the steel for the tank stands of the new 40 000 litres reservoirs appeared too weak and started bending when the reservoirs were filled for the first time. The supplier of the steel had already been paid so the IA had to replace that steel with stronger steel. Also, one of the two municipal boreholes appeared too weak to push water up through the new main line to the new storage. The IA added an electric booster pump, but collecting money to pay for the electricity bill was cumbersome.

This underlines the importance of flexibility to finance such adjustments. Contractors who are only accountable upwards to implement fixed designs often lack this flexibility. In the MUS project, the IA and MUS Forums created a flexible reserve fund. In future community-led construction, contingency funds can serve this purpose.

2.9.2.3 Municipal boreholes

Although the construction of improved storage and reticulation of four municipal borehole systems went well, it took almost a year before two of the municipal boreholes started working. In the Maswie section of Tshakhuma, the borehole was constructed in 2015 but had been idle since. Early in 2020, it was finally connected to the new storage and main line. In Ha-Gumbu, the diesel engine broke down in mid-2018 when the upgrades of the pump house, storage and reticulation had just started. The municipality promised to replace the diesel engine by an electric motor and to provide two complete sets of boreholes, reservoirs and reticulation to the two new sections. This took till April 2020. In the meantime, rumours emerged that the municipality-appointed contractor for this work had disappeared with the money.

The municipal diesel-powered pump in the Tawaneng/Letlabela section had problems. The pump broke down in March 2019. In September 2019, the municipality replaced it with a petrol-powered pump, and promised to deliver petrol but within the municipality it took long to approve the shift from the common diesel provision to providing petrol. In the meantime, the Tawaneng section organized to collect money and buy fuel. The pump operator is volunteering. However, the users of the new storage and reticulation in Letlabela kept waiting, fearing that own-purchase of petrol would discourage the municipality even more to provide petrol. Promises make people passive; everyone loses.

For all municipal boreholes, even the repair of minor breakdowns took a long time. In principle, all users interviewed were ready to speed up repairs by taking charge of small repairs, leaving the big repairs of the borehole, pump and reticulation in the hands of the municipality. New co-management arrangements can advance such win-win division of roles and responsibilities between communities and municipalities.

2.10 Step 5: costs of facilitation, training and supervision of construction

Table 7 gives the required staff time (in days) and total staff time and travel costs per community for the IA's facilitation of community-led construction from the recruitment process onwards. This includes advice, classroom and on-the-job training, supervision and quality control of works. **Table 7** shows that the costs to the IA comprised 36% of total capital costs. The national Cost Benchmark Guide estimates the proportional costs of secure storing, construction supervision fees and training and capacity building fees ranging from 10 to 22%, depending on the size of the project. As noted in the method, it is unclear how local contractor costs are calculated – a role that the IA implicitly took up as well.

Table 7 Costs to the IA of facilitation, training and supervision of construction

	total days facilitator	total days technologist	total days engineer	total staff time and travel costs (ZAR)
Ga Mokgotho	43,5	10	8	113 307
Ga Moela	53,5	31	6	199 222
Phiring	35,5	21	6	141 729
Khalavha	46	7	3	104 544
Ha Gumbu	33	6	3	95 752
Tshakhuma	149	16,5	10	283 667
Total days facilitation/ supervision	360,5	91,5	36	
Total costs staff and travel				938 222
IA's contractor insurance				24 000
Rental SDM and VDM offices (ZAR 1000 /month per office)				16 000
Classroom training 5 days with 69 participants @ ZAR100				34 500
Sub-total				**1 012 722**
Overheads 12%				121 527
Total				**1 134 249**
Total capital costs				**3 153 746**
IA facilitation and supervision costs for construction as % of total capital costs				36%

2.11 Step 5: employment created

With 72% of the total amount for all labour for semi-skilled workers in community-led construction, this generated a total of 3550 person-days of semi-skilled employment in the six communities. The rest was for skilled jobs. **Table 8** gives the overview of these numbers of workers, total workers' remuneration, and the proportion of this amount for semi-skilled workers, and the total person days of employment created for semi-skilled workers at the daily rate of R90. The total labour costs of ZAR 446 690 are 14% of the total capital costs of ZAR 3 153 746

Table 8 Numbers and total remuneration of all workers, and proportion of payment and person days for semi-skilled workers

Community	Number of skilled and semi-skilled workers	Total payment to semi-skilled and skilled labour (ZAR)	% payment to semi-skilled labour	Total payment to semi-skilled labour (ZAR)	Person days semi-skilled employment @ZAR90/day
Ga-Mokgotho	58	61 500	71%	43 631	485
Ga-Moela	38	123 890	74%	92 284	1025
Phiring	50	81 350	62%	50 084	556
Khalavha	22	62 500	88%	55 000	611
Ha-Gumbu	31	53 150	82%	43 840	487
Tshakhuma	77	64 300	54%	34 700	386
Total/average	276	446 690	72%	319 539	3550

2.12 Preparing hand-over

In preparation of the use phase, the IA organized another five-day training session on operational skills for the Vhembe communities (20 participants in December 2018) and Sekhukhune (January 2019 15 participants). Topics included: knowledge of environmental health and community hygiene practices, water quality especially of the 3-5 litres per person per day used for drinking and cooking (for example, the use of a teaspoon of bleach in 20 litres of water, and wait for 30 minutes before drinking), climate change adaptation, operation & maintenance (see also Bassole 2018 and White 2018), gender equality and women's empowerment to raise awareness and promote change, and basic bookkeeping. In February 2019, training was given on homestead irrigation. Seeds were provided as well. Officials of the municipality visited the schemes end 2019, preparing for an official move to the use-phase without the IA. However, the COVID-19 crisis early 2020 left this process entirely in communities' hands.

The process of these five steps was similar in all six communities, in spite of the diversity between the communities. We now turn to specificities of each of the communities. This will show how outcomes and potential co-management arrangements can differ depending on local context. These differences underline the need for participation including a thorough diagnosis of each different locality and solutions as prioritized by those who know their needs and environment best.

For both Ga Mokgotho and Ga Moela, similar impact studies were conducted so these communities will be discussed simultaneously in the next chapter.

3 Ga Mokgotho and Ga Moela

3.1 Pre-project situation

3.1.1 Method

The following findings are based on the same base line assessments and process documentation as in the other four communities, and, in addition, post-construction surveys. In Ga Mokgotho, 59 households (out of 800) were randomly selected (see **Figure 9** below). Interviews were held with the primary adult found at home. These were 14 men and 45 women. In Ga Moela, the sample consisted of 42 (out of 108) households (see **Figure 10**). The respondents were 12 men and 30 women.

The closed and open survey questions focused on respondents' participation in and opinions of the participatory process and on the project impacts in terms of changes in the water infrastructure and its operation, the water uses and livelihood benefits. For the latter the pre-project (2018) and post-project (2019) period were compared through oral recall. The survey took place at the end of the dry season, so for better comparison, questions about the pre-project period also focused on the dry season one year ago. However, in one of the four sections in Ga Moela (the Letlabela section), households only received water from mid December 2018 to March 2019, so respondents were asked to recall water uses during that period as the 'post-construction' uses and benefits.

3.1.2 Ga Mokgotho: a large sub-functional community-operated gravity system

Ga-Mokgotho is situated in a mountainous area with average rainfall of about 800 mm per year. It lies about 40 km north of Burgersfort, Limpopo Province. Ga-Mokgotho is in Ward 16 of Fetakgomo/Greater Tubatse Local Municipality of Sekhukhune District Municipality. It has about 800 households. There are four sections in the study: and Segabeng, Lekgwareng, Nkoteng, and most downhill Sethogeng. In 2007, a bridge over the adjacent river opened access to the community, which has fast been growing since. In 2013, all households were connected to electricity lines. **Figure 9** below illustrates the community on a GIS base.

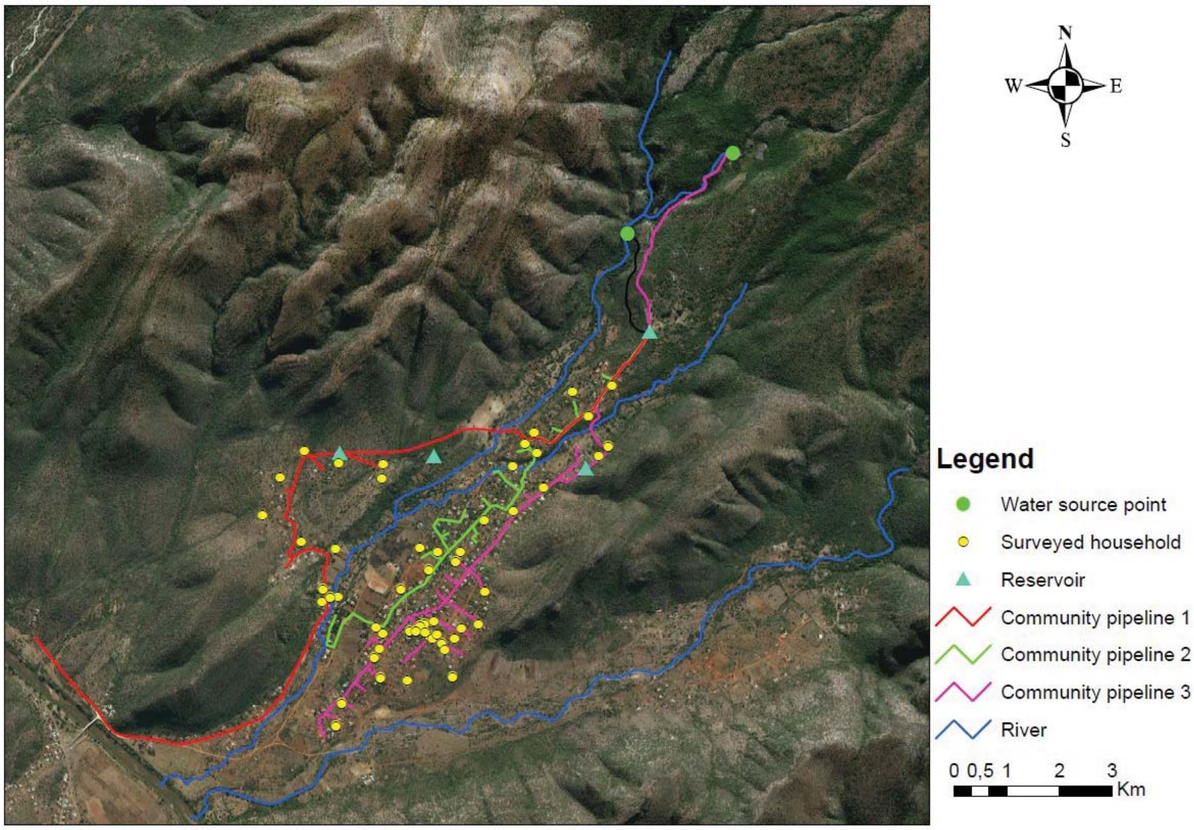

Figure 9 Ga Mokgotho including the communal system and surveyed households

The main source of water is a communal system that was constructed in 2007 by Tsogang Water and Sanitation. Taking water from a spring stream and protecting that source, water filled a large brick reservoir of 200 m^3 that initially supplied 94 taps serving some 400 households. In 2013, the municipality refurbished the system by adding a separation box and 43 taps. In 2015, a second intake was constructed to better fill the reservoir. After that, a fire burnt part of the 1350 m HDPE pipes from the spring to the main reservoir, and was only partially repaired. From the main reservoir, there were, and still are, three main reticulation pipe lines to the street taps. The two outer lines went to two smaller steel reservoirs and, from there, each to one line supplying the taps. The third line in the middle from the main reservoir directly provides water to street taps. The 135 taps were shared by the surrounding households.

Immediately after construction in 2007, a water committee was established with support by the tribal authorities. One of the builders during the construction phase took up the responsibility of scheme operator. According to written rules, the water users were supposed to pay ZAR 10 per household for operation and maintenance. However, over-time only very few paid and the committee stopped functioning. In the absence of a communal structure that represented the common interests to set and enforce rules for all members and to hold the operator accountable, the system started deteriorating.

The operator simply left the valves to all three lines open for 24 hours. The valves of the two smaller reservoirs got damaged. Pressure fluctuated unpredictably. The pipes from the reservoir to the taps were increasingly leaking without anybody attending to them. Where pressure in the system was too low, water in the buried pipes could not be pushed up to the tap. Taps were even stolen, allegedly also by people from a neighbouring community.

The operator hardly followed up on water users' complaints. Without being paid and without obligations to report to a communal authority, the system became his private business. When demands for water expanded, individuals started asking him to install new household connections. During the night, he constructed, for example, multiple underground connections a few meters away from a tap point. Amounts of ZAR 500-600 were mentioned as his remuneration. He was part of the elderly advising the tribal authority, who saw his behaviour as illegal, but also failed to act.

In response to these unreliable services and aspirations for higher service levels, also for productive uses, and water needs in new settlements, some households installed their private pipes from streams higher up in the mountains to their homesteads. Other households asked water from their neighbours, either from those who were luckier with better access to the communal system, or from those who privately installed gravity pipes. Most neighbours provided water for free, but some asked payment. For example, in the tail end of the Sethogeng section, the private pipe owner charged ZAR 50 per month. Two schools and two households had their own borehole.

Respondents of the post-construction survey summarized this pre-project situation as follows: there was a lack of proper water provision and system operation; there was only one person controlling; and no one was responsible to manage the system; the reservoir was not cleaned; there were no rules for water distribution; pressure was low; pipes were leaking; taps were dripping, taps were not working properly, broken, stolen, or at distant locations; there was insufficient water to fill household storage; there were periods of three days or two weeks or months without water; and people were forced to ask neighbours for water.

3.1.3 Ga Moela: dispersed groundwater wells and municipal boreholes

Ga Moela is a small community of 118 households situated on the Leolo Mountains 20 km east of Jane Furse, Limpopo Province. It is part of Ward 14 of Makhuduthamaga Local Municipality of Sekhukhune District Municipality. The 118 households are dispersed and divided over five sections: Tawaneng (36 households), Letlabela (22), Moela (27 – not to confuse with 'Ga Moela', which indicates the entire community), Mabusa (23) and Ga Pudi (10). In 2010, almost all households received electricity connections. **Figure 10** illustrates the community on a GIS base.

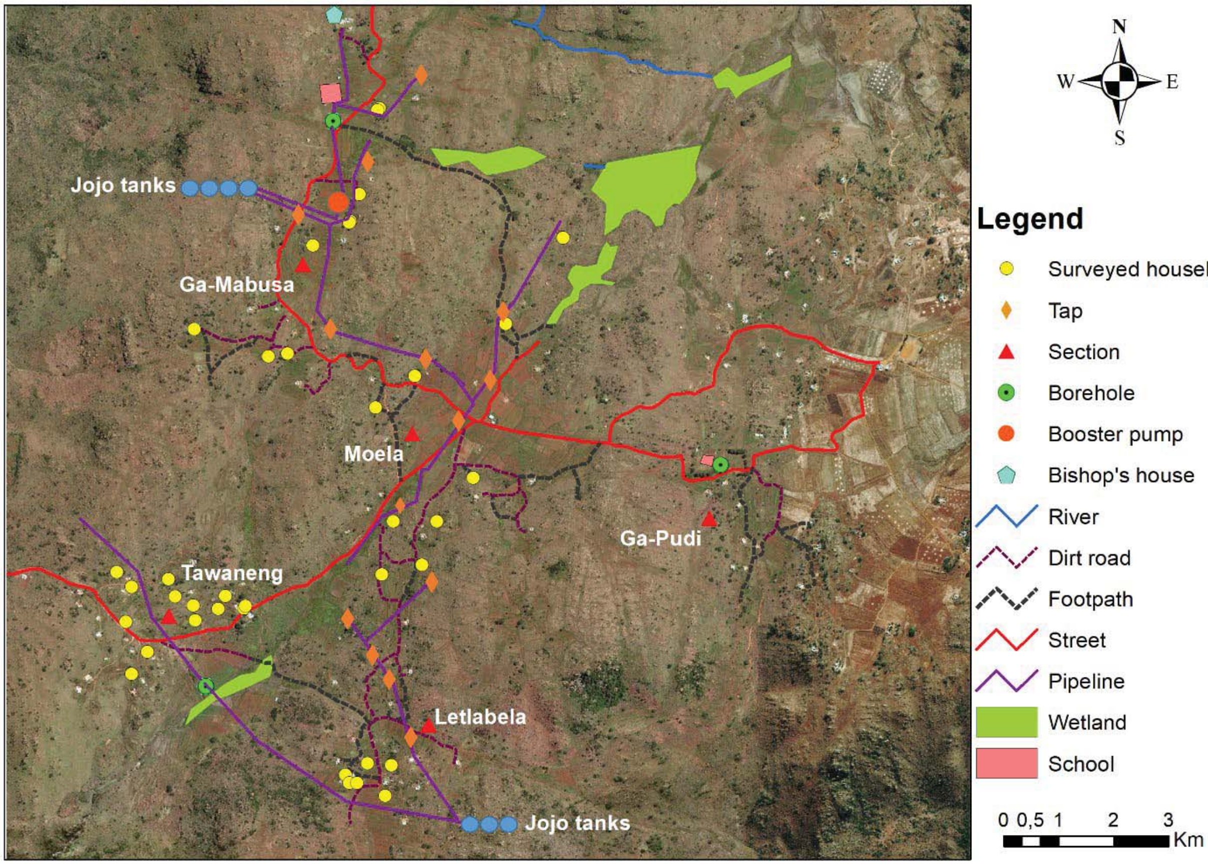

Figure 10 Ga Moela including communal systems and surveyed households

Rainfall between 500 and 750 mm enables rainfed agriculture, mainly maize, on the fertile soils, and livestock keeping. Poverty led to outmigration, mainly by young men. Sixty percent of adult family members in the sampled households were women; half of the households were female headed. Three quarters of all household heads were older than 50 years. With low numbers of students, the community's Lerato Secondary School had to close to merge with a distant school.

The main water sources were some 20 scattered shallow hand-dug wells of 0.5-1 m depth, and small streams some of which turn into wetlands in the rainy season. Part of the streams dry up at the end of the dry season by August, September. Almost all respondents used to depend on these wells as their primary source, mostly carrying buckets and, wherever the rocky terrain allowed, using wheel barrows. The water in the shallow wells is dirty. 'We shared water with animals' is respondents' most common description of the pre-project situation.

There were three functioning public boreholes in Ga Moela, each installed for a different purpose: a former prospector's borehole near the Tawaneng section, the borehole of the former Lerato Secondary School in the Mabusa section, and a borehole of the Ntshitshimale Primary School in the Ga Pudi section.

The diesel borehole near the Tawaneng section was installed by mineral prospectors. Without finding minerals, they left. Ownership of the borehole shifted to Sekhukhune Municipality. In 2016, a contractor employed by the municipality constructed a main line, four 10,000 litres plastic tanks, called 'jojo's'[2], and reticulation to five taps in the Tawaneng section, which is the largest section and closest to the borehole. Two other taps were constructed but when the contractor left, they were not connected. Moreover, more steel standpipes for the jojo's were procured but left unused. The municipality provided diesel infrequently, at best. Consequently, in order to access water, people in the Tawaneng section started contributing money to buy diesel. An elected woman volunteer operated the borehole twice a week to fill the communal jojo's for distribution the next day until 17.00 hrs. In the MUS project, this former prospector's borehole became the Tawaneng/Letlabela borehole: the project finalized the reticulation in the Tawaneng section and installed a new main line to new storage and reticulation to the Letlabela section at the opposite side of the borehole.

After the Lerato Secondary School had been closed, the municipality took over from the Department of Education as owner and manager of this borehole with its four 5000 litres jojo's reservoir and three nearby public taps. The municipality also continued providing diesel and paying the operator as before. A nearby small religious congregation of three households agreed with the municipality that the congregation would buy a private pipe and connect this from the pump system to its premises uphill. The congregation called the operator when water in the reservoirs was finished. Households very near to the public taps also continued using these taps. When there were small breakdowns and when it took long before the municipality came to repair, the congregation repaired it. In the MUS project, this former Lerato Secondary School borehole became the Mabusa/Moela borehole. The project constructed a new main line from the pump house to new storage tanks uphill for most of the Mabusa section and the Moela section over the hills. It also extended the existing reservoir near the school to the few houses at that side of the Mabusa section.

The borehole of the Ntshitshimale Primary School in Ga Pudi was owned by the Department of Education and used by the school only. A hand pump was to serve surrounding households but that was broken. Two households had their own private boreholes and also shared or sold water.

Three earlier municipal projects to drill new boreholes had failed in Ga Moela. Two boreholes never worked (the engine of one was immediately stolen, and the jojo stored at the chief's place). A large multi-village project that had started in the adjacent community of Ma Chupi also stopped without finalization. The idle equipment disappeared soon after.

Lastly, there were various water vendors, who also served the Ga Moela community during functions and droughts. One respondent in the Tawaneng section was such a water vendor and explained how clients call him, after which he goes and fetches water in his car with a 1000 litres tank. He used to take water from the former prospector's borehole, but he was not allowed anymore to do that. Then he went to take from a hand-dug well, but he also stopped doing that when more people started using that well. After that, he bought water from the borehole owner in Ga Pudi at ZAR 50 to fill his tank of 1000 litres. He sold one tank at ZAR 170.

This was the context in which the MUS project started.

[2] These plastic storage tanks, which range from 2 500 litres to 10,000 litres, are named after the brand name 'jojo'. The remainder of this close-out report continues to use the popular name 'jojo'.

3.2 Community-led processes

3.2.1 Step 1: Agreeing to collaborate and establishing a MUS forum

As part of the MUS project team's selection of both communities, Tsogang informally visited each of them to ensure endorsement by the tribal authority. They expressed their full support. Tsogang then called a mass meeting (in March 2017 in Ga Mokgotho, attended by 130 community members; and in June in Ga Moela attended by 31 men and 24 women). These mass meetings were inclusive. Most respondents remembered they were invited to this introductory meeting and next meetings (Ga Mokgotho 83% of respondents; Ga Moela 92%). Elderly and disabled community members did not always attend. In both communities about two thirds of the respondents attended the meetings. Common reasons for not attending included: not being around that date, old age, taking care of children, pregnancy, other commitments, or another family member already attending.

At the first mass meeting, Tsogang introduced the MUS project team and explained the project's goal of meeting multiple water needs and the participatory approach. Further, a committee was established in the first or second mass meeting. This became known as 'water committee' in local language, or as 'MUS Forum' in project terminology. Tsogang explained their tasks: to oversee the implementation of the project; serve as the link between the community and Tsogang; and report back to the community. Selection criteria included gender, youth, representation of all governance structures and geographic sections. After that, participants in the meeting were invited to mention names of potential candidates, which were then seconded. Tsogang asked the new MUS forum members to elect the committee's executives (chair, secretary, treasurer and, as needed, vices) among themselves, without further interference by Tsogang. After that, Tsogang instructed the MUS Forum about roles and responsibilities and assessed existing skills and skill development needs.

In Ga Mokgotho nineteen members were nominated: eight females, eleven males and four of them were young people. The chair was dynamic and had participated in local government elections. He was well connected with the tribal authorities and local government structures. A new operator came forward. Over-time some ten members appeared most active. During the survey, most respondents knew the MUS forum to a certain extent: 77% knew the chair by name; 50% knew the new operator of the main reservoir by name. In addition, depending on those representing the geographical reticulation line and its segments, between 11 and 44% knew the names of one, more or all of the ten active other MUS Forum members as well.

The survey also asked to evaluate the tasks and performance of the MUS Forum after all steps so, in hindsight, respondents' views on the tasks of the MUS Forum throughout the project period were ambitious: ensuring the community gets water. This included water provision (operation, rotations across the three lines, fixing broken and blocked pipes and taps), oversight (checking reservoir, taps and flows), and problem solving by facilitating 'fair and satisfactory processes to accomplish all the tasks'. Respondents appreciated the Forum's fulfilment of the task, as reflected in respondents' comments. 'They listen to people before doing work and are committed to their work'. 'The forum calls for a meeting and gets a solution and this is swiftly implemented as per community discussions'. 'At the meetings, they report back every time via meetings and show all quotations before buying and invoices after purchasing materials'. Respondents were satisfied about this budget transparency and the report-back of financial matters to avoid rumours, with the exception of only one respondent who was still not satisfied about the explanations on the finances. As shown below, the MUS Forum played a vital role: it filled the main existing gap in Ga Mokgotho: a member organization of water users with a governance structure that enforced rules and obligations and to which the (new) operator reported.

In Ga Moela's establishment of the MUS Forum, six women and six men were nominated; seven were youth. However, the composition changed immediately afterwards. Later, three of the new MUS forum members left. Moreover, after a year the young chair, who was also chair of the tribal council, got a job in Pretoria and left Ga Moela altogether. Further, two of the three other young committee leaders also got nearby employment outside Ga Moela. When the survey probed respondents to mention names of the MUS Forum members, these three most active persons were known by 55% of respondents; moreover, three other members were mentioned by 26%. Other names were mentioned only once or by a few respondents.

None of the MUS Forum members had earlier experience in committees, chairing meetings or record keeping. Moreover, unlike Ga Mokgotho with over a decade of experience with a communal scheme, infrastructure in Ga Moela was scattered, without a community-wide need to organize for water. Yet, in hindsight during the survey, respondents realized the important role of the MUS forum: 'they ensure water'. 'Without them, water would not be available'. Various respondents specified their roles. One is organizational: calling meetings, giving information, monitoring project, conveying members' messages to Tsogang, serving as a new committee for water management so people can go and report water challenges, and solving conflicts. Also referring to the MUS Forum's positive role in community-led construction, respondents were overwhelmingly satisfied about the MUS Forum's performance. Other respondents also expected the MUS forum to operate the new systems in the future.

3.2.2 Step 2. Diagnosing

In the diagnosis phase during the following three to four months, Tsogang, the MUS forum and community members analysed the water situation of the whole community through participatory resource mapping on the ground (see **Figure 11**) which was copied on paper; focus group discussions, including pair wise ranking of needs; transect walks; interviews; and otherwise. Information collected was presented back in next mass meetings. This generated a shared understanding of the current situation and problems as basis for next steps. Tsogang also started technical measurements of flows, the state and discharges of pumps and other infrastructure and GIS measurements of sites and elevation. Half of the respondents (Ga Moela) or more (69% in Ga Mokgotho) participated in the resource mapping and focus group discussions.

With regard to the resource mapping, respondents in Ga Mokgotho mentioned how the mapping helped them to learn about 'each household in the community', 'water to other sections', 'water flowing in three supply lines, buried pipes, or more reservoirs in the community'. Only a few participants, mainly older men, appeared well aware of the detailed water sources and infrastructure across the community. They shared their insights, teaching some others.

Figure 11 Participatory resource mapping in Ga Mokgotho (photo credit Barbara van Koppen)

Ga Moela, respondents learnt from this map how the houses, boreholes, wells, or, for example, the water system in Tawaneng, and rivers in their community look in the landscape 'from the sky'. 'I now know all areas in the community because of community mapping'. One respondent realized 'how challenging it is to provision taps as households are far away from each other'. The Tsogang facilitator noted how men launched into the map, and how women gently corrected them. In both communities, one respondent felt that the explanation of the mapping exercise was unclear. They could not follow, but were 'shy to ask questions'. In both communities, the map helped to plan for the locations of the new taps and valves.

In Ga Moela, Tsogang also liaised with officials of the nearby satellite office of the municipality (in Schoonoord), which is also the Depot for diesel. Tsogang briefed them about the project, which the local officials fully supported, and asked further technical information about the municipal boreholes.

3.2.3 Step 3. Envisioning solutions and prioritizing.

In step three, the range of technical and institutional solutions were further analysed. Community members had already envisaged solutions before the project and, during the introductory and diagnostic phases, other solutions came up as well. In step 3, Tsogang further detailed, costed, compared and ranked solutions according to their priorities, in collaboration with the MUS Forums. Conditions were set as well. After two-three months of measurements and deliberations, the crystallizing solutions were listed and discussed in mass meetings. Moreover, in both communities, the project included supplying jojo's of 2500 litres to vulnerable households: 15 in Ga Mokgotho and 10 in Ga Moela. Tsogang left the selection of those households to the MUS Forum and community authorities.

3.2.3.1 Ga Mokgotho

In Ga Mokgotho, Tsogang insisted that the community should swiftly take action to address the management failures of the system, before any renovations to the existing infrastructure would take place. Frustrated about a full decade of scheme dilapidation, the MUS forum publicly dug out some of the illegal connections made by the former pump operator and brought the households concerned to the tribal authority to discuss this illegal behaviour. The MUS forum also gradually started supporting another pump operator, who had also been part of the construction of the communal system in 2007. The former operator, who became a pensioner in the meantime, participated in meetings, but not anymore in decision-making or implementation.

Technically, the long-standing wish of the community was to develop a new dam from a more distant source, the Diphalafaleng river. Tsogang assessed and costed this option, but found that it would be too expensive for the available budget. Moreover, the intakes of the existing reservoir were to be upgraded to enlarge the water supplies to the scheme.

By October 2017, the further listing, costing and prioritization led to the following proposed solutions: refurbish both intakes at the source and fence and protect against leaves and other debris falling in; install a new pipe from one intake to the reservoir (1.4 km) and repair the other line (1.1 km); replace four dysfunctional valves; add a valve box and a control valve to increase pressure; repair or replace leaking pipes and broken or stolen taps; extend the reticulation line in the tail end of Sethogeng with 600 m and three more taps to 50 households; and build two animal troughs connected to the system (which was an entirely new idea proposed by Tsogang). Moreover, the community aspired to get yard connections instead of sharing street taps. This would better meet people's needs and avoid the intrinsic risks of vandalism of public taps. However, households were supposed to self-organize and finance such yard connections. Tsogang would help to avoid leakages when people were connecting into the reticulation lines.

Respondents attending these meetings supported and trusted the process, generally feeling that 'they proposed what I want', even 'without fully understanding the technical details', as one respondent commented.

3.2.3.2 Ga Moela

In Ga Moela, a similar process was followed and respondents expressed a similar appreciation. 'Tsogang really listens to our ideas'. 'I was thinking about the same things as discussed'. 'It gave a chance to speak up and discuss about problems and changes wanted'. 'I proposed that we should have a water committee to maintain taps and pipelines once project is finished'. Moreover, some respondents felt that their own listening skills and communication skills also improved in the process.

As the MUS project's budget was too limited for a new borehole, the straightforward next incremental step proposed by the community members and Tsogang alike, was a system upgrade of the three existing boreholes by adding more storage and newly installing or extending reticulation to more street taps to reach more households. Separately women and men groups suggested sites for the new storage and its operation and for street taps. (See **Figure 12**)

Figure 12 Participatory design to locate new street taps in Ga Moela (photo credit Barbara van Koppen)

In the following months of 2017 further technical measurements were made. Tsogang hired an engineering company to advise the pumping capacity of the boreholes and water availability, head loss in this undulating terrain, and on the diameter and class of the required pipes.

For the former prospector's borehole, neither the Makhuduthamaga Local Municipality nor the existing users in the Tawaneng section objected to sharing the borehole with the Letlabela section, so a new main line from the pump house was proposed with a storage reservoir of three 5000 litres jojo's, and reticulation to serve the 22 households in Letlabela. In Tawaneng, the two already constructed taps were to be connected to the existing storage, requiring just 20 m extra line and couplings.

The satellite office of the Local Municipality and the congregation that already used the former Lerato Secondary School borehole also supported the proposed sharing of the borehole with others. The municipality provided some information of the capacity of the borehole, but this was not further tested. One small new extension was planned to serve a few scattered households. A much larger extension from the pump house was planned to feed a new storage (of initially three, but ultimately four jojo's of 5000 litres each) on top of the hills. This was to provide water for some 20 households in the Mabusa section and most of the 27 households of the distant Moela section over the hills. Later, the proposed best site for that reservoir appeared too rocky. The next favourable site was owned by a household that refused to have the reservoirs on their land. So a third site for the reservoirs was selected. The household owning that site got a tap near their house as compensation for keeping an eye on the storage. In the whole of Ga Moela, 14 new taps were proposed.

The MUS Forum also proposed the School Governing Board of the Ntshitshimale Primary School in Ga Pudi to extend their borehole to the surrounding households. However, the school governing board refused. So the plan for this section was limited to the repair of the hand pump. The repair was finalized after the post-construction survey, so Ga Pudi was not included in the survey sample.

Lastly, similar to Ga Mokgotho, Tsogang also proposed two cattle troughs, one in the Mabusa section and one in Moela section.

3.2.4 Step 4. Fitting the financial framework.

In step four from December 2017 to April 2018, these proposals (and proposals from the other four communities in the MUS project, which had followed a similar participatory planning and design process) were screened and adjusted to fit the project's overall financial framework. This was then translated into contractual arrangements between all parties that stipulated the implementation modalities for procurement of materials and labour. For the technical designs, Tsogang finalized the draft designs, bills of quantities and costs in a draft Scope of Work book for each community, and proposed these from the bottom-up to the national project managers and financiers; - the Water Research Commission and African Water Facility. In various iterations, Tsogang communicated the results of these deliberations, including the final budget allocation to the two (and other four) communities and Work Design Books back to communities. For the procurement of materials, the Water Research Commission was obliged to follow national procurement procedures, so the total cost estimates for materials were tentative. Materials in Ga Mokgotho were budgeted at ZAR 241 530. In Ga Moela, the amount for materials was ZAR 363 097.

For the procurement of labour, all six communities and Tsogang were adamant that communities should do the works. Especially in Ga Moela, community members pointed at earlier negative experiences with outside contractors to underline the argument. The Water Research Commission and African Water Facility supported. The question was whether semi-skilled workers should be remunerated, and if so, how much. All parties preferred following South Africa's employment generation programs and to pay modest 'stipends' of ZAR 90 per day, *not* 'wages'. Once the Water Research Commission had approved this, Tsogang divided all works in the designs into 'tasks' that corresponded with one day of work. Digging a trench of six meters length, 70 cm depth and 50 cm width was the standard for one task of ZAR 90. Backfilling of that stretch was estimated to cost ZAR 30. For skilled jobs, the costs were estimated as lump sums. In this way, Tsogang calculated total semi-skilled and skilled labour costs for Ga Mokgotho (ZAR 65 250) and Ga Moela (ZAR 158 020). Payment for the works would only be done after completion and quality checks by Tsogang and the MUS Forum.

For handling money, the MUS Forums had to formalize into a legally recognized institution and to open a bank account, co-signed by Tsogang and two MUS forum members. The choice fell on the

'Primary Cooperative' under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005) under the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries. Tax clearance certificates and Broad Based Black Economic Empowerment certificates were also required. The other advantage of this structure was that it enabled community structures to also bid for government tenders. Such successful tendering was expected to render the MUS Forum more sustainable, also for operation and maintenance of the water infrastructure. Thus, the Kgomotso Multipurpose Primary Cooperative Ltd (Ga Mokgotho) and the Phela ke Phele Multipurpose Primary Cooperative Ltd (Ga Moela) were registered by end 2017. This formalization was difficult in Ga Moela. All MUS Forum members were supposed to become Directors of the Primary Cooperative but the MUS Forum's precise composition was unclear. The lack of experience and the resignation of the chairperson and search for replacement caused further delays in opening a bank account. Guidance by Tsogang and learning from the example of Ga Mokgotho were indispensable.

In both communities Tsogang used the new structure for catering purposes of project meetings. In Ga-Mokgotho, the dynamic leadership also used the Primary Cooperative to successfully tender for government assignments. In Ga Moela, this did not happen. In December 2018, Tsogang facilitated two MUS Forum members from Ga Mokgotho and one from Ga Moela to attend a three-day training in tendering skills, facilitated by the Limpopo Economic Development Agency in Fetakgomo-Tubatse Municipality and the CIPC in Burgersfort.

A formal Memorandum of Understanding between Tsogang and each of the two MUS Forums (now officially as Primary Cooperatives) was compiled and signed in April 2018. This specified all works, mutual roles and responsibilities and the amounts for the stipends for the semi-skilled tasks and skilled tasks. In meetings with the MUS Forum and community leaders, Tsogang also explained the budgets. Such transparency was to mitigate the common suspicion that community members involved in development projects 'eat money'.

Last but not least, Tsogang also tried to formalize relations with Sekhukhune District for the combined three communities by compiling a Memorandum of Understanding for approval of the works and hand-over of finalized works to Sekhukhune District Municipality. In Ga Moela, this included the expectation of continued operation and maintenance, more fuel and longer operation hours of the municipal boreholes to enable many more people's access to more water. The district officials reviewed the Memorandum and did not object, but never signed.

3.2.5 Step 5. Implementing

3.2.5.1 Procuring materials

Step 5 of implementation started. Based on the bills of quantities and estimated total price for the three communities in Sekhukhune District, the Water Research Commission proceeded to procure materials, following the national government procedures. In March 2018, WRC issued a Request for Quotations to suppliers in Sekhukhune District. However, the winning supplier appeared to need a loan. This took time, so he only delivered materials in June in Ga Mokgotho. For Ga Moela, the supplier appeared unfamiliar with the area and he underestimated the rocky, steep access road to Ga Moela. Other transporters had to be mobilized, which took till July.

At delivery, Tsogang checked the quality and signed off. Materials were safely stored at the chief's kraal. Tsogang and local transporters assisted in transporting construction materials such as cement, cement blocks, pipes and tools to the construction sites, either voluntarily or as a task for a stipend. However, in Ga Mokgotho the two intakes in the streams were inaccessible by car, so workers had to carry those materials by foot.

At a meeting in August that Tsogang had organized for the three demonstration communities in Sekhukhune District, communities looked back at their experiences with procurement. Feeling side-lined by national procurement, they proposed the opening up of procurement for communities or local enterprises or agencies as well. Locally available materials can be cheaper and reduce transport costs. In Ga Mokgotho the supplier delivered river sand and building sand from 200 km distance, while sand is locally available at much lower price. Also, communities know the local road conditions and can immediately provide appropriate transport. Local procurement would further strengthen contacts and inform community members where to get spares during operation and maintenance of systems. Moreover, this would have saved money. A comparison of the prices that WRC paid to the suppliers and Tsogang's quotations for local on-the-shelves prices of the same materials: the supplier's mark-up was 12% in Ga Mokgotho and 4% in Ga Moela.

3.2.5.2 Recruiting

In April 2018, in preparation for the construction works, Tsogang gave a five-day technical training to MUS Forum members in Ga Mokgotho and Ga Moela. Themes included reading and interpreting drawings, identifying different types of pipes, pipe laying, excavation and back filling process, checking the scope of work against materials requested, and Occupational Health and Safety and First Aid. Tsogang exposed cultural beliefs and habits that disadvantaged women. Women found it interesting to learn new things about water resources they previously thought that only men need to know.

Tsogang left the procedures to recruit workers in the hands of the MUS Forums and local leaders, providing they would include women. After intensive discussions in Ga Mokgotho, it was decided to call for a mass meeting and put yes/no cards in a hat for participants to pick. Ga Moela followed the same procedure. Almost all resident who were available attended that mass meeting. Even though the majority of the participating respondents drew a 'no' card, the process was unanimously seen as fair. A respondent in Ga Mokgotho even suggested that 'this method must be adopted worldwide'. Some who drew a 'no' card voluntarily helped. Family members also helped, in some cases also for remuneration. MUS Forum members did not follow this procedure and took up tasks as each of them saw fit.

Even at the recruitment meeting, Tsogang and the MUS forum kept managing expectations about remuneration by emphasizing that they needed 'volunteers'. The main reward of the works would be the community's improved access to water. One respondent in Ga Mokgotho who did not attend the mass meeting was unhappy about that: 'I did not know that recruited people would be paid and I thought they were just volunteers; hence I was confused'.

The recruitment was different for the skilled masons, fence installers, welders, and plumbers that were to fence springs or build intakes with filter boxes, valve-boxes, concrete slabs and animal troughs, and, in Ga Moela, also foundations and erection of the steel stands and installation of the big jojo storage tanks. For these tasks, Tsogang and MUS forum members invited local builders and explained technical designs. Then, builders submitted quotations as total lump sums. Tsogang and MUS Forum members inspected their previous works for quality control. Skilled workers were also paid upon satisfactory completion of the works. However, in Ga Moela, only the few artisans who had worked on the initial Tawaneng system were available, so builders from Ga-Mokgotho were invited to build and train workers of Ga Moela on site.

These procedures often led to lower quotations than the estimated tasks and lump sums on the construction budget, so money was saved from the fixed amount allocated. This gave some flexibility to adjust designs and expenditures for materials or other costs. Accordingly, in both communities Tsogang held budget discussions with (part of) the MUS Forum members on how much money was saved and, hence, available for other local expenditures.

Parallel to the recruitment of workers, both MUS Forums selected the beneficiaries of the household jojo storage tanks in collaboration with the ward committee and tribal authorities. Tsogang instructed them on how to operate, clean and maintain their new jojo's.

3.2.5.3 Constructing

Construction was swift: all main works were finalized and ready for testing by November 2018. MUS Forum members guided the organization in groups, marking of sites and recording. Tsogang regularly supervised, trained, participated in works ('to show that we are not commanding') and inspected works at key moments, such as connection of pipes, or remained on site for more complex works. Designs were flexibly adjusted when new opportunities arose (for example, in Ga Mokgotho a 100 m shorter route was found for the planned 1450 m long pipe line from the source to the reservoir) or when obstacles were encountered (in Ga Moela, for example, some soil was rocky and warranted galvanized pipes instead of polyethylene pipes). Also, in both communities, negotiations about the siting of taps continued.

Design documents and drawings for Ga Moela and Ga Mokgotho are attached as **Appendices 1 and 2** respectively.

In Ga Mokgotho, the survey respondents who had been lucky to pick a 'yes' card mentioned how they learnt to excavate trenches, laying pipes, backfill, and connect pipes of gradually reduced diameter. The number of days and stipends received varied from 1 to 30 days and ZAR 30 to ZAR 1000. All workers mentioned how they liked learning new things; team work; the purpose of water provision; but also that 'when you dig deep, pipes will be cold as compared to surface pipes which will give hot water'. Explicitly probing for any disadvantages, they mentioned in order of frequency: payment rates 'below the national employment act'; lack of sufficient personal protective equipment; late payment; and preference for payment in workers' bank account over cash payment 'to avoid theft'. A MUS Forum member thought the payment rates were generally accepted, laughingly commenting: 'we had no strikes'.

The semi-skilled workers in Ga Moela expressed similar views in the survey. They appreciated both the stipend and learning excavating trenches, laying pipes, connecting pipes, back filling, or joining taps. Probing what respondents liked least, some said they liked everything. Others mentioned that the stipend should have been ZAR 120 per task or that there was no protective clothing. One complained 'my back would hurt'. Another remark was that machines are more effective to dig trenches than manual labour. Payment to bank accounts was seen as safest and easiest, but this was delayed because the MUS Forum member who was bank signatory inadvertently used a different signature on the bank cheque. In that instance Tsogang organized the payments in cash.

As a result, in Ga Mokgotho, 58 semi-skilled and skilled workers had employment for total stipends of ZAR 61 500. Semi-skilled person days employment generated was 485 days. In Ga Moela, 38 semi-skilled and skilled workers had employment for ZAR 124 890. Semi-skilled person days generated were 1025 days. One MUS Forum member told he had earned ZAR 8000 in total. In both communities, women and men unanimously emphasized that there was no difference whatsoever between women or men doing the semi-skilled jobs.

3.2.5.4 Testing and starting operation

By November 2018 works were completed and water should start flowing. For such operation, Tsogang held a five-day training for MUS Forum members of all three communities in Sekhukhune in Ga-Mokgotho from 20-25 January 2019. Topics included: knowledge of environmental health and community hygiene practices, water quality, climate change, operation & maintenance, and basic bookkeeping. Moreover, in Ga Mokgotho MUS Forum members and others received training in homestead cultivation and seeds.

In Ga Mokgotho, the refurbished system started functioning from November 2018. However, the higher volumes that entered the reservoir and longer storage for the new rotation caused a crack to develop. Tsogang rapidly repaired. However, the plan to organize yard connections instead of street taps and ensure connections would be leak-free, never materialized. There were no local champions to initiate such a process.

In Ga Moela, unfortunately, technical problems arose. The construction of the new reservoir and reticulation in Mabusa/Moela went well and was ready for testing. However, the diesel pump broke down. After a while, the municipality found out the causes: it needed servicing and replacement of a drive belt. Instead of further waiting, the users of the pump at that time collected money to buy the belt themselves for ZAR 20 per household. The municipality sent people to repair the belt. Then, the new Mabusa/Moela storage and reticulation system was ready for testing.

Two problems came up during the testing. One was that the steel stands of the big jojo tanks started bending once the jojo's filled up. The materials delivered appeared of too low quality. Tsogang organized the welding of additional steel bracing to achieve the required reinforcement. The second problem was that the diesel pump appeared too weak to fill the new storage. Tsogang installed an additional electric booster pump half way to help push water from the pump up to the storage. The electricity line was temporarily linked to a volunteering household nearby. This required the users to mobilize money to buy prepaid electricity, each for ZAR 10 per household. The MUS Forum submitted a request to ESKOM (the national electricity company) for a new communal line, but by the time of the survey there was no response as yet. By then, the system had been operating three to four times, mainly for testing purposes. Hence, the survey in most of the Mabusa and Moela sections assessed the impacts of these instances of water supplies.

In Letlabela, the construction of the new storage and reticulation system and the final connections in the Tawaneng section also went well (see **Figure 13**).

Figure 13 New storage in Letlabela section, Ga Moela (photo credit Tsogang)

From December 2018 water started flowing. Without diesel from the municipality, both sections collected money to buy diesel so that the voluntary pump operator from the Tawaneng section could operate the pump. She did from December onwards. However, the pump stopped working mid-March 2019. The satellite office found that the generator had broken down. However, after repairing the generator, the pump itself did not work. In September 2019, after five months, the municipality replaced the diesel engine by a petrol engine, intending replacement by an electric motor at a later date. The satellite office reported that the municipality had ordered petrol, but that it had not been delivered as yet. (It explained to Tsogang, but not to the community, that the approval of the shift from diesel for diesel pumps to petrol for petrol pumps took time). The Tawaneng section decided to take up collecting funds again and to buy petrol, as it had often done before. Urgent water needs for a funeral triggered the initiative. However, such collective action remained absent in the Letlabela section, for whom the system and required organization was still new. One argument was that the municipality would stop providing fuel when it saw that communities could organize themselves. So the survey in October 2019 in Letlabela and Tawaneng assessed impacts of the MUS project by asking respondents to compare post-construction water uses during the period that the system was working in early 2019 with the pre-project situation.

The following sections present the findings of this comparison between pre- and post-project access to water, livelihood benefits and views on the overall process. The presentation of findings for both communities is separated as appropriate.

3.3 Improved access to water in Ga Mokgotho

3.3.1 More water

In Ga Mokgotho the average volumes per household per week increased from 733 litres per household per week in 2018 to 1138 litres on average without the project's jojo beneficiaries (55%), and to 1305 litres per household per week (so 78%) if the jojo beneficiaries were also included.

For 88% of respondents (52 out of 59) the communal system was their primary source. Among them, almost everyone noted at least one, but often a range of tangible improvements in their water supplies this year (2019) compared to a year ago (2018). Almost everyone mentioned that there is more water with higher pressure this year. One respondent even commented: 'We never perceived such tremendous pressure could be possible in the Ga-Mokgotho community'. Improvements in water quality were noticed as well (see below under domestic uses). Even six households who maintained the same quantities of water used emphasized other advantages compared to the 2018 situation: 'higher pressure', 'more reliable', and 'somewhere to go for complaints'. Only one respondent mentioned advantages and one disadvantage: the tap had been relocated to a more distant place. One household located in a valley saw no change because it always had enough water.

For 7 out of the 52 households that primarily depended on the communal system, this was their only source. All other households with the communal system as primary source also had a secondary source. The MUS project also improved those other sources. Secondary sources were most often water from a neighbour with a private pipe or, in one case, with a borehole. Only few owned a private gravity pipe as secondary source. Thanks to the improved communal system, households were relieved as they could stop asking their neighbours for water, or, as one respondent admitted her earlier behaviour: to steal water from neighbours. It also relieved the households with private self-supplies that neighbours stopped asking for their water. The water vendor at the tail-end of Sethogeng, where three new taps were placed, lost most of his customers in that way.

Out of the 12% of the remaining households in the sample with another primary source than the communal system (so 7 out of 59), two households still benefited: they kept their private pipes as primary source, but started using the new communal tap as secondary source. Moreover, one of these household shifted their private gravity pipe to tap into the stream where the main reservoir overflows. Two other households owned boreholes with sufficient water. They were uphill where the communal system cannot reach. The other three respondents did not see any benefit of the MUS project. They were still dependent on private pipe owners or neighbours. In one case the communal system supply under her tap became unreliable so she continued to depend on her neighbour's private pipe as primary source and the communal system at best as secondary source. Another respondent complained that the MUS project 'like all earlier water projects' had not resolved her problem that her neighbours refused to share water of the communal system with her. Both had reported their problems to the MUS forum, but without any results. The third household had just arrived in the community and got a distant stand where the system did not reach.

3.3.2 More reliable and equal operation

Asked about the details of these improvements, both technical and institutional improvements were cited. Technical improvements were that the taps were nearer to the house, new and of better quality.

Blocked and leaking taps were repaired. There were also more and bigger pipes of better quality. Respondents also noticed the new operational arrangements. A new operator, who had also been involved in the construction of the system in 2007, had come forward. He managed water supplies from the intakes at the streams to the main reservoir and from the reservoir to the three lines. He closed the three reticulation lines at night, so storage built up and opened water to the three reticulation lines during the day. Each day, two lines got a full supply, and one line got half. The line that got half of the supply rotated over the three lines during three consecutive days.

There are two or three segments within each of the reticulation lines. The MUS Forum included community members of each segment to operate the valves for that segment. However, when there is a function or ceremony in the community, water has to be supplied to that location. Seventy-one percent of respondents knew to which of the three supply lines their household belonged. For their own line, 90% of respondents who used the communal system as their primary source reported to know about the rotation schedule of getting water: this was every five days in parts of the middle reticulation line or every two to three alternate days in the other two lines. Some noted how all sections in the line were open on Sundays. For the remaining 10%, water still came as a surprise; they checked the tap to see, or heard whether there was water. A few households mentioned continued access to at least some water in their lines. Only two households did not notice any difference in reliability compared to last year.

Respondents appreciated this predictability and reliability compared to 2018, when water would not come for up to two weeks or a month, and when there was no-one to report to. 'The rotational supply of water is different than last year…it is more reliable in 2019 and I get water according to what was promised'. Most also remarked how the distribution across the three lines and across the segments within the lines was fair and equal, unlike before when some sections in the community were advantaged. 'The old operator did favouritism in water supply, now no such things take place and everyone has equal water rights', 'illegal connections are stopped and everything is transparent now'. 'We now share water properly without conflict and if there are problems, we report to the MUS forum'. In sum: 'In 2018 there was no water and no water committee; now there is more water and reliable water'. 'Now random people cannot open valves and hence we get more water more reliably'.

The only overall negative comment came from an independent household with self-supply. To this respondent, the former pump operator had been better in all respects. One other respondent also felt that the community could have benefitted more from his technical knowledge.

Explicitly probing whether the respondent saw any disadvantage of the MUS project's technical and institutional changes, less than a quarter could find one. Most of them regretted that there were still no household connections. 'The project should help install household connections and then we all can be responsible for maintenance and fixing it ourselves'. One called this 'an empty promise'. Disadvantages that were mentioned by one respondent only were: insufficient improvements in pressure, rotation, tap repair, or tap location.

3.3.3 Maintenance, repairs and upgrades

By the time of the survey, no breakdowns of taps or reticulation lines had happened as yet. Nevertheless, respondents were aware and cited their responsibilities for maintenance and repairs. When taps break down, the households sharing the tap should inform the MUS forum to organize somebody to fix and they will contribute money for somebody to go and buy the required equipment or components. They expect that person to show a receipt as proof of expenditure. In case of a breakdown of the reticulation line, a similar procedure is envisaged. All users of that line have to contribute. The MUS Forum members who operate the reticulation line, the operator, and in all cases the MUS Forum chair were seen as vital in these arrangements. Especially the MUS Forum chair 'is the one who knows what has to be done', and the last resort if households and MUS forum members cannot solve a problem.

The chair also catalysed the further improvements and expansions of the system to accommodate new sections in this growing community. Encouraged by Tsogang and on behalf of the Primary Cooperative and in collaboration with the ward councillor, the chair of the MUS Forum continued writing letters to request materials to the Area Manager of the water division of the Fetakgomo/Greater Tubatse Local Municipality in Burgersfort. In 2018, his request of a value of ZAR 110 658 was successful for two jojo's of 10,000 litres, pipes and other materials to extend the small steel reservoir. A second request was submitted a year later, in September 2019, for four jojo's of 10,000 litres, pipes and other material that would use the current overflow of the main storage reservoir. In these extensions, future users helped digging and connecting voluntarily.

3.4 Improved access to water in Ga Moela

3.4.1 More, closer and cleaner water

Respondents in Ga Moela also reported positive changes. As many new taps had been installed, the survey also included questions about change in time required for water fetching. On average, the quantities used per household per week for all respondents in 2018 was 613 litres, taking 9,5 hours per household per week. After construction, the average for respondents, excluding jojo beneficiaries, moved to 965 litres per household per week (so 57%), taking only 4,1 hours per week. Inclusion of the jojo beneficiaries increased the average of volumes used to 1167 litres per household per week (so 90%). Time requirements were similar: 4.3 hours per week.

For 79% of respondents the system was a new source. All were happy about: the new infrastructure of closer taps, the (good quality) pipes and the new communal storage: 'We are pleased as water is near and we do not have to carry buckets over a long distance anymore for fresh and clean water'. 'We store more water, do not travel far for water and do not have to depend on wells and buying water anymore'. For all households, the time required to fetch water also decreased. This also held for two of the three respondents that already had connections to taps and boreholes (two in Tawaneng and the congregation in Mabusa). The third household already accessed the public tap in 2018, at 40 minutes walking distance. This household spent as much time post-construction as before but stored more than three times the quantities of water.

Probing for any disadvantages, almost half did not see any disadvantage. The others had just wanted further improvements: regular continuous supplies; more communal storage; steel pipes; more and closer taps; sharing a tap with just one other household, so no long queuing; or, as always, the most preferred: a household connection. Also, some households were dissatisfied about the location of taps. One of them noted how during the participatory design the tap was located in-between her household and that of the chief, but, during construction, that tap had suddenly moved nearer to the chief's premises, where a new storage tank to provide the Moela section had been installed.

All households with access to the communal system as their primary source kept hand-dug wells or rivers as secondary sources. Water purchase also remained a secondary source, especially for events. The water vendor in Tawaneng benefited from the extension of the pipe to a tap near his house. He acknowledged that he lost business, but, overall, he was pleased, emphasizing that 'it is good that other people do not suffer'.

The remaining 21% of randomly sampled respondents did not use the new system. They lived far from the taps, at the bottom or top of slopes and they had access, with or without a gravity pipe, to nearer hand-dug wells or a perennial stream. One third of these households were satisfied with the situation. However, the others would have liked to get connected to the new communal system through a new, nearer tap or by using a hose pipe from a tap. Moreover, they were worried about the increasing use of their current hand-dug wells and streams, which might dry up. Then, the groundwater-fed communal system would become the community's only available water source.

3.4.2 Pump operation and maintenance and water distribution

Pumps posed problems in Ga Moela. For the Tawaneng/Letlabela borehole, users had to arrange for fuel and an operator. This worked in Tawaneng. There, the water users managed to appoint a volunteer operator and to raise funding for fuel. The pump operated twice a week (mostly Saturday and Tuesday) to fill the two big jojo storage tanks. The next day the valve operators, who were well known, opened the valves but only till 17:00 hrs to save water. Or people heard when the pump was working and knew that there would be water the next day. Or neighbours told that there was water in the tap.

However, in Letlabela, fund raising and buying fuel to give to the volunteer pump operator worked in the first few months, but was not taken up again when the municipality had repaired the pump (but did not provide petrol as yet). People reverted to their alternatives of hand-dug wells and streams. Various factors played a role. Unlike Tawaneng, their experience in collecting money for fuel had been a few months only. Collecting money was felt to be embarrassing (as also testified by the household in Mabusa that temporarily provided the electricity and was designated to collect money there). When users refused to pay, it created conflicts. However, non-paying neighbours could hardly be excluded from using a communal tap as sanction for non-payment.

The initial rule in Letlabela was that each household had to pay ZAR 20 per month but this ignored family size, or the living together of two or more related small households in one compound. Also, the poorest households could not afford this amount. Last but not least, the municipality's promise to bring fuel, as they saw also happening in the Mabusa/Moela borehole, further discouraged efforts to solve these problems intrinsic to collective action. Some water users preferred waiting for the municipality, while others were tired of waiting and were willing to start contributing.

For the Mabusa/Moela pump, the municipality provided fuel, paid the pump operator and maintained the pump – although, as mentioned above, repair was so slow that the few users at the time decided to solve that problem themselves. The segment of the congregation was well served. However, with the same problems around fund mobilization for the booster pump and without an independent electricity line, the new Mabusa/Moela segment had hardly been operated as yet. Water still came as a surprise. Respondents referred to a few MUS forum members who operated the valves, but realized: ‘a local committee needs to be formed to decide when we can get water and to help the operator to check for storage and tap maintenance’. ‘With time we will know who takes charge’. The chief was hesitant to get involved because the system was still new and Tsogang and MUS Forum members were still working on it. However, he confirmed: ‘if the management of water supply is not resolved at short term I will get involved as custodian of community’. Respondents, including the chief, also awaited Tsogang to catalyse the last step towards a collective authority to set and implement rules for collective operation and future maintenance.

When probing for any disadvantages of the new system, no respondent complained about payment of the ZAR 10 or ZAR 20 for diesel or petrol (Tawaneng/Letlabela borehole) or electricity (Mabusa/Moela booster pump). However, respondents noted how payment instilled a strong need to use water efficiently, and, for example, reduce hours of water distribution in Tawaneng. Intrinsic problems of internal organization for fund raising and the municipality’s lack of clarity on its commitments seemed more important.

Not surprisingly, in the relationship between the municipality and the community, respondents’ preferred way to solve these problems would be ‘more fuel from the municipality to allow better access for all’. Respondents knew the two pump operators and saw how they served as communication channel between the community members and the municipality, but also saw that they had not much power either to make the municipality move. Lack of clarity by the municipality on when promises could realistically be met aggravated the limbo in which some people still waited and, therefore, hindered those who were willing to organize and raise funds.

3.5 Sharing taps in both communities

In both communities users had to share street taps with an average of 4,1 households (Ga Mokgotho) or 4,3 households (Ga Moela). Qualitative interviews highlighted the many similarities in both communities in the informal organization of such lowest-level water distribution and maintenance and repair of broken taps. Water sharing was not only time consuming but often also a conflict-ridden zero-sum game: ‘If someone uses the tap for a longer period this provides less water for the other’. Ga Moela’s costs of pumping were a further incentive for diligent water sharing. There were various rules for ‘fair and equal’ sharing, but rules were not necessarily implemented.

Physical factors influenced the sharing of scarce water in the taps. The physical location of taps and distance to the house favoured the household closest to the tap. ‘The household closest to tap gets more water and does not have to queue’. This easily created jealousies, even if those households ‘tried to ensure that downstream users get their fair share’, or took the responsibility ‘to keep an eye’. Water distribution further depended on how water was transported: carried by foot in 20 litres containers (the most common arrangement in Ga Moela) or in wheel barrows (hardly possible on the rocky terrain in Ga Moela) or by connecting pipes to taps (or neighbours) at a higher elevation so water would flow by gravity (as most respondents in Ga Mokgotho did). As water supplies rotated over two, if not more days, households’ storage capacity had a strong, if not the strongest influence on volumes of water taken.

In addition to these physical factors, the most common way to distribute water was by agreeing on turns. Turns could be based on a range of considerations. The simplest was first-come-first-served. That person could either take water as long as she or he needed. Or, certainly in Ga Moela, the common rule was 'first some for all'. One respondent commented: 'No one fills a lot of containers when others are waiting to fetch water'. Another respondent specified: 'Priority is given to those who have smaller containers'. So, a water fetcher could only take a certain quantity (1, 2 or 5 containers, and in one case a 210 litres drum). Then, they had to give the turn to the next one so that all got that minimum quantity first. After everyone had their turn, households could come for a second or third round.

With reliable rotational water availability in the taps, which was the case in Ga Mokgotho, turns could also be fixed on certain times of the day or certain days, so one (part of a) day was for one or several households and the next part or day for others. Turns on the same day ranged from one to five hours per turn. If there was no queuing, it was good practice that someone who finished her or his turn notified the next household that the tap was available again. It was forbidden to just remove a hosepipe connected to the tap. One should first communicate with the owner of the pipe.

Sharing arrangements were based on volumes and less on a person's water needs. Larger families, for example, had to abide to the 'some for all' rule in Ga Moela. A respondent clarified: 'I live alone so I do not queue for many rounds and I am ok compared to those who have to go for more rounds'. Similarly, it was seen as everybody's right to decide whether to use water for domestic uses, livestock, irrigation or otherwise. For example, one respondent filled all storage and continued to irrigate, and only then handed the tap over to the next household. Exceptionally, respondents in both communities invoked a particular use (water for irrigation, livestock, or brick making) as having a lower priority than everyone's access to sufficient water specifically for domestic uses first. Only one respondent referred to water quality concerns and clarified that river water can be used for irrigation. Nevertheless, especially in Ga Moela limited and costly water available stifled irrigation, which they would have desired. 'I need to have water from the tap regularly so that I can start irrigating'

Even when households agreed about rules for sharing, rules were not necessarily implemented. 'Some households take water for more than two hours'. A respondent in Ga Mokgotho narrated: 'One neighbour just puts her hosepipe. I tried so many times to confront her, but after some time it was the same problem again. Now I do not talk at all with her anymore. Two of the other four households that share our tap also confronted her without results. The other two households did not confront her'. A similar story was noted in Tawaneng, Ga Moela. 'When the pipe is in their house, it does not come out'. As the tap closed at 17:00 hrs, this respondent just reverted to the hand-dug well for his domestic water needs, avoiding confrontation.

Another set of rules prohibited water wasting. Taps should be closed. Children should be disciplined and monitored to avoid leakage when they play with taps. Hosepipes should be tightly connected to the tap to avoid leaks. Hosepipes should not be left open on the ground awaiting the moment that water arrives at the tap, because when the water arrives and flows out, it is wasted. Respondents in Ga Moela added how animals in search of water could damage taps, and should, therefore, be kept at a distance. However, these rules were difficult to enforce as well.

As advised by Tsogang, half (Ga Mokgotho) or four fifth (Ga Moela) of the respondents had put a lock on the tap to enforce water sharing rules and avoid leakage. This also avoided theft of the tap cap or damage to the tap by playing kids. It also enabled total closure when pipes had to be repaired. If the number of keys of the locks did not allow every household to keep a key, some households kept the keys and shared with others. Respondents in Ga Mokgotho without locks indicated that the lock was broken; keys were lost; a lock was too expensive; they were still planning to buy a lock; or the available locks did not fit the specific type of steel taps. Two respondents thought that taps should remain open so that people who pass can get water.

Some respondent tried to address breaching of rules at higher organizational levels than the group of households. A respondent in Ga Mokgotho encouraged exposing these issues to the new MUS Forum: 'Some are afraid to raise water issues during community meetings at the tribal. However, people should speak up confidently about their problems to the water committee'. In Tawaneng, the respondent tried to involve the pump operator, but in vain: 'We just keep quiet because it leads to quarrels and conflicts; we told the pump operator but she cannot resolve the issue either so we keep quiet'. The importance of a higher-level community structure to assist in agreeing on rules and enforcing those was felt in Letlabela: immediately after finalizing the new storage and reticulation, one household illegally connected a pipe to her yard. Tsogang invoked the rules against illegal connections of Sekhukhune District Municipality and the MUS Forum reprimanded her. After this, Tsogang changed the tap location and added a tap.

According to all respondents, the only solution to these palpable tensions of water sharing and damage to street taps is yard connections, fed by sufficient supplies, and possibly equipped with meter boxes to measure water use.

3.6 Jojo beneficiaries in both communities

As already indicated above, water uses by the beneficiaries of household jojo's increased even more than for other respondents in both Ga Mokgotho and Ga Moela.

In Ga Mokgotho, the MUS Forum and ward committee selected the 15 beneficiaries based on the list of indigent households maintained by the ward committee. Some of the seven respondents who were jojo beneficiaries had attended meetings and asked for a jojo; for others, it was a surprise. One beneficiary had left Ga-Mokgotho in the meantime; that jojo was stored at the tribal. With year-round reliable water supplies from the communal system, all respondents in the sample who benefitted from a jojo used the jojo as storage, and not for rainwater harvesting. Probing for possible disadvantages, one respondent mentioned how her jojo was constructed near the road, so people would well be able to see. However, people talked and seemed somewhat jealous that she got a jojo instead of them.

In Ga Moela, the chief led the selection of the jojo beneficiaries. He included households that could not be reached by the new reticulation. Half of the jojo's were mainly used for rooftop rainwater harvesting, and half for storage. One respondent beneficiary filled the jojo with water from the nearby stream that provided abundant water and she was happy. However, a respondent living at an elevated site without any nearby water sources did not accept the offer: there was no source sufficiently nearby to fill the jojo. An elderly woman who benefited did not use the tank at all; the jojo was stored at her son's homestead without being used. Lastly, the three most active MUS Forum members also got a jojo. Their jojo's were first allocated to others, but they moved out of the community or otherwise did not need (although other MUS Forum members somewhat complained about this). Two were active farmers and justified having a jojo because this enabled irrigation, in line with the project's aim to promote agricultural water uses. One of them irrigated at her homestead, commenting: 'the jojo changed our lives as we can store water now'. The other put the jojo at his distant field, filling with water from the nearby stream. The third MUS Forum member filled his jojo at his homestead with the gravity pressure of the reticulation system. The only disadvantage of jojo's mentioned was that jojo's without water can crack or fly off due to the wind.

This section presented households' improved water supplies. We now turn to how these increased supplies led to more water uses with multi-purpose infrastructure as the rule. The use, at its turn, enabled more livelihood benefits, as discussed in section 3.8.

3.7 More multiple uses in both communities

3.7.1 Multiple uses

Figure 14 (Ga Mokgotho) and **Figure 15** (Ga Moela) show the respondents' multiple water uses. Only 10% (Ga Mokgotho) and 5% (Ga Moela) of respondents used water from their infrastructure for domestic uses only, whereas 86% (Ga Mokgotho) and 54% (Ga Moela) of households irrigated, with or without watering livestock as well. In Ga Mokgotho 68% used water for livestock; this included the 64% of households using water for all three purposes plus 4% of households using water for domestic uses and livestock. In Ga Moela, with more livestock, 82% of households gave water to livestock (the sum of households using water for three purposes (41%) and households with domestic and livestock uses (also 41%)). (Other water uses, such as brick making, which were less frequent, are discussed further below).

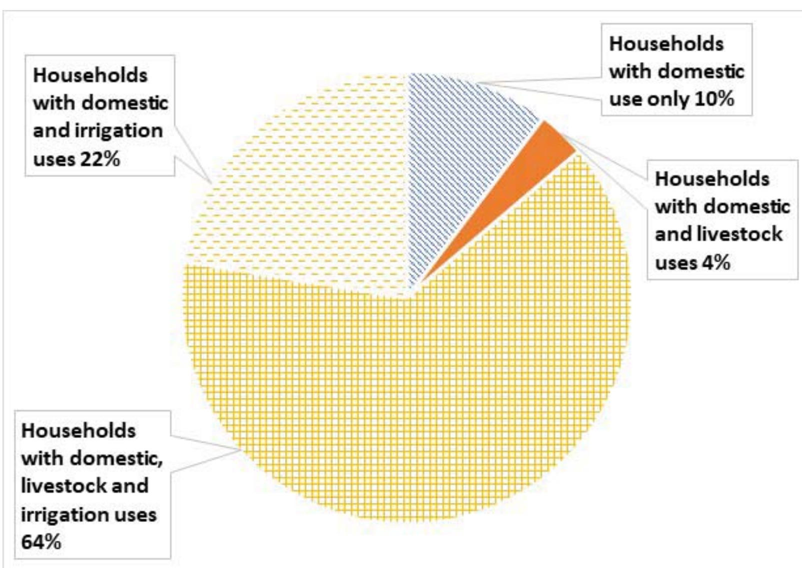

Figure 14 Categories of households by use-pattern (n=59) in Ga Mokgotho

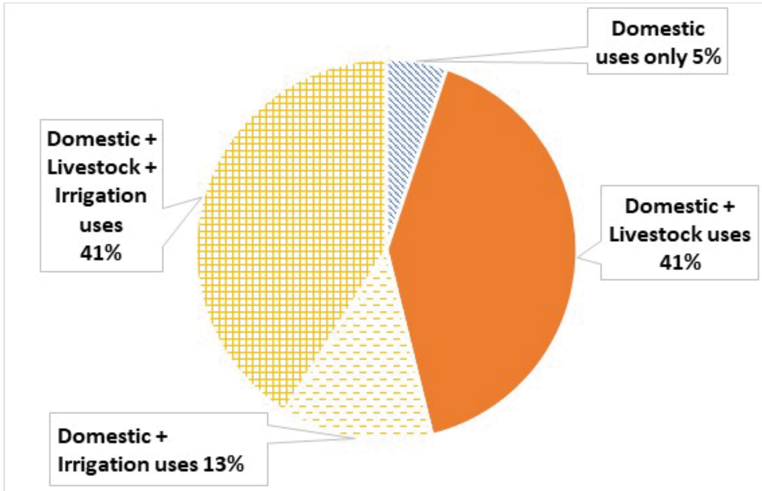

Figure 15 Categories of households by use-pattern (n=39) in Ga Moela

People's multiple needs were met with water from the same infrastructure to homesteads (communal system, private pipes, boreholes). Water was also re-used for livestock and irrigation. In Ga Mokgotho, only four households (7% of all respondents) used one source for one use and another source for another use. Two of these households used the communal system as primary source for domestic uses and a private pipe (owned or from a neighbour) to irrigate. They explained that this avoided the use of the communal system for irrigation, especially when water was scarce and many others needed water as well. The third household did the opposite: she used a pipe connected to the new tap from the communal system to move around to irrigate her yard, and her private pipe that filled a jojo for domestic uses. For similar practical reasons, the fourth exception used the private pipe of her neighbour to irrigate the vegetable plot adjacent to his yard, but her own storage from the communal system for her vegetable plot at the other side of the homestead.

3.7.2 Increased water quantities per use category

In **Figures 16 and 17**, households are grouped according to their multiple uses (domestic only; domestic plus livestock; domestic plus irrigation; or domestic plus livestock plus irrigation). For each category, average quantities per person per day are calculated, as derived from the quantities per household per week and the number of household members, comparing 2018 and 2019. The 2019 averages were calculated both excluding the jojo beneficiaries and including the jojo beneficiaries. This is compared with South Africa's constitutional right to water and the quantities of the Free Basic Water Policy, which are set at 25 litres per capita per day (lpcd). (The analysis excluded a few households without the appropriate data for all uses).

Figure 16 shows, first, that the multiple uses already prevailed in all three categories in 2018 at average water quantities less than the Free Basic Water norm in Ga Mokgotho. Also, the six households that used water only for domestic purposes used *more* water per capita per day than the three multiple-use categories in 2018. The higher water uses of domestic-use-only households continued in 2019 for two multiple-use categories; while quantities used by third category, the domestic-livestock-irrigation category, were comparable.

Second, **Figure 16** also shows that the relative increases in quantities per capita were highest for the irrigating households. Overall quantities used by the jojo beneficiaries were considerably higher in 2019 than in 2018.

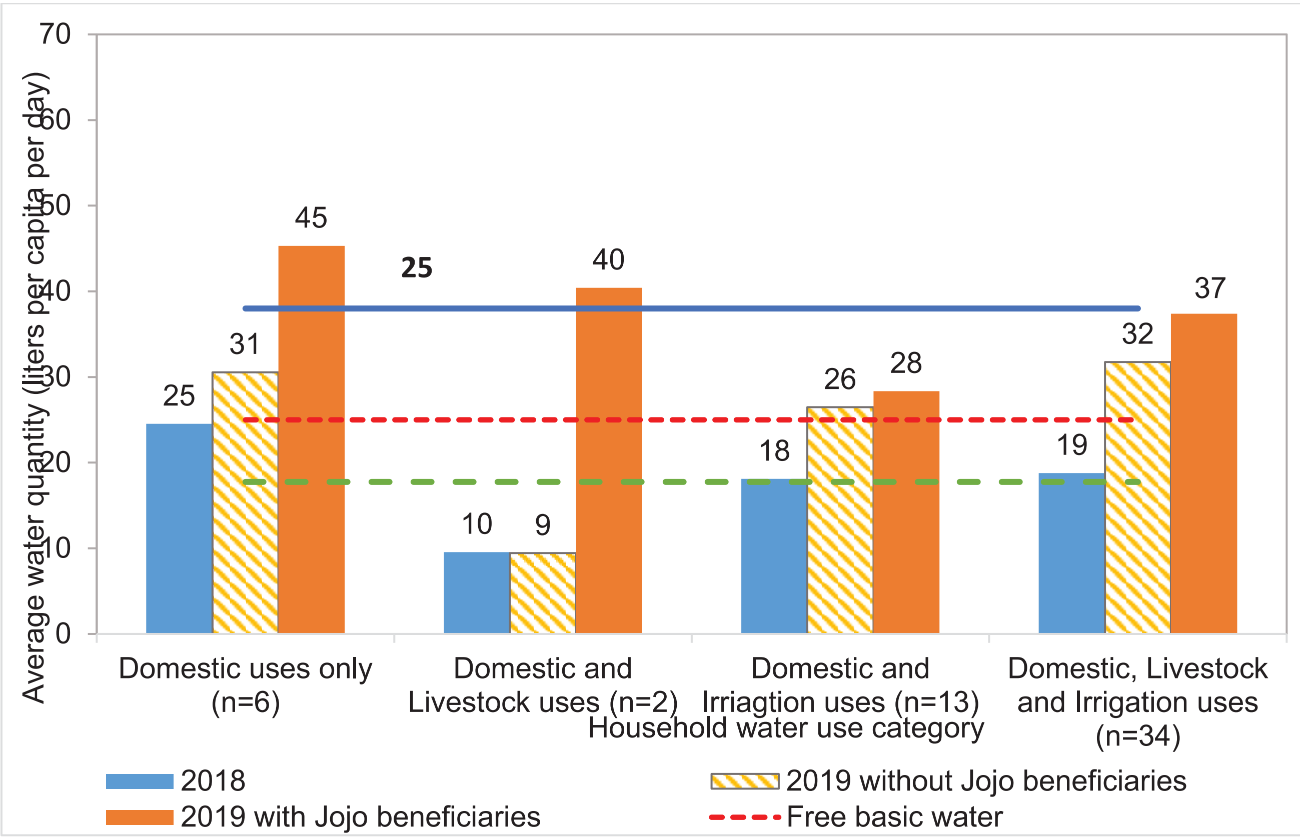

Figure 16 Water quantities (litres per capita per day) used at homesteads by use category in 2018 and 2019 with and without jojo beneficiaries in Ga Mokgotho (n=55)

Figure 17 for Ga Moela also shows how multiple uses took place well below the 25 lpcd for 30 of the 34 households analysed. Unlike Ga Mokgotho, average service levels (for multiple uses) of these 30 households also remained below the 25 lpcd level after construction, except for the jojo beneficiaries of households using water for domestic uses, livestock and irrigation. The quantities used by the four households that irrigated (without livestock) increased most – but their number is small. The impacts of the jojo's on water quantities per person per day were mixed.

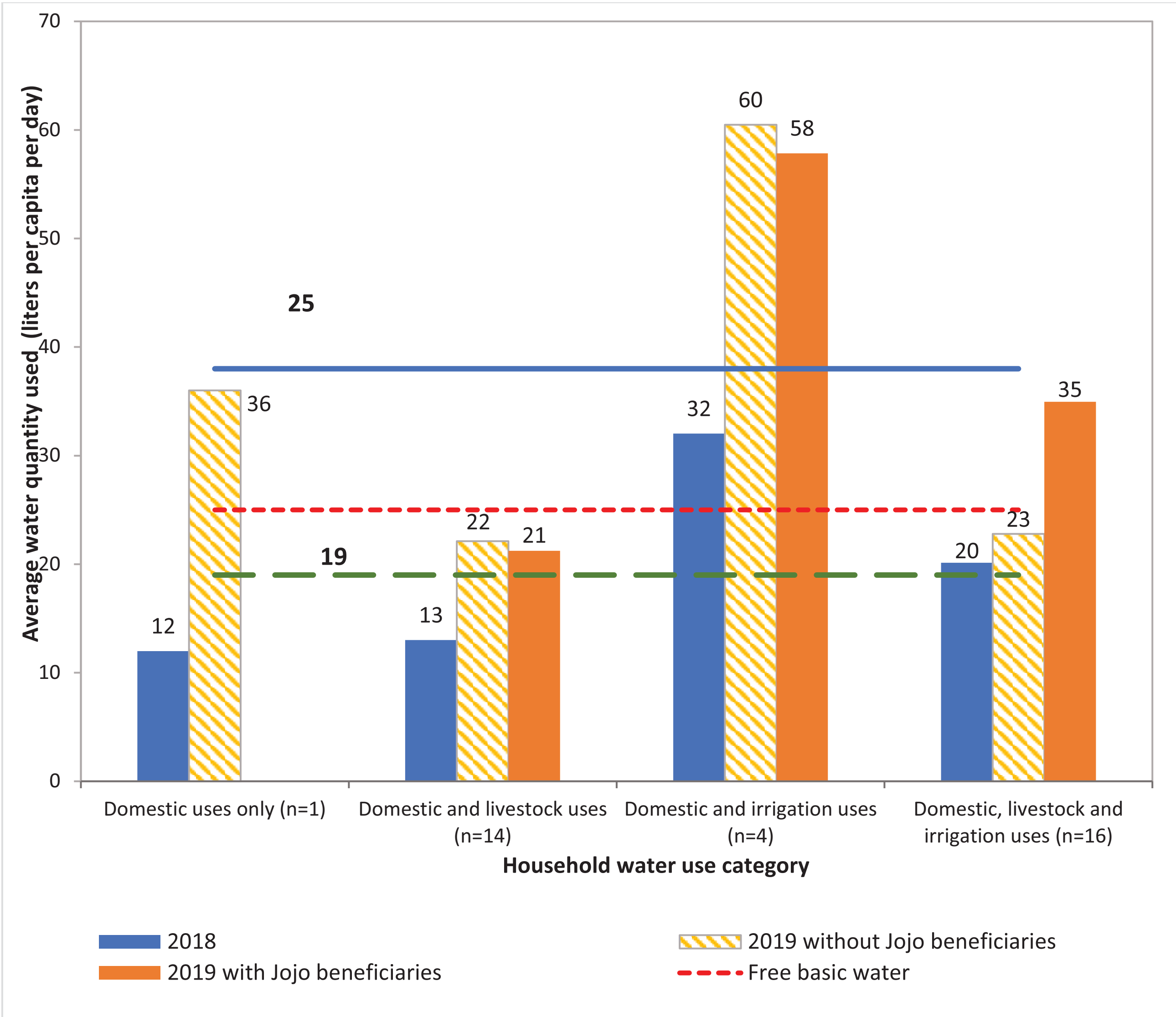

Figure 17 Water quantities (litres per capita per day) used at homesteads by use category in 2018 and 2019 with and without jojo beneficiaries in Ga Moela

Overall, these findings challenge the assumption that water uses up to the threshold of 25 lpcd only meet domestic uses and that multiple uses only start at higher service levels. Instead, in rural areas where people depend in many ways on water, they seek to meet all water needs from small volumes onwards. Second, multi-purpose infrastructure is the most common. The MUS project's recognition of these rural realities was welcomed. One respondent in Ga Mokgotho commented: 'I already had awareness of multiple uses of water and I discussed it with my neighbour. I was happy and amazed that the idea was implemented in my community'.

By improving water supplies and uses, the MUS project generated more multi-faceted wellbeing from these water uses, as reported in 3.8 below.

3.8 Better health, nutrition and income in both communities

3.8.1 Domestic uses: less efforts, more health

Water use to meet domestic needs increased in both communities. All respondents in Ga Mokgotho, except one, reported to use more water for domestic purposes, in particular for washing blankets (‘before only once a year, but now every two months’) and cloths (‘once a week now’), but also for bathing and cleaning floors and windows.

In Ga Moela, the new system became the primary source for drinking and other domestic uses for almost all respondents connected to the system. Less efforts increased quantities used, also for laundry. Whereas households used to walk far to the river or Lerato Secondary School borehole or carried buckets home to wash clothes, after the MUS project they could do at home ‘every week’ or ‘any time’. Only two households still used the well or river as primary source for laundry and bathing. One of them sought ‘to save water from the tap’. The other did not want to confront the household that refused to share. Eight households did both: they did their laundry at the homestead and sometimes took it to a well or river. Two respondents explicitly mentioned the cost savings thanks to the MUS project, because they did not have to buy water anymore even for bathing, at ZAR 170 for four 210 litres drums.

The quality of water for drinking also improved in both communities. In Ga Mokgotho only one fifth of the respondents noted an improvement as the result of the project’s spring protection to avoid debris, cleaning of the reservoir and the high pressure, which made water look whitish. Water was also cooler, so better for health. One household noting the better quality continued treating water. However, one household stopped aloe treatment and another household stopped boiling. The other four fifths of respondents found that the water quality was the same as before. One commented: water can still be brownish with sediments especially in rainy season. Only one of these other households always boiled water.

In contrast, in Ga Moela, respondents were unanimous in reporting a major improvement of water quality ‘not having to share dirty well water with animals anymore’. Two respondents noticed that ‘the pipe has some smell of oil but reduced over time’. One household stopped treating water whereas three households continued putting bleach or vinegar.

During Tsogang’s above-mentioned training of all MUS Forums in Sekhukhune District in January 2019, Tsogang taught about hand washing and water treatment options, including bleach (with a chlorine tester to assess chlorine concentration) and boiling water for drinking. The training also discussed how indigenous filters like sand, rocks and cloth removed physical dirt.

3.8.2 Water for livestock

The watering of livestock also improved in both communities. In Ga Mokgotho, two thirds of the households had one or more types of livestock. Among these households, poultry was the most common (kept by 61% of livestock keeping households), followed by goats (55%) and 34% for cattle. Very few kept cats or dogs. Almost half of them noted a positive change, mostly in available quantity of water. Respondents clarified. ‘This year I could give more water to livestock without thinking twice. Last year the priority was for domestic uses and livestock got less water’. One household noticed how her improved water availability for poultry also attracted more wild pigeons; she eats those. Water quality improved as well. Instead of re-using bath water, cleaner and cooler water was used to fill the cattle drinking containers once every one or two days. Poultry, which had to fend for itself last year, were given water in 2019. The new cattle troughs are the positive change for 11% of livestock owning households. The troughs reduced cattle movement to distant places to graze and drink and, in one household, ‘the cattle only returned home after two weeks’. The troughs also alleviated burdens of giving water to cattle at homesteads.

In Ga Moela, most respondents (82%) had one or more types of livestock, mostly poultry and goats but also cattle, donkeys, and cats and dogs. In 2018, livestock solely depended on the shallow wells, rivers, re-use of water at homesteads or purchased water. The new system enabled a partial shift to the use of cleaner water at homesteads, or for some households the nearer new animal trough, as primary source. The earlier sources continued as secondary sources.

Post-construction, out of the 17 households with cattle, 11 continued to use a distant well or river as their primary source. The cattle of other households drank at the homestead as primary source (three households); both at the homestead and distant source (two); and the new animal trough (one). In seven households, goats continued drinking water from distant sources. Six households gave tap water to their goats at homesteads; two households re-used water. Five households with goats used the new trough as primary source. Poultry directly benefitted from tap water in 17 poultry-keeping households. For one respondent, more and cleaner water contributed to an increase in the number of chickens. Poultry from five households drank from the new trough. Similar sources held for the 13 households with cats and dogs: most households gave tap water. The trough was the primary source in four households.

3.8.3 Irrigation for nutrition and income in Ga Mokgotho

3.8.3.1 More irrigation

Detailed calculations highlighted how irrigation yields in both communities expanded. Starting with all findings in Ga Mokgotho, overall, the improved water supplies boosted irrigation of both fruit trees and vegetables and the planting of new seedlings. Out of the 51 irrigating households in 2019 (86% of total sample) 41 households indicated an increase in water quantities used. In ten of these cases, irrigation was newly taken up in 2019. Eight out of the remaining 10 irrigating households used the same quantities but still noted improvements in water pressure, taps closer and fixed, reliability and frequency of water supply. Also, in 2018, trees were mainly irrigated with bathing or laundry water. Some households removed soap remains by adding ashes. After the improvements, water from the communal system was also directly used to irrigate.

Benefits in homestead irrigation largely accrued to women, as in 68% of households with homestead cultivation, this was managed by women only; in 17% mainly by women; in 9% by both women and men equally, and only in 6% of households with homestead cultivation, this was exclusively managed by men (See **Figure 18**).

Figure 18 New homestead cultivation in Ga Mokgotho (photo credit Barbara van Koppen)

The 14% of the sample households that still did not irrigate in 2019 had diverse reasons for this. In order of frequency of being mentioned, these reasons were: using the communal tap for irrigation may lead to deficiency of water in other communal taps; we irrigate at a distant field instead of the homestead; we are not staying at the homestead all the time because of employment elsewhere, and; I am disabled.

3.8.3.2 Fruit trees

Most households irrigated fruit trees. In order of frequency these were: mango (by 84% of fruit tree growing households), banana, avocado, papaya, orange, guava and peach. Other fruits were pomegranate, grapes, apples, and apricot. Mangos were the most common cash fruit and sold to the achar-manufacturing facility in Ga-Mokgotho or to other markets. A proportion of the mangoes and larger proportions of the other tree fruits were consumed, especially when trees were few and yields low.

At the time of the interviews, which was initial stage of fruit production, respondents reported good growth of the fruits as a result of better watering. For 38 out of the 51 respondents, data collected were sufficiently detailed to compare production in 2018 with estimates of future production. Assuming that weather would remain normal, the total yields harvested in 2018 and estimates for 2019 were calculated as in **Figure 19**. For mangoes as the most important fruit, yields would increase by 36% from 1,267 crates in 2018 to 1,722 crates in 2019. Total yields of all fruit trees (in crates) were expected to move from 1,447 to 2112 crates, an increase of 46%. The unit price of produce increased by an average of 2.8% in 2019 compared to 2018.

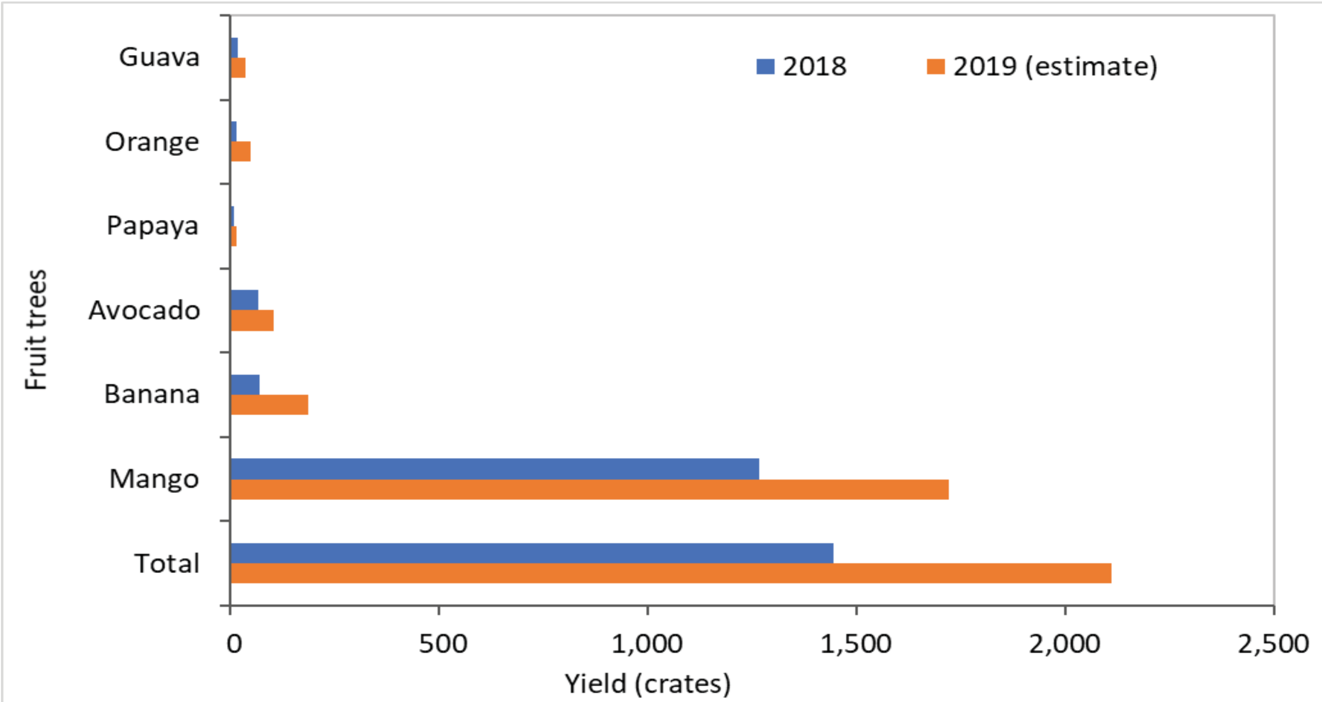

Figure 19 A comparison of yields from fruit trees in Ga Mokgotho in 2018 and 2019 (n=38 households)

As respondents expected prices to slightly increase as well, the aggregate gross market value of all fruit trees yields (so irrespective of their factual use for own consumption and/or sale) is shown in **Figure 20**.

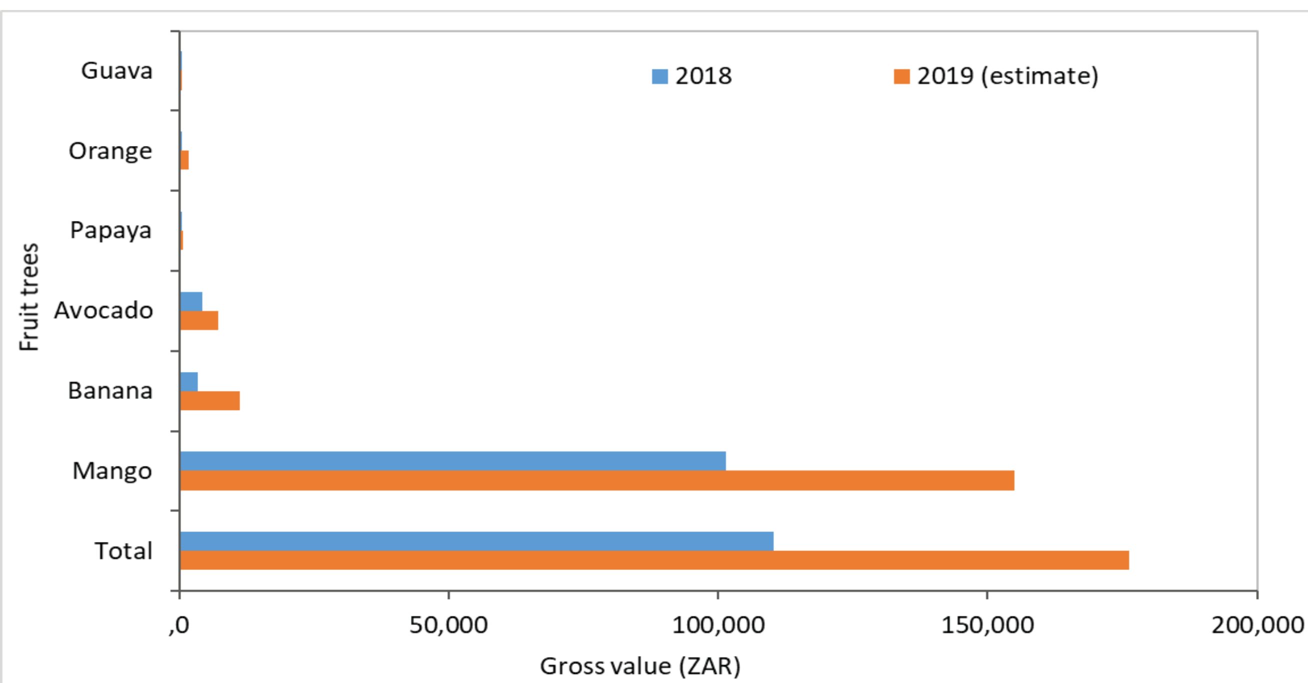

Figure 20 Market value (ZAR) of yield from main fruit trees in Ga Mokgotho in 2018 and 2019 (n=38 households)

Figure 20 shows that the value of mangoes is expected to increase by 53% from ZAR 101 320 in 2018 to ZAR 154 980 in 2019. Total value of all tree fruits was expected to increase by 60% from ZAR 110,300 to ZAR 176,281.

For extrapolation of these findings to all 800 households in Ga Mokgotho, it was assumed that both the 38 households with valid data were representative for all 51 irrigating households and that the randomly selected sample of 59 households were representative for the 800 households of Ga Mokgotho, so 692 households were assumed to irrigate fruit trees. This equals a total value of ZAR 2324123 in 2018 and, with an increase of 60% (ZAR 1389075), a total value of ZAR 3 713 198 in 2019.

3.8.3.3 Vegetables

The other important irrigated crop in Ga Mokgotho was vegetables, in particular spinach, cabbage and onions. Less frequent vegetables were beetroot, butternut, chillies, and lentils. Flowers and sugar cane were rarely grown. Vegetables were exclusively or mainly used for own consumption for improved nutrition. Some households sold vegetables and one respondent started a nursery enterprise.

Based on past yields for groundnuts and on already harvested production or estimated future yields, the yields would increase by 105%, from 959 kg in 2018 to 1,963 kg in 2019. For tomatoes, the calculated increase in yields was 28%, from 48 crates in 2018 to 62 crates in 2019.

Tsogang's pro-active encouragement of irrigation throughout the project steps and their teaching 'how to sell and earn money' were also appreciated. In sum, in addition to better meeting domestic and livestock water needs, more irrigation contributed to higher productivity, better nutrition, food security, and income and to self-esteem, as in the comment: 'We are now a developing community as we have more water for production'.

3.8.4 Irrigation for nutrition and income in Ga Moela

3.8.4.1 More irrigation

In spite of more recent and smaller water supplies at higher costs than in Ga Mokgotho, half of the sampled households in Ga Moela irrigated at their homesteads in 2019. The majority (81%) of these 21 irrigators noted improvements because of the new system, if not the opportunity to start irrigation. Six households used the communal system as primary or only source. Eleven re-used bath or laundry water at homesteads, also benefiting from the larger quantities available. For two of them tap water was the secondary source. The other four irrigating respondents used rivers and streams at their homesteads and/or distant field as primary source. This included the MUS Forum member who used his jojo at his distant field.

Irrigation was mainly or exclusively for own consumption. Only five respondents, including two MUS Forum members with jojo's, mainly sold irrigated produce. Women managed irrigated cultivation in 60% of the cases; men managed in 25%, and both women and men were managers in 15% of the irrigating households.

For all respondents who did not irrigate, the single most important reason was lack of sufficient water for irrigating. Taps were still far. One respondent did not want to re-use water for irrigation.

Moreover, respondents referred to a rule that the communal system should not be used for irrigation. Respondents explained that this was to save fuel for pumping and ensure that everybody gets water. Yet, many expressed a desire to get more fuel from the municipality for more water for irrigation and were interested in further training. A less often cited reason for not irrigating was the lack of fencing: livestock would come and destroy plants.

3.8.4.2 Fruit trees

Most irrigating households irrigated fruit trees. In order of frequency these were: peach, granadilla, grapes, guava, mango, apple, avocado and apricot. At the time of the interviews, which was initial stage of fruit production, respondents reported good growth of the fruits. Based on detailed data from 16 of the 21 irrigating households and on estimates of future production provided normal weather conditions, the total yields harvested in 2018 and estimates for 2019 were calculated (**Figure 21**). The total yields increased by 46% from 280 crates in 2018 to 439 crates in 2019.

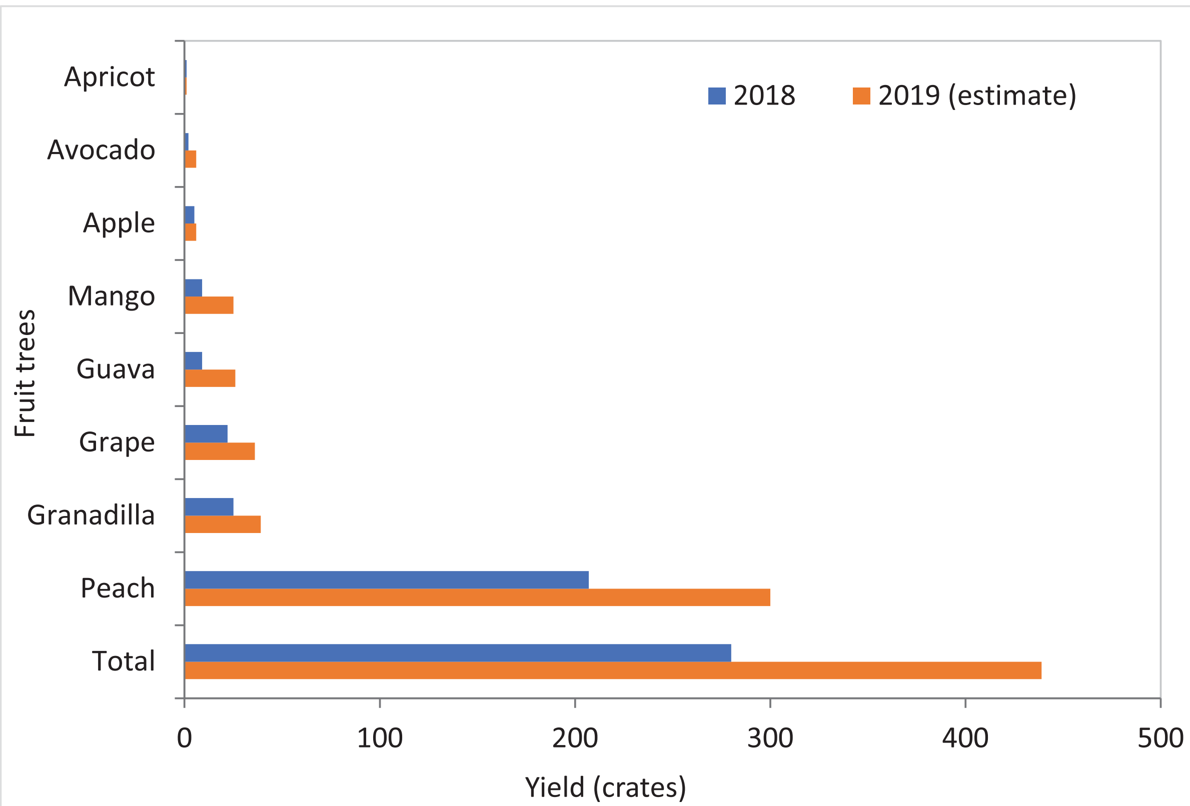

Figure 21 A comparison of total yield of main fruit trees in 2018 and 2019 in Ga Moela (n=16 households)

Figure 22 gives the change in total monetary value for all fruits, irrespective of actual use, based on respondents' given market prices. Calculating the total value of irrigated fruits, this increased by 64% from ZAR 29860 in 2018 to ZAR 48850 in 2019 as a result of improved water availability and price rise. The unit price of produce increased by an average of 3% in 2019 compared to 2018.

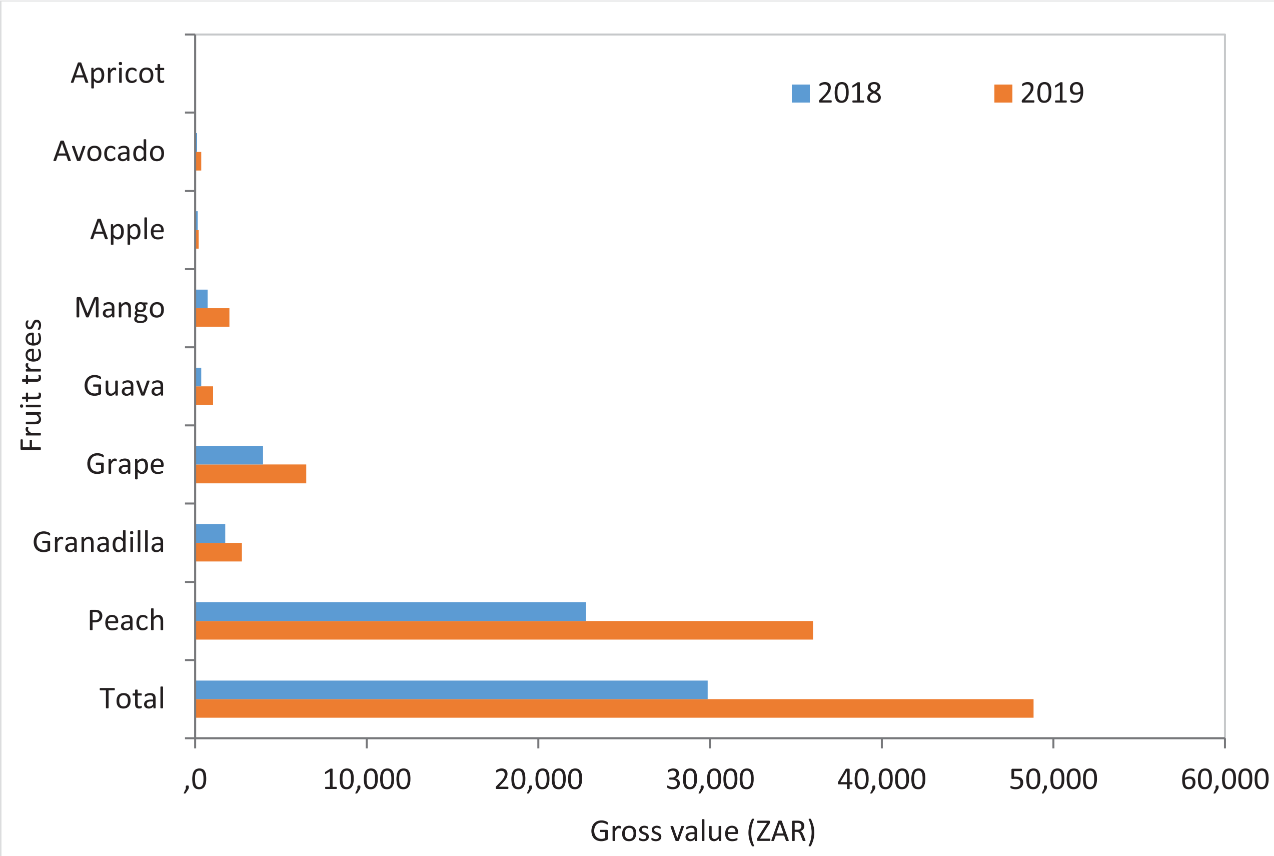

Figure 22 A comparison of the total market value (in ZAR) of yields from main fruit trees in 2018 and 2019 in Ga Moela (n= 16 households)

3.8.4.3 Vegetables

The second most important irrigated crop was vegetables: potato, beans, onion, tomatoes, beetroot, spinach, and carrot and minimal sweet potato. **Figures 23 and 24** are based on data from the same 16 irrigating households. The total yields increased by 34% from 273 crates in 2018 to 366 crates in 2019.

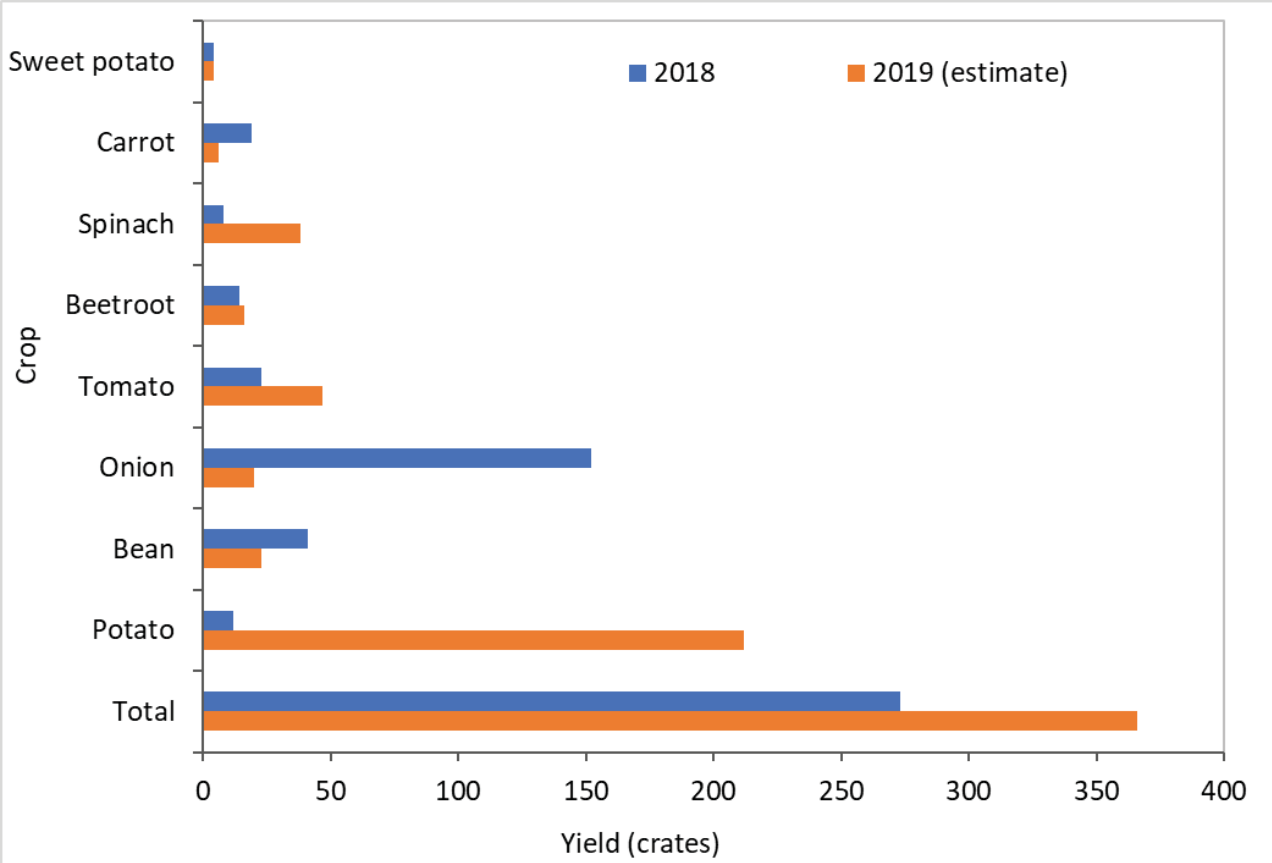

Figure 23 A comparison of the total vegetable yields (in crates) in 2018 and 2019 in Ga Moela (n=16 households)

As above, the monetary value of this produce was also calculated, as shown in **Figure 24**. Especially because of the major increase of profitable potatoes, the total value increased by 95% from ZAR 18930 in 2018 to ZAR 36820 in 2019. The average increase in vegetable produce price was 7.8%, mainly contributed by beetroot and sweet potatoes.

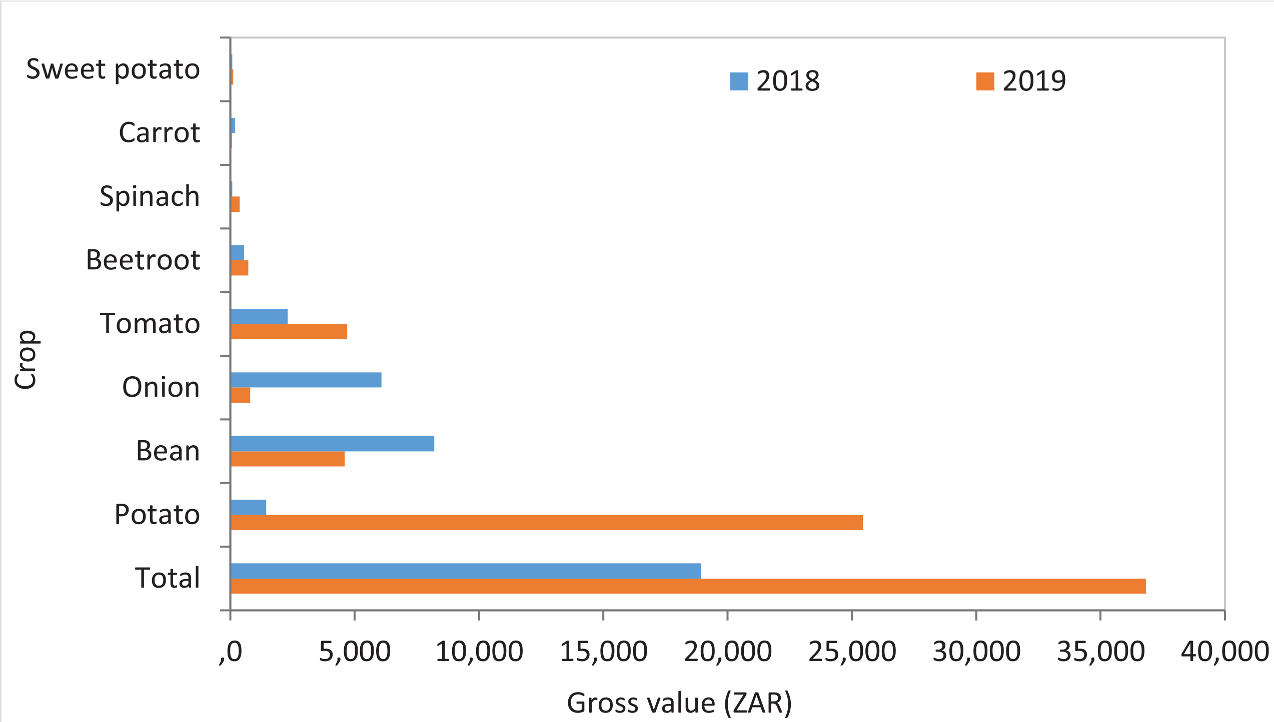

Figure 24 A comparison of the total gross income (in ZAR) from vegetable yield in 2018 and 2019 in Ga Moela (n=16 households)

As for Ga Mokgotho, for the extrapolation of these findings of the value created by irrigation to the entire community of Ga Moela, it was assumed that both the 16 households with valid data were representative for all 21 irrigating households and that the randomly selected sample of 42 households were representative for the 108 households of Ga Moela, so 54 households were assumed to irrigate.

Then, for the whole of Ga Moela community, the irrigation of fruit trees increased the value produced by 64% from ZAR 100778 in 2018 to ZAR 164869 in 2019.

Similarly, for the whole of Ga Moela the irrigation of vegetables increased the value produced by 95% from ZAR 63889 in 2018 to ZAR 124268 in 2019.

Taken the value of irrigated fruit trees and vegetables together, irrigation in 2018 created a value of ZAR 164666. After the MUS project and expected price increases, the estimated value of irrigated produce was ZAR 289136 in 2019. This is an increase of ZAR 124470 or 76%.

In summary, in addition to better meeting domestic and any livestock water needs, more irrigation contributed to higher productivity, better nutrition, food security, and income of an added value of ZAR 124470. Water scarcity remains the main impediment to broader irrigation uptake.

3.8.5 Improved other uses in both communities

In both communities, the new water supplies also improved other uses than domestic uses, watering livestock or irrigation. The most common other water use was brick making for own house construction. Water was also mixed with cow dung for floors, and used to settle dust, and for floor and wall decoration. Further, water continued to be provided to neighbours who may ask for it. Income generation was enabled by using water in tuck shops, making artwork for sale, or selling water.

The next section presents the perceptions of the respondents and MUS Forum members in each community about the process as implemented by Tsogang, also comparing with earlier experiences of interventions managed by contractors; and their views on longer-term co-management with government. The respondents' (positive) evaluation of the MUS Forum itself was presented above.

3.9 User satisfaction in Ga Mokgotho

3.9.1 Process and outcomes

In Ga Mokgotho, respondents and MUS Forum members appreciated the overall process and capacity development, as implemented by Tsogang, was unambiguous: 'they fulfilled their promises'; 'a great job done'. 'In the meetings, Tsogang listened to our thoughts and perceptions. 'They allowed the community to learn by doing themselves', which included: 'working as a team in the community', 'doing things on our own', 'learning to organize and raise community problems and making the community share ideas'. Also, the project, including the participatory mapping, created awareness of, and insights in the importance of water, water reticulation, storage, irrigation, and how to save water and avoid kids tampering with taps. 'The meetings were empowering and educative to us'. The major advantage of this approach was that, once the contractor had left, 'the community can sustain and keep responsibility of the infrastructure and project'. 'A community driven process makes the community stronger'. 'We would not vandalise resources because we worked extremely hard for them'.

The respondents compared the community-driven approach with earlier experiences with contractors. A contractor 'comes and goes'. He 'works on his own terms', 'without the community even benefitting'. A contractor 'does not listen'. He may even 'run away before finishing project'. This negatively affected sustainability: 'Without involving the community in fixing taps, the community cannot do anything itself about a new system when he has gone'. A few other respondents were milder about contractors: 'They can work according to their rules as long as the community gets water and promised results are met'. Nevertheless, 'contractors should at least inform the tribal authority and explain work plan, and be transparent about the process'. The community should also 'talk to contractors to get involved in construction process so that they can learn and maintain the system and infrastructure'.

In sum, in all collaboration with outside support agencies respondents found that the community should *lead* projects, because 'the project is for us'. 'We know our problems, needs and struggles best'.

3.9.2 Future co-management

Exploring respondents' perceptions about communities' and government's respective longer-term roles in water services provision, the most frequently mentioned expectation from government was what still had not been achieved during the MUS project: ensuring a household connection for everyone. Some even expected government to drill boreholes to achieve this. However, one respondent alerted: 'If the government does not help with household connections, the community should help each other'.

The second most common expectation was that government should provide materials to increase water supplies, also tapping into more distant streams; materials for maintenance of the infrastructure; and materials to fence the communal storage. Bigger, galvanized pipes would better prevent leakage. All sections and households should be supplied with water. The provision of individual jojo's would help households to store water for irrigation.

Other roles of government, in order of frequency mentioned, were: paying the people who look after the reservoir; treating and purifying water; bringing knowledgeable persons to advise and plan and teach the community how to do it; fining people who use water unnecessarily; giving crop seeds for irrigation; and providing a toilet at the public grave yard.

This co-management is two-way: from community's side, respondents agreed that community members should attend all meetings and discuss the scope of work. Volunteers should help to dig trenches. Households could also pay for their own tap, although one respondent emphasized that people with money can contribute but others cannot. Two respondents found: 'the community has done a lot so far; the municipality should help now'. Others exposed that government is often slow and ineffective to respond to community needs; hence, it is better to do ourselves.

The MUS Forum would maintain a key role, as in each of the steps in the process. The selection of a committee, in collaboration with the tribal authority, was critical: 'We know about each other's efforts and diligence so we can select the best persons to lead the project'. 'The committee should get the chance to plan the project steps, and be involved from the planning in the beginning to the final stage'. The committee should also 'ask the community about what their problems are and what they want to be implemented'. It should 'draw a list of materials for reticulation lines and also lead on procurement'. By hiring local labour instead of bringing sub-contractors from elsewhere and by being involved in construction process 'we can learn and maintain the system and infrastructure'. In case of a problem, 'the committee should inform the tribal, who will alert the community to find a solution'. 'The budget and expenditure should be transparent by showing quotes and receipts'. The community should 'be united to improve themselves as a community, attend meetings and support each other and not undermine'.

3.10 User satisfaction in Ga Moela

3.10.1 Process and outcomes

In Ga Moela, respondents also liked the process, as implemented by Tsogang. Tsogang 'is reliable', 'comes back to check whether it works', 'finishes work and keeps promises'. Respondents appreciated how Tsogang 'introduced themselves to community', 'listened to us and let the community take decisions'; 'involved the chief'; and 'handed the project to the community to lead'; and 'taught us how to work independently'. Tsogang staff 'worked very well with us'; 'they are 'energetic', 'hardworking' and 'passionate about their work'. A respondent emphasized in particular: 'they do not discriminate, and involve everyone, including the poorer'. Respondents further detailed:

‘Tsogang designed the map with us’ and ‘guided the community and helped in planning of water supply, training, and organisation’; ‘finished sections left open by contractors (Tawaneng)’; ‘provided material, including household jojo’s’, ‘monitored people on how to build infrastructure’ and ‘made sure the community is doing its work to get water’. The process had developed community capacities. These were both technical capacities (‘digging trenches’ ‘laying and connecting pipes’, ‘giving knowledge about water management’) and institutional capacities: ‘how to work together as a community’.

Most respondents were also satisfied about the information provided by Tsogang. However, one respondent regretted when Tsogang only met with the MUS forum, whereas Tsogang could have invited the whole community. On the budget, most found that Tsogang ‘clearly explained and provided clarity on budget sheets’. ‘They showed purchase records’. However, two respondents had wanted to get more clarity on budgets ‘which did not make sense’ and one awaited Tsogang’s allegedly promised further explanations. Another one also missed sufficient information, but ‘did not mind as long as the results were delivered’.

When probing about any disadvantages of the project, most respondents did not see any disadvantage. Those who saw disadvantages included the five respondents who were not serviced by the new systems. The main disadvantage was the limited project funding, which only partially satisfied their water needs. The capacity of both new storage reservoirs was also too small. Taps were still too far from homesteads for some. More household jojo’s and more galvanized steel pipes could have been given. Some had wanted more information on gardening and irrigation. Some still awaited clarity on the days of the week when there will be water in taps. Similar to Ga Mokgotho, the ideal remained homestead taps without the hassle of sharing water and with the possibility of irrigation.

Given the negative experiences with contractors in Ga Moela, the comparison between the participatory process in the MUS project and contractors was straightforward. Two respondents highlighted that any contractor could and should adopt the participatory process. ‘I wish other projects learn from MUS’. One respondent compared with the failed project in the neighbouring community Ma-Chupi and summarized: ‘Comparing to Ma-Chupi I wish they had given the ZAR 5.5 million project money to Tsogang; then there would be water everywhere and money would be saved to do other betterment’.

3.10.2 Future co-management

Unlike Ga Mokgotho where light-touch support by government can already improve water distribution, maintenance and upgrades for better performance, in Ga Moela the community entirely depends on the municipality for first-time access from functioning boreholes (preferably with payment of the operator and the provision of sufficient fuel). Also, the Mabusa/Moela sections still waited for the national electricity company to install an independent line to the electric booster pump. A respondent from a section without any access to municipal water points complained how ‘the municipality does not help with anything; we wonder if it even exists’. In other sections, respondents realized: ‘the municipality pays the fuel and still pays the person who pumps the water and buys fuel for us’ (in Mabusa) and ‘the municipality replaced the diesel pump with a petrol pump’ and ‘in the past they helped sometimes with diesel’ (Tawaneng/Letlabela).

The frustration that was most often mentioned was that ‘the municipality takes time to respond to community needs’, if not ‘it keeps us waiting forever’. Some others accepted again: ‘they do their best; they try’; or ‘that is the way it is’. Respondents agreed that it would be quicker if the community took care of small repairs of taps and leakages, or, as a respondent from Letlabela highlighted, provided for petrol. Some community members ‘already know how to do those repairs’. Otherwise ‘people could be trained and getting skilled in fixing smaller repairs’. The role of the municipality would then be to help in buying pipes and maintaining and fixing boreholes.

Respondents were generally ready to contribute labour and money, as they had had to do previously to access their unimproved sources or to purchase water. The problem they saw was organizational: how to avoid ‘that some people will benefit without contributing’? Existing ‘conflicts may lead to unfair contribution’. And the other way around: ‘disagreements in making contributions may result in conflicts’. Moreover, ‘some households may not contribute as they may not earn much’. Three respondents further highlighted that ‘when community contributions are limited, the quality of materials bought from local shops can be poor’. ‘Cheap material breaks down fast, which also causes conflict’.

Lack of clarity on mutual roles and unmet promises further complicated collective fund raising, because some users preferred waiting for the municipality to keep its promise, even if it took very long. The proposed solution was that the municipality gives the money and that community members fix, wherever possible. This lack of clarity by the municipality also contributed to the continued inaction by water users, the MUS Forum, the chief and Tsogang to strengthen the organizational structures in the Letlabela and Mabusa/Moela sections to operate and maintain their respective schemes.

3.11 Conclusions: co-management in Ga Mokgotho and Ga Moela

The in-depth comparison of community participation from the early planning phase onwards showed strong community buy-in in the two communities alike. Community participation first, cost-effectively built on past investments in public infrastructure and on any community participation in operation, maintenance and upgrades or extensions where that existed; second, mobilized local innovation of multi-purpose infrastructure and practices, and, third, mobilized communities’ priorities for repairs, upgrades and next incremental improvements. The mobilization of local semi-skilled and skilled workers not only ensured cost-effective and locally appropriate construction but also developed skills that stayed in the community. Local procurement of materials could have further reduced costs and developed skills and contacts with suppliers. All these features are key for sustainability in any local situation.

These benefits were created in an innovative socio-technical process of facilitation with technical and institutional capacity development, advice, supervision and quality control, besides financial support for materials and labour. In principle, governments can provide such support at scale as their share in co-management in any local situation.

Whereas the above-mentioned benefits of community-led MUS and support requirements are generic, the comparison also highlighted important local differences between the two communities in geo-hydrology, infrastructure and service levels that further shaped the abilities of the community and the required external support in co-management.

In the large gravity system in the ever-expanding community of Ga Mokgotho, the MUS project reversed failing post-construction community management and scheme dilapidation by establishing a member organization linked to both tribal and political structures and with an accountable operator; and by providing materials and advice on repairs and upgrades. For the future, the community already saw small repairs as their own responsibility. As gravity energy is free, future support can probably remain, as respondents indicated, a matter of providing materials on request for expansion, some technical and institutional advice and remuneration of the operator. However, this does not yet address the strong desire for homestead connections and expectation that government will somehow provide for those. This latter aspiration warrants some further attention by government or other support agencies to catalyse community organization for this last mile service, and possibly the implementation of the long-awaited new and bigger system connected to the Diphalafaleng river.

In Ga Moela, the challenge was first-time access that entirely depended on municipal boreholes. The benefits that were experienced during the short use of the new storage and reticulation can only become sustainable when the municipal boreholes work, and work harder than before. In co-management of boreholes, municipalities remain in the driver's seat. Other authors in South Africa (Gibson, 2010; Lagardien et al., 2010) and globally (Moriarty et al., 2013) flagged the same need for systematic change of local government. However, even then communities can participate more strongly. People in Ga Moela expressed the willingness to take responsibility for quick responses to repair small breakdowns and to organize the purchase of fuel and operate the pump. Financial support by government would be even better. One section already proved its capacity to manage the – often underestimated – complexity of internal organization and steady fund mobilization. However, municipalities' promise that they will do, but without doing, may paralyze such initiative. A first step towards co-management would be to agree on temporary or longer-term arrangements in which communities take up what they can and want to do to access water, and in which municipalities do their critical part as they are realistically able to do.

In sum, involving communities from the earliest phases in service provision mobilizes community innovation that sustainably caters for people's multiple water needs. However, the precise contents of co-management depend on local conditions. In this diversity, government may just have to provide light-touch support or remain the pivot in providing water services.

4 Phiring

4.1 Step 0: Selecting

Phiring (or Sterkspruit – meaning ‘strong spring’) is an expanding rural community with about 2500 inhabitants of around 420 households in ward 26 of Fetakgomo/Greater Tubatse Local Municipality (with capital Burgersfort/Praktiseer), Sekhukhune District. Situated at the eastern edge of the District, the area is surrounded by mountains with generally good rainfall (although rainfall reduced from 2016 onwards), fertile valleys, and surface and groundwater resources.

The MUS project decided to consider selecting Phiring because the community was listed on the ‘Community-based water management’ initiative of the Sekhukhune Department of Water and Sanitation (DWS), which is part of the national initiative with the same name. The two exploratory visits by the small team of Sekhukhune municipality and Tsogang, on 16 December 2016 and 14 February 2017, were to confirm a possible selection, without raising expectation, also without formal contacts with the tribal authority as yet. The main resource person met, who was seen as ‘custodian’ of development activities, was the young chair of the Rural Development Committee, the son of the family owning a newly acquired farm along the R532 road under a land restitution case. He was an active farmer.

In addition to being able to work with active entrepreneurial youth, three issues and opportunities of improving multiple water uses emerged. First, a large irrigation scheme reflected widespread efforts towards profitable irrigation businesses, although the 2016 dry season had been very dry with low dam levels. However, pipes were leaking, inputs expensive, markets difficult, and, without fencing, animals entered. Quite a number of fields remained unused. Second, in 1996, the municipality, through Mvula Trust, had constructed an electric groundwater system with two adjacent boreholes and two reservoirs. The smaller reservoir of 80 m^3 was designed for use by Phiring and a 100 m more-elevated concrete reservoir of three times that volume, which was equipped with another pump, was meant to pump up water to the upstream community of Leboeng. However, the small reservoir was insufficient for Phiring, and rotational supply each other day was needed. Moreover, the community kept expanding. So the people in Phiring negotiated with the municipality that the big reservoir remained unused (the pump house dilapidated as well). Third, in Vrystad, there had been various borehole drilling projects that had failed. Even the most recent borehole with jojo’s had remained unused because of problems with the contractors.

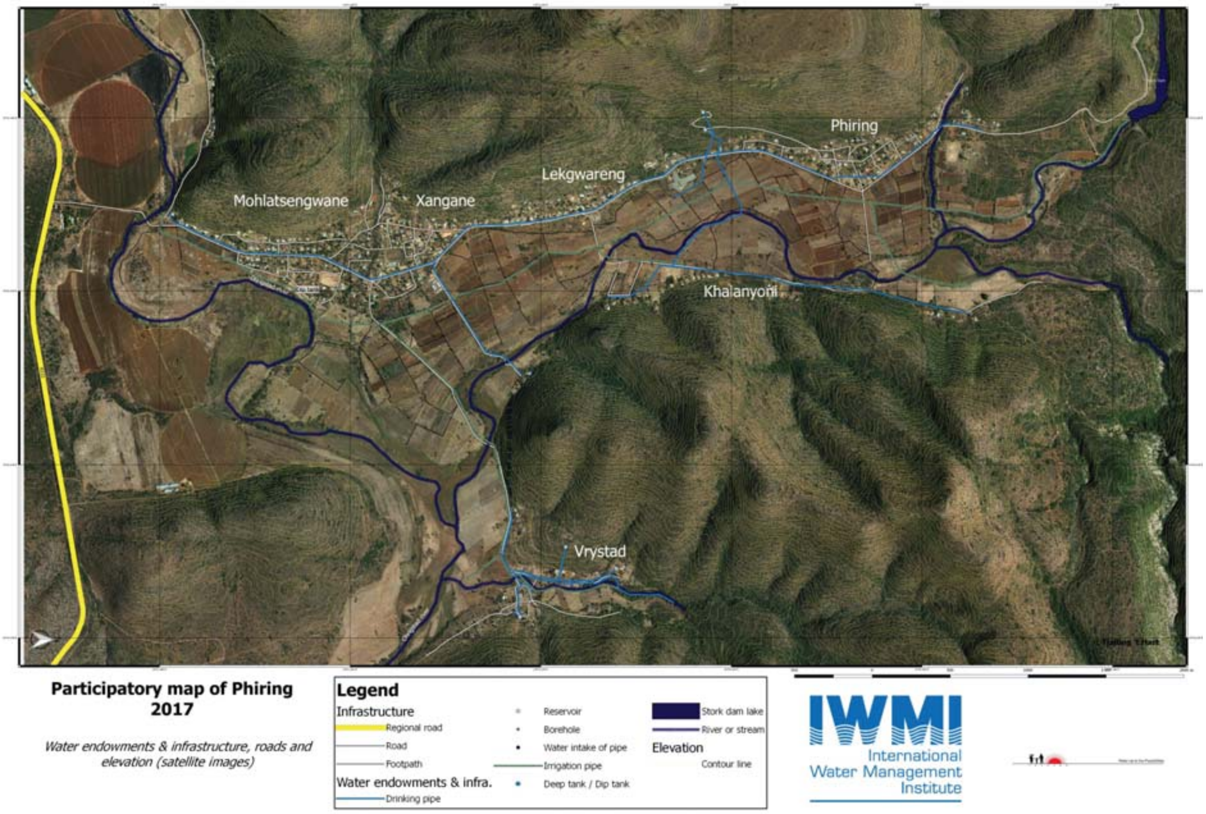

Figure 25 Map of Phiring (Source 't Hart, 2017)

As shown in **Figure 25**, there are four adjacent sections namely Mohlatsengwane (103 households), Tshangane (81 households), Legwareng (58 households), and Phiring (105 households). Somewhat separate are Khalanyoni (31 households) and Vrystad (or Marakalala, with 36 households). A seventh section is Sarel Mokoena's household and farm which borders the road R532.

The map also shows the five rivers in Phiring community, the dam (Stocks and Stocks) and the large irrigation scheme. The Phiring (Sekweneng) river, which gave the name to the community, flows into the Stocks and Stocks dam, and continues downstream to join the Ohrigstad river. Before that, two smaller streams flow into the Phiring. One of these is the Setunyeng river, which, as will be seen, became part of the MUS project. Moreover, the Sedibaneng flows through Vrystad (Marakalala) before also joining the Ohrigstad.

4.2 Step 1: Introducing and establishing a MUS forum

After these two exploratory visits, and the decision to select Phiring as a demonstration community, the MUS project was officially introduced to the tribal authority on 7 March 2017. The chair of the Rural Development Committee, the scheme operator, and the ward committee member, who represented the ward councillor, were among the 11 attending community members. Tsogang clarified the purpose of the two earlier visits and explained the envisaged participatory process to improve of access to water for multiple uses, but without money for big infrastructure. All welcomed the project, and already flagged two problems in particular: that the municipality fails to follow up on its promises and the problem that community meetings are poorly attended.

The next day and continuously during the later months, Tsogang and IWMI made site visits, interacted, and organized diagnostic meetings to further collect ‘pre-feasibility’ information and further listen to what the community members raised as problems from these very first contacts onwards.

On 22 March, a meeting was planned to establish a MUS forum, but attendance was insufficient, so the meeting was postponed to 25 March. Chaired by the Rural Development Committee chair, there were 49 participants. Tsogang explained selection criteria, including gender, youth and representation of all governance structures and geographic sections. A 14 member MUS forum (8 women, 6 men) was partly self-nominated and partly appointed.

On 28 March, these 14 members elected their 7 executives (with the female ward committee member as chair, one woman from Leboeng, and one other woman) and 2 subcommittees, one on water and one on agriculture. The chair of the Rural Development Committee was in the latter, but not in the executive committee. The new MUS forum members’ past training was assessed to identify further training needs. Compared to other MUS demonstration communities, a relatively high level of training was found: 7 members were trained in all aspects of project management, and another 3 in most aspects. Training in agriculture, organizational training, and health had been less, in this decreasing order. Only 3 members had received training in book keeping.

4.3 Step 2. Diagnosing

4.3.1. Resource mapping and participatory rapid appraisal

On 29 March 2017 Tsogang organized the community and resource mapping on the ground as the first item using Participatory Rural Appraisal (PRA). Initially, many participated but this reduced to a core of some 25. Initially men launched into the map, then women gently corrected them and street by street they identified their plots and the structures. Then, the Department of Water and Sanitation came for another meeting, which had been planned for the day before but was postponed. So only six could finalize the map; later, others confirmed that the map was right.

On 24 April, the PRA continued with 34 participants (29 females). An inventory was made of all community institutions and structures, the health situation and priority problems for the community. In the face of problems mentioned, participants encouraged each other to mention this in the Integrated Development Plans and, in the case of lack of proper roads, to write a letter to the President’s office and Public Protector (the IDP mentions for all communities in ward 26 the need to gravel internal roads).

A Rural Development Committee had started in August 2016. It consisted of five committee members which were one female and four males (including the scheme operator). When the woman left, she was not replaced. Participants openly flagged that it lacked a constitution and failed to report back to the community so they did not know what was happening (the committee’s chair was part of the meeting).

The discussions on the specific water problems focused on the two schemes for domestic use. First, for Phiring's functioning borehole scheme, the limited current storage capacity of the small reservoir only and the lack of use of the big reservoir was identified as well as blockage of the main pipe of 63 mm to about 50 households in Mohlatsengwane. The latter was confirmed when that pipe was exposed in that same month of March. The Department of Water had advised new pipes of 63 mm. Moreover, the PRA raised that some households were not reached at all.

Second, the failures to connect Vrystad to electricity (which is mentioned in the 2019/2020 IDP) were raised as one of the reasons why the water supply system there remained unused. However, just before the PRA, in February, the contractor had replaced the three 5000 litre jojo tanks by three 10,000 litre jojo tanks). The idea was raised to extend the line from the borehole system. As also mentioned in the IDP, the need for RDP houses and road improvements came up.

During Tsogang's transect walk and ride on 12 May, these issues and potential solutions were investigated in further detail. Tsogang also assessed the broader issues raised: social (for example, unequal land allocation; barren fields; high crime rates with theft and re-sale of properties; youth unemployment; poor attendance of community meetings; isolation of Vrystad); technical (as below); political (in addition to the main party of the ANC there are two other parties; they collaborate) and economic (underuse of the irrigation scheme; need for fencing off of roaming animals). In June, an IWMI intern also compiled the above presented GIS map ('t Hart, 2017). The Municipality had tested the water quality of the borehole system for drinking: this was good. However, cholera occurs in winter.

The IWMI base line study and continuing further investigation and triangulation by both IWMI and Tsogang tried to further diagnose reasons for the poor attendance of meetings and, as increasingly emerged, mistrust that also affected MUS project implementation. Paradoxically, relatively strong government efforts to *support* communities and *improve* wellbeing appeared to contribute to such mistrust. The roots of mistrust are also anchored in the area's history before the project engaged in 2016, as follows.

4.3.2 Diagnosing Phiring's history

Historically, chieftaincies, colonial rulers, pre-1994 apartheid government have shaped Phiring. Relatively strong post-1994 interventions by government continue to shape Phiring. Till mid-19th century, Phiring was the capital of Pedi King Sekwati before he moved in 1853 to a safer stronghold when battles for land started with the Boers who took the fertile and well-watered land in Phiring and wide surroundings. Only in Vrystad (Marakalala) and Kalanyoni people, including the Mokoena family, stayed; they worked as unpaid farm labourers of the white farmer in Phiring. The latter white farmer started storing and channelling water for multiple uses to homes and fields. He left in the mid-1950s, when people from Boomplaas near Mashishing (Lydenburg) were forcefully removed to Phiring under the Group Areas Act. Chief Michael Dinkwanyane, a grandparent of the current chieftainess Kgoshigadi Merriam Naraedi Dinkwanyane, formed the Sterkspruit Tribal Authority. This authority was imposed on the existing tribal leadership structures of about 11 communities, including Leboeng. This contributed to leadership factions and eroding cohesion ever since.

As elsewhere in some of Apartheid South Africa's forced removals, for example the Flag Boshielo irrigation scheme, the apartheid government spent significant amounts to settle and pacify the displaced people; an irrigation scheme, probably improving the pre-1950s scheme of the white farmer, was part of that. In Phiring, families got plots allocated on cultivatable land of about 350 hectares. Some people from the upstream community of Leboeng also got plots. The common size was 1.25 ha per household, so some 280 families could have received plots overtime. Farmers were organized to do maintenance: 'everyone had to go out for cleaning'. There were also tractor services. Wheat was the main crop, which was stored and milled in Lydenburg. In 1994, a dam, called after the name of the contractor 'Stocks and Stock's or just 'Stocks' was completed. The dam is relatively small: two consecutive days of rainfall is sufficient to fill. The dam feeds a newly constructed pipe and branches to quadrants at the fields for furrow irrigation to Phiring and two downstream communities of Malaneng and Mapareng. The total size is 456 ha (data base of the Department of Agriculture). Several pump houses were constructed (but none was ever used). The pump house upstream was meant to increase pressure so that part of the strong gravity flows leaving the dam could be pushed into the piped branches serving the head end of the scheme.

Part of the community members, including in Vrystad, used, and continue to use, the piped water for domestic purposes, homestead cultivation and livestock as well.

Phiring was also the first community to receive a school (in 1957), and later a clinic, and – in total – six churches of various Christian denominations. In 1993, the community received electricity, except in Vrystad, which still had no electricity until early 2020.

This history of intensive government intervention continued to shape Phiring post-1994 in land reform, new local government structures and interventions that, unfortunately, also divided the community members in new ways. First, the Mokoena family of Vrystad successfully lodged a land restitution claim as one of the few realized claims in the large areas surrounding Phiring, where many white farmers had also dispossessed Africans. These large farmers remain the main employers in the region nowadays. No other land restitution claims have been lodged.

In Phiring, the Mokoena family took over a capital-intensive irrigated farm of about 300 ha alongside the R532 road near the turn-off to Phiring. The son, chair of the Rural Development Committee, continued fencing and developing 9ha of land along the gravel road between that farm and Phiring community. As the land claim was made in the name of the community, the school may receive some donations. However, the family claims the property rights to the land. For example, elderly women entering the land to collect any remnants of harvested crops, a common practice, are chased away. Being placed at the downstream end of both the irrigation scheme and the borehole domestic supplies, the family has a natural stake in their improvements and upgrades.

Also, under the demarcation of the new local government boundaries, all sections of Phiring came under Limpopo Province. The downstream communities of Malaneng and Mapaereng in the irrigation scheme became another ward together with Leboeng, so the scheme is administratively split now. Moreover, many people continue their pre-1994 bonds with Mashishing and elsewhere, which is in the new Mpumalanga Province. For example, some still go to Mashishing for advice on extension and purchase of agricultural equipment. Markets also continue to be in Bushbuckridge, Mpumalanga.

History also continued in the sense of strong government interventions in Phiring. Thus, in addition to electricity, Phiring got two telephone towers. The Community Works Program/Extended Public Works Program (EPWP) is also active. Each government department creates its own committee that serves as link between a specific department and 'the' community, such as the Electricity Committee; School Governing Body; Farmers committee; Water Committee; Community Policing Forum-CPF or Pensioners Committee, besides the local Burial Societies. Ward 26 committee members of Phiring are Ms. Matete, chair of the MUS Forum, and Ms. Sekope Riba. The ward councillor for Phiring and surrounding communities is from upstream Leboeng. The same strong influence of government interventions continued to divide factions, both for the water infrastructure at the start of the MUS project, as follows, and, as seen in the next steps, during the MUS project.

4.3.3 Water infrastructure

4.3.3.1 Dam and pipes for irrigation and cattle dam

After finalizing the construction of the dam, pumps and pipes, the support to the irrigation scheme by the new government became minimal. As for many – already functioning – smallholder irrigation schemes in South Africa, the pre-1994 rigorous command-and-control management and maintenance by government or by development companies stopped. Most tractor services, input provision, marketing, and scheme operation, maintenance and water use was left to the farmers. No department has become the clear owner of the infrastructure. Support from only one extension worker from the district department of agriculture in Praktiseer, Burgersfort, continued.

Out of the 280 potential irrigators in Phiring, a roughly estimated 60-70 are active. Some are leasing land, for example for ZAR 1000 per ha per season. The fear of losing land when someone else cultivates for several years inhibits title holders to lease out land. More clarity on both long-term security for title holders and short-term security for those who lease could stimulate more intensive land use, as recommended for irrigation schemes elsewhere (Denison, 2018). In the rainy season, maize is the main crop for own consumption or sale. In the dry season, tomatoes, butternut, spinach, cabbage, green beans, sugar cane, sweet potatoes, and other vegetables are grown for sale.

For water distribution, one farmer, who used to be part of the construction team, was asked by the constructors to take up the voluntary role as scheme operator to distribute water. He is the chair of an irrigation committee with some four others. During the rainy season, water flows are continuous and can be used for supplementary irrigation as needed. When the water levels in the dam fall during the dry season, he opens the valves on Monday, Wednesday and Friday. By end of the dry season, he further reduces to once a week on Monday. Increased water uses in upstream Leboeng contributed to low dam levels as well. Leboeng constructed a weir in the source to the dam. When it rains, the dam overflows, but in the dry season all water is diverted to domestic uses and irrigation. This upstream water use is accepted in Phiring, as commented: 'those people also need water'.

The dam ran completely dry in the dry season of 2016. Some downstream farmers bought pumps to lift water out of the river; others borrowed water from them. One farmer installed a borehole in the scheme to tap into the still abundantly available groundwater. A few also shifted from furrow irrigation to drip irrigation, with or without government support; this not only saved water but also labour and time. In 2017 and 2018 rain was also less and dam levels very low. In September 2019, some irrigation from the scheme was possible. However, irrigators in Vrystad also took water from streams in their section.

In the upstream part of the irrigation scheme, the lack of pumps to distribute the fast-flowing water to the branches contributed to water scarcity there. In the more downstream parts, including the two other communities, dilapidation of the (asbestos or PVC) pipes and quadrants compounded surface water scarcity in the dry season. In some cases of broken (asbestos) pipes, the operator organized some 100 farmers to contribute and repair.

These water scarcity issues contributed to low land use and productivity. As mentioned, other contributing factors that community members raised were expensive inputs (seeds, fertilizers, and chemicals); difficulties in finding rewarding markets (in Mpumalanga and Limpopo); pests (like leaf miners on tomato); lack of transport or cold storage of produce, and roaming animals as fences were broken or had disappeared. Moreover, outside the dam and irrigation command area, at some 600 m distance from the pipe, across the R532 road, three men designed and fenced a place for about 200 cattle in 1998. This prevents cattle roaming and raiding. In 2001, they also constructed a small reservoir and got water from a neighbouring large-scale farmer. With half of the Phiring community keeping one, two or three types of livestock, an estimated total of 2000 cattle and cows needed pasture, feed, and water from homesteads, open streams, distant hand-dug wells, this camp, or the irrigation scheme. Roaming animals, which used to be well herded in the past, are one of the reasons why (unfenced) irrigation plots are not cultivated.

The dam and pipes are multiple-use. The pipes are also used for domestic purposes when the borehole (see below) sometimes fails. And in Vrystad there has never been any alternative as yet, except for a small communal self-supply gravity scheme.

In 2017, simultaneously with the MUS project, the Department of Rural Development stepped in with the promise to spend ZAR 3.3 million for the irrigation farmers. This was initiated by the current chair of the Rural Development Committee. He had asked support for his 9ha farm, but in order to obtain any government support, it should be a community initiative. He collected over 200 names to register as Primary Cooperative. However, interviews in 2017 confirmed that some younger farmers welcomed this emphasis on youth and business farming, deserving support. However, other respondents were sceptical about this new project: 'names are listed, but those at the bottom of that list never hear anything'. As elaborated below, this (and other) projects targeted the same people as the MUS project. This created confusion. Moreover, it appeared impossible to create synergies between improved water supplies for irrigation and these other measures to improve irrigation.

4.3.3.2 Borehole system

As mentioned, in 1996 Mvula Trust constructed a borehole system, which is the reason why all sections in Phiring (except Vrystad) have the highest water service level to homesteads of all six demonstration communities. Nevertheless, the current capacity is low: even with 24/7 pumping (which is not recommended) the water available is only 26 lpcd (DMV Limpopo 2017). The reticulation system consists of buried pipes; the diameters decrease to increase pressure inside the pipeline. As households preferred yard connection, it was decided that they had to make their own underground connections from the main line. Four households next to the reservoir did not access water because houses are on the hill higher than the water storage. About 12 newly built houses in the Mohlatsengwane section, which is nearest to the road and Mokoena farm, are not reached by the reticulation. There is an overflow from the small reservoir; a farmer has channelled this water to irrigate his net shaded nursery. The bigger and more elevated reservoir and pumps, designed for Leboeng had never been used.

Immediately after construction, a mixed-gender water committee was established, but this became inactive. An operator from elsewhere, who is appointed and paid by the municipality, comes a few times per week to operate the pump and fill the reservoir. He is also responsible for maintenance and repairs, including electricity outages. So the Phiring inhabitants receive water for free. The scheme is operated from 8 to 16 hrs in rotation: one day for one side of the community and the other day for the other side. Almost all households have one or more 210 litre drums to store water to bridge the gap. However, electricity outages, either technical or due to non-payment of electricity bills by the municipality, interrupts services. In such cases, or to supplement water supplies, people use water from the dam and pipes, sometimes after putting some bleach to water for drinking. Or they took wheel barrows or cars and went to the adjacent community of Maraleng, which also got a similar borehole as Phiring. The pipes had unrepaired cracks and leaks, and pipes were vandalized.

As water was insufficient and supplies were rotating, productive uses had been discouraged. Moreover, land for irrigation was adjacent. In a random sample of 100 households (except for Vrystad) taken during the dry season of 2018/19 households cultivated vegetables; 45 irrigated fruit trees, and 44 households had green grass and/or flowers (Kok, 2019).

4.3.3.3 Vrystad

The 36 households in Vrystad, whose ancestors have lived there for generations, neither got clean water nor electricity, even by the end of 2019. The municipality initiated four borehole water supply projects, which all collapsed or were vandalized. A large borehole scheme had been constructed by 2016 for an amount of over ZAR 3 million. Allegedly, two contractors, Malumash Enterprises and Mdina Engineering each got well over a million Rand to construct. The keys of the borehole house are still with one of them who refuses to hand over until he is paid by the municipality. The other brought the poles for the national electricity company Eskom to connect both the scheme and Vrystad, but that was still to be done. By the end of 2019, one 10000 litres jojo had fallen; empty jojo's in the sun also risk cracking. An official from Lepelle Water Board also came and made a report, but she also started failing to answer phone calls.

In the meantime, the Vrystad community organized their own scheme from a low-quality passing stream, also using some of the equipment of the three abandoned schemes. This scheme is seen as one of the reasons why fatal malaria incidence recently occurred. In the past the Department of Health used to seasonally spray against mosquitos.

Hence, in spite of the significant public investments, people in Vrystad and, with them, in Phiring are very unhappy about the District and Local Municipality. They keep exposing how government fails to deliver on their promises.

This diagnosis, which kept being refined in the course of the project, was the basis to identify solutions within the MUS project's limited financial framework.

4.4 Step 3. Envisioning solutions and prioritizing

At a community meeting on 4 August 2017 with the tribal, MUS forum, ward committee, and various committees, Tsogang presented a list of potential solutions that had emerged in the earlier engagements. Tsogang committed to further investigate, cost, and then prioritize together with the community. In addition to the problems already raised, the list also included an extension of the irrigation pipe to the cattle dam. Tsogang's proposal was endorsed.

A Technical Inspection with Tsogang's engineer was conducted on 11 August 2017. After this, Tsogang checked whether the upper large reservoir was leaking (which it was found not to do); conducted precise measurements of water quantities of the electric borehole (which showed its capacity to fill both reservoirs in two days); took GPS coordinates (to compare with the elevation of the reservoirs); costed the proposed solutions into bills of quantities; and contacted the municipality and the two contractors of Vrystad consultants to explore solutions.

By 15 September 2017 the following solutions were presented. A costed overview was made by 25 September (for a total of ZAR 495 107 excluding labour, but including 10% contingencies).

Upgrading electric borehole water supply (total ZAR 338 497):

- Borehole: repair leaks in the galvanised elbow
- Big reservoir: start using this by fencing, repairing and replacing damaged and leaking pipe connections; install valve to the small reservoir
- Small Reservoir: repair leaks under roof and in pipes; fence; repair damaged pipes; replace and protect/lock control valves
- Main line: further investigate and possibly remove blockage in Mohlatsengwane section affecting 50 households (not budgeted).
- ***Vrystad***: construct a new 300 metre extension to Vrystad (or, if not possible, refurbish the existing informal water scheme) and engage with the municipality and the contractors in order to connect electricity and render the water supply scheme operational.
- In all this: work closely with the municipality's paid pump operator

Upgrading Stocks & Stocks irrigation and livestock dam pipe line (total ZAR 96 913)

- Repair five leaks on the main pipelines and check and repair all branches for leaks
- Replace stand pipe rubbers of 120 irrigation quadrants.
- Install a new HDPE pipeline supplying water to livestock farmers on the other side of the tar road.

Household jojo's (ZAR 9697)

- As in other demonstration communities, 2500 litres jojo's with gutters were to be donated to 15 poor selected households for rainwater harvesting.

At a meeting on 13 October with 22 participants, and now also including the Ward Councillor, these finalized solutions were confirmed. The MUS Forum member from Leboeng also reported on the leaks in the shared irrigation pipe in the next downstream community of Mapareng. The Ward Councillor further mediated to sign two letters for Sekhukhune District Municipality and Fetakgomo Greater Tubatse Local Municipality to assist. Further, she encouraged youth and women to form Close (or Primary) Cooperatives, so that community members instead of outsiders can apply for tenders by the municipality.

By 21 November, a new idea was added: an alternative source to increase the water supplies to the irrigation scheme. During its engagements, the MUS Forum drew attention to the option to construct a weir and intake for a pipe in a more distant year-round stream, the Setunyeng, and to pipe the diverted water by gravity over 2000 metres to connect to the irrigation pipe just downstream below the outlet of the pipe from the dam.

4.5 Step 4. Planning and fitting the financial framework.

4.5.1 Final designs and costing

By end 2017 and early 2018 Tsogang further interacted, on the one hand, with the Phiring community and on the other hand with the funders, the Water Research Commission and African Water Facility. Designs, bills of quantities and estimated costs were refined, as in the Book of Drawings of January 2018 and the Work Design Books by March 2018. The total material costs of these final plans were ZAR 406 060 (excluding labour and contingencies).

The Works Design Book and budget included an extension of the pipe line to Vrystad. Tsogang had heard from the municipality that they had tried to find other funding to pay the contractor of the almost finished borehole, but failed; they had no other plans. This underscored the need for the proposed extension of 3000 metres from the borehole system. However, later, this plan disappeared. One of the reasons was that the donor preferred not to interfere in outstanding problems within the municipality.

In parallel to the continuing negotiations on the final technical designs, a plan for financing and clear contractual arrangements was drawn up in line with the requirements of the Water Research Commission at national level and the African Water Facility at international level. One discussion at these levels was whether the works should be voluntary or remunerated with stipends. Agreement was reached to pay a modest stipend of the same amount as the Extended Public Works Program applies: ZAR90 per day. Accordingly, Tsogang subdivided the scope of works into daily tasks. For example, six meters of trench digging of 70 cm depth and 50 cm width is one task of ZAR 90. Backfilling of that stretch is ZAR30. Stipends of ZAR 115 350 plus the Work Design Book's amount for materials of ZAR 406 060 gave a total budget for Phiring of ZAR 521 410.

Tsogang also opened a Contractors Risk Insurance against fraud and theft with Smit & Kie Insurance Company.

4.5.2 Formalizing community structure

Workers would be paid once works were done and approved. For such payment, the MUS Forums had to be formalized. For all demonstration communities it was decided to get registered as a Primary Cooperative under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005) under the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries. This structure enables bidding for government tenders as well. Further, a bank account needed to be opened, co-signed by Tsogang and two MUS forum members. Tax clearance certificates and Broad Based Black Economic Empowerment certificates were also required.

This formalization for external support triggered internal conflicts within the MUS Forum. The chair of the Rural Development Committee, who had just created the other Primary Cooperative for the Rural Development project, was seen as unwilling to share his extensive knowledge and he refused to contribute money for the joining fee. This frustrated other members, who, nevertheless, continued. The Tsogang field worker spent much time during three months to drive them to nearby towns and make appointments with different banks. The Ga-Mokgotho MUS Forum chair also gave precious advice. Accordingly, 18 December 2017 the Bapedi Ba Dinkwanyane Multipurpose Primary Cooperative Ltd was registered (without the chair of the Rural Development Committee).

Tsogang also started using this structure for catering purposes of project meetings. A year later, in December 2018, Tsogang enabled two MUS Forum/cooperative member to attend a three-day training in tendering processes, facilitated by the Limpopo Economic Development Agency in Fetakgomo-Tubatse Municipality and the CIPC in Burgersfort.

4.5.3 Memorandum of Understanding

In line with the Work Design Book of March 2018, a formal Memorandum of Understanding between Tsogang and the newly created Primary Cooperative was compiled that specified mutual roles and responsibilities and the budgeted stipends of ZAR 115 350 for the semi-skilled tasks and skilled jobs and other possible expenditures (but without amount for materials). On 1 April 2018, the Memorandum of Agreement was signed (see detailed contents above in chapter 2.6.2.3).

Tsogang also compiled a Memorandum of Understanding with the Sekhukhune District Municipality for approval and signing. This was not signed. Nevertheless, it informed the municipality and served implicitly as a ‘no objection’. There was no direct discussion or agreement between the community and the District Municipality.

4.6 Step 5. Implementing

4.6.1 Procuring and delivering materials

Based on the bill of quantities and estimated prices by Tsogang, the Water Research Commission proceeded to procure materials, following the national government procedures. In March 2018, WRC issued a Request for Quotations to suppliers in Sekhukhune District. WRC received more than the required three quotations. After allocating the tender to the winning supplier, the latter appeared to need a loan. Materials were delivered on 21 June. Tsogang checked the quality. However, the supplier had not understood what the 120 rubbers/heads for the irrigation hydrants were (of an amount of almost ZAR40 000), and delivered other materials instead. They were returned. No further action was undertaken to repair the farm-level leaks in hydrants. After checking all other materials Tsogang signed off on 22 June.

Materials were stored at the Local Dinkwanyane Secondary School, which has a guard. Tsogang and local transporters assisted in transporting construction materials to the sites, either voluntarily or as a task for a stipend.

The supplier’s purchase order price was ZAR 342 923. Comparing the supplier’s price with maximum prices of the materials on-the-shelves in local shops, Tsogang found the amount of ZAR

354 138.68, which is 3% higher. This shows a negative mark-up, unless the supplier had been able to get a discount for his bulk purchases compared to on the shelf prices.

4.7 Community-led construction

4.7.1 Organizing works

In preparation of the construction works, Tsogang gave a four-day technical training from 16-20 April 2018 to 7 men and 5 women, representing the MUS forum, farmers and livestock groups. Themes included reading and interpreting drawings, identifying different types of pipes, pipe laying, excavation and back filling process, checking the scope of work against materials requested, Occupational Health and Safety and First Aid.

Tsogang held a budget discussion on 5 June 2018 with five MUS Forum members. It was calculated how local costs could be less than the amounts for stipends budgeted, so how money could be 'saved', and used for other local expenditures. On most items, one third up to half of the budgeted amount could be saved. In this way, an amount of ZAR 31 698 was saved and used for other materials.

For the recruitment of the semi-skilled workers, there was a strong emphasis on 'volunteering'. After the first activities, workers realized they received stipends as some compensation. Four members of the MUS Forum checked the number of tasks and satisfactory completion by each worker. Payment was made after the works were completed and approved. The Tsogang facilitator and the co-signatories went to the bank to withdraw money and paid the workers in cash.

Ten community members responded (one woman and nine men). They started digging trenches and laying the pipes and backfilling from the weir in the alternative source of the Setunyeng. Seven MUS Forum members assisted and the chair of the irrigation group advised. Six women and 11 men were recruited to excavate trenches for Mohlatsengwane section.

Workers were also recruited to lay the 600 metres pipe line to the cattle dam. They preferred receiving a lump sum. However, later they realized the works took more time than if it had been calculated by task. They were unhappy about that. Also, payment was late, they found, as it required approval, payment from Tsogang to the Primary Cooperative's bank account, withdrawal and cash payment.

For skilled workers, the rule across all six demonstration communities was to ask for quotations from local builders and inspect previous works to check quality. In this way, one (male) builder was recruited to erect the fence at the small reservoir site and another (male) builder for the valve box at the reservoir and the valve box at the animal camp.

In total 50 workers and 721 person days of employment had been created by March 2019.

The emphasis was on volunteering: a compensation as an ex-post 'thank you' for support, and not a contract with agreed wage beforehand. In practice, stipends were provided, which was well known in Phiring because of the Community Works Programme's activities. Yet, the MUS Forum's approach was criticized by outsiders, in particular the other ward committee member. Rumours were spread that a stipend was 'robbing' the community, who were 'not slaves'. This dampened enthusiasm; in the end the MUS Forum had to beg for workers to help. In response to this, Tsogang held a meeting to explain the differences between the MUS project and the Rural Development Project, the role of the MUS forum, the budget, and the records on who had been working and had been paid. This explanation was appreciated.

The MUS Forum continued. They greatly appreciated the hard work by the Tsogang facilitator who 'didn't get hungry' to pause, and who 'didn't go home till the work was done'. They also liked what they had learnt, including connecting pipes, joking: 'we didn't know there was a husband and wife coupling!'. However, they flagged that the formalization into a Primary Cooperative had suggested that the MUS Forum was not about improving access to water for everyone in Phiring, but about competitive tendering for government assignments. This had further fuelled mistrust.

4.7.1.1 Borehole system in Mohlatsengwane

As planned for the blocked pipe line in the Mohlatsengwane section, 600 metres of pipe was replaced. However, while working and testing it was realised that the whole pipeline was blocked, not only 600 metres. So an additional 600 m pipes including fittings were bought. For the digging and backfilling of the trenches, additional labour was recruited and an excavator was hired. By November 2018, the entire 1200 m HDPE class 6 pipe was ready. Households were connecting their yard taps again under supervision of the MUS Forum to ensure that proper fittings were used. Unfortunately, though, the pipe remained blocked. A range of technical and social causes were suggested. Maybe the new pipe's diameter had failed to continue building up the pressure by increasingly smaller pipes. The re-connection of the individual pipes from the main line to the yard taps of households could still have damaged the pipe, also because households used 32 mm pipes instead of 20 mm. Or it was vandalized, possibly out of jealousies.

The full work design and drawings for Phiring are attached as **Appendix 3**

In parallel to this, already by March 2018, the chair of the Rural Development Committee had started acquiring a much higher amount for new steel tanks reservoirs and new pipe lines altogether to reach both unconnected houses in Mohlatsengwane and his house/farm. The Sekhukhune District Municipality's IDP/9 (page 62) mentioned an amount of ZAR 2 353 179 for Phiring. The chair directly interacted with a newly recruited contractor on this. By December 2019, Tsogang adjusted the repair of the last part of the pipe to link to this expensive new scheme as well for the benefit of all, including the houses at elevated areas.

4.7.1.2 Alternative source: Setunyeng pipe to irrigation scheme

The initial construction of the alternative source was finalized within a couple of months. A weir was constructed in the Setunyeng stream and a 1700 m long pipe was laid (on the surface) so that water would flow by gravity to the most upstream part of the irrigation pipe. However, a small error in surveying meant that there was just insufficient pressure to deliver water as intended. As a solution, the MUS forum proposed to add another 300 metres so that the longer pipe could reach and fill the dam itself.

In the meantime, the unfinished pipe was left unprotected and unburied during the 2018 dry season. A water vendor from upstream Leboeng got the idea to come and fill his tanker with this pipe. When MUS forum members observed this, they measured the time it took to fill the tanker, calculating a discharge of 12,600 litres per hour. This corresponds with 302,4 m^3 per day. An estimate of the additional hectares to irrigate with this quantity shows that for the three months of dry season the alternative source would yield about 27 000 m^3. Crop water requirements for full irrigation per ha for three months can be estimated as 2000-2500 m^3/ha. So the alternative source would enable to irrigate an additional 10,8-13,5 ha (ignoring evaporation from the dam and leaks).

After this, parts of the pipe were cut or disconnected. One can speculate that disabling the pipe was an effective way to prevent the upstream water vendor from using the pipe for water sale elsewhere. Or a downstream farmer who also used the Setunyeng stream to irrigate his field feared that the stream would at least partially be blocked. By vandalizing the pipe, all water would reach his field. Or the above-mentioned jealousies and internal factions could have led to vandalizing the pipe itself. Vandalism would have been more difficult if the pipe had been buried.

Once the idea of an extension of 300 metres had been proposed, the MUS Forum reached out to the chair of the Rural Development Committee to see whether there was funding for this unforeseen additional expenditure. The ZAR 3.5 million Rural Development project had just started to be implemented. After all, without water for irrigation, the envisaged cultivation and fertilization of groundnuts or butternuts would be impossible. However, according to the chair, such request would require extensive procedures, including approval by the members of the Primary Cooperative and the Department of Rural Development. The extension worker of the Department of Agriculture was also unable to assist. So in the end, the MUS project paid for this unforeseen item.

Unfortunately, again, when placing the extended pipe directly into the dam, the pressure appeared to be very low: the difference in elevation between the intake in the Setunyeng and dam was too small to generate sufficient pressure. As a solution, the old intake from the Setunyeng was demolished and a new intake was constructed at a higher, upstream point by end November 2019.

4.7.1.3 A comparison with the irrigation project by the Department of Rural Development

A comparison with the irrigation project of the Department of Rural Development, as analysed in Kok (2019) not only illustrates the impacts of ignoring water in irrigation projects. It also shows the importance of inclusive participation, especially in the first three steps of the six planning steps and the risk of elite capture in projects.

The important goals of the Department of Rural Development were to boost profitable irrigated agricultural business, also involving youth, in a 'one household, one hectare' vision. Large sums of funding and other support were available. As mentioned, initially, the chair of the Rural Development Committee sought to mobilize funding for his own field. However, in his first contacts with the Department (step 1) the Department clarified the conditions: funding is only available for communities, and not individuals. A Primary Cooperative needed to be created as a condition for receiving funding. So, the chair of the Rural Development Committee, the scheme operator and one other man and one woman (who left) became the directors or committee. Many people were asked to join as members in registering for a Primary Cooperative. They had to pay a ZAR 20 joining fee for registration costs and transport costs for the committee. As promised, such nominal membership would enable them to obtain free goods for irrigation. In February 2017, the Phiring Irrigation Scheme Primary Agricultural Cooperative Ltd was registered with 96 founding members on the certificate. Later, realizing that more members would generate more funding, more names were added, amounting to a total of 223 names equalling the total hectares of the irrigation scheme (Yet, some irrigating farmers interviewed had not been aware of the project).

Without a participatory diagnostic step 2, the committee took step 3: identifying solutions. Their business plan identified materials and other support, including boreholes for irrigation. Members approved the plan during a meeting, which went to the national Department of Rural Development and Land Reform (DRDLR). However, the boreholes were rejected for an unknown reason. In total, a budget of ZAR 3 311 842.57 was approved, for a tractor and trailer, ploughing equipment, fencing and seedlings, and support to link the production of butternut and ground nuts to bulk buyers. As a condition of the support, the committee was assisted by both an independent accountant and a site manager of the Rural Development division (but she went on maternity leave and was not replaced).

Implementation started in January 2018. It immediately became clear that there were only 173 farmers instead of the 223 members on the certificate. The Department made clear that the 'one household one hectare' principle would imply a proportionate reduction of the funding. Hence, the committee quickly added 50 additional names on the certificate. This encouraged several members of the same household to sign up. The site manager assisted in developing a detailed implementation plan. After approval by the Department, the committee could buy materials. Payment was in two tranches to check on proper implementation of the first tranche of ZAR 2 248 853 (for ploughing a new tractor with implements, hiring tractor services and diesel; fertilizers and insecticides). When the latter two arrived early in September 2018, rumours went that market prices plummeted because people immediately sold.

Unlike farmers' preferences for high value vegetables, the choice for seedlings was limited to either the new crop of groundnuts (selected by 150 farmers) or lower-value butternut (by 73 farmers). The butternut seedlings arrived end September, but except for the earliest farmers, irrigation water was lacking by then, so butternut could not be planted on the hard soils, or seeds died soon afterwards. When farmers complained, they were given groundnut seedlings to plant when the rains would start.

In response to the site manager's efforts to find bulk buyers for butternut, traders promised to come to the scheme and buy at the market price. However, with the delays, farmers missed the most favourable marketing period of December. For groundnuts, a five-year contract was negotiated with Padishe Resource & Capital, a groundnut oil company. In this bulk contract farming, the company checks on farm practices and progress of cultivation and pays per kilogram, depending on the quality. Farmers are expected to organize the collection and distribution of payments. Time will tell whether the potential and sustainable profitability of bulk contract farming for smallholder irrigation schemes will be realized. Instead of receiving goods for free, the Cooperative will need to organize. More and more reliable supplies of water for irrigation and the downstream cattle dam and Mapareng and Malaneng communities will become even more urgent.

4.8 Conclusions

Whereas the step-wise process followed in the MUS project was similar to the other five communities, outcomes were again different depending on the history and context. In Phiring, continued expensive government interventions, including land restitution, had seriously widened inequalities. Few elite have become gate keepers to build the networks to mobilize abundant government funding. Other community members are, at best, nominally involved to fulfil government requirements while waiting for handouts. Or worse, jealousies and mistrust discourage any collective endeavour, such as the MUS Forum's efforts to improve access to water for all. Mistrust especially grew once the benefits became tangible in step 5. Development risks becoming a competitive race by Primary Cooperatives for outside financial support from government or tenders. Rates for workers and budgets for materials proliferate, instead of aiming at value for money.

In spite of this hostile environment in Phiring, the MUS Forum stayed committed. The community-led design in the first three steps opened the space to 'let all flowers bloom'. This led to local innovation, in this case, to propose to expand water supplies to the irrigation pipe by tapping into the Setunyeng river. This not only showed initiative and commitment but also the trial-and-error nature of local innovation. Flexibility, also in contingency funding, is required to accommodate unforeseen obstacles when new infrastructure is tested.

At the same time, all community members in Phiring were deeply frustrated about the failure of five very expensive water projects in Vrystad, calling for a better representation of communities' interests in municipalities.

Building back internal cohesion would probably require involvement of elected leaders and open invitations of all community members and full transparency of any external support available, and its conditions, from step 1 onwards; members' open elections of their representatives and committees; the strengthening of oral communications and agreements in writing, records, minutes, and action plans. Also, to silence rumours and mistrust; incentives to reduce budget in order to save money for newly prioritized expenditures, ensuring 'value for money'; and rewarding of hard work in a common interest.

5 Tshakhuma

5.1 Step 0: Selecting

In the project's pursuit of diversity in the selection of demonstration communities, Tshakhuma was selected because of its remarkable large-scale development of self-supply, which would also give the opportunity to learn about how to implement community-led MUS at scale. Tshakhuma is a growing, urbanizing community of 3s666 households, so an estimated population of about 16300 people. It comprises wards 28 and 29, each with a councillor and ward committee, in Makhado Local Municipality. The main road R524 between Makhado and Thohoyandou crosses the community, including the Tshakhuma Fresh Market. The tribal chief is Nematshivandela, who oversees about 17 headmen. He reports to Va-Vhenda King Mphephu Ramabulana. Tribal structures and community forums ensure a strong community cohesion.

Rainfall is good and feeds many mountainous water sources, up to an estimated 9 big springs and 29 small springs. There is a multi-purpose dam for irrigation (by large-scale farmers in former white Republic of South Africa outside Tshakhuma) and for the municipal system. This system, which provides water for free, is the main source of water to homesteads for only 28% of the people (IWMI, 2017). As the municipal system had become too small with unreliable rotation and many leaks, since 2010, over 12 groups across Tshakhuma had come together and contributed to buy materials to tap into the surrounding mountainous springs or streams. With that money they built an intake at the source, a main pipeline to the storage of between one and seven 5000 litres jojo tanks, and reticulation, mostly to yard taps. These gravity systems were used for domestic uses but also to irrigate trees and vegetables (mango, spinach, avocados, banana, litchi, tomatoes, maize, mustard, naartjies, papaya, potatoes, onion, peri-peri, macadamia, sugar cane, carrots, cabbage and beetroot). Rainfed maize is cultivated during the summer. As one of the MUS forum members expressed: 'If you are poor and things don't come your way easily as for others, you have to work and think hard'.

This collective action has been described in detail in IWMI's diagnostic study (2017); the 10 minutes video of the water story of Tshakhuma designed and video-ed by MUS Forum members (available at http://stories.iwmi.org/voicing-water-visions/mus-south-africa/), and in Hofstetter et al. (forthcoming in Water SA). See **Figure 26**.

On 26 September 2016, Tsogang met with Vhembe District officials and the Department of Water and Sanitation to introduce the MUS concept and the upcoming MUS project. Tsogang also asked for advice on which communities to visit as potential demonstration communities. Collaboration with government structures from the earliest phases onwards was vital for the ultimate project goal to upscale the replicable advantages for downstream investments.

On 6 October 2016, following up on this request, officials of the Department of Water and Sanitation enabled a meeting with 54 Tshakhuma community representatives from 11 sections, including civics, ward councillor committee members and represenatives of the tribal authority. The Department had also implemented other water projects, for example 'Adopt a River' in Tshakhuma. Tsogang explained the project goals, clearly indicating that this was a small project of partnership and mutual learning – not mentioning money at all. Participants raised the issue of ownership: will Tsogang and

IWMI take away what the community has started, which is their own innovation? Tsogang assured that nothing is going to be taken away. The project is only to support what has started and is driven by communities, to build capacity and learn from them and share the knowledge to sustain their projects. Participants at the meeting also raised the need for coordination through a steering committee. If Tshakhuma was going to be selected for this project, there should be an inclusive, gender sensitive committee representing all sections. Participants of each section were encouraged to compile a small profile of their water supply. The project team also visited the nearby Mulangapuma-1 storage and Mulangapuma 2 intake in the Barrota banana farm.

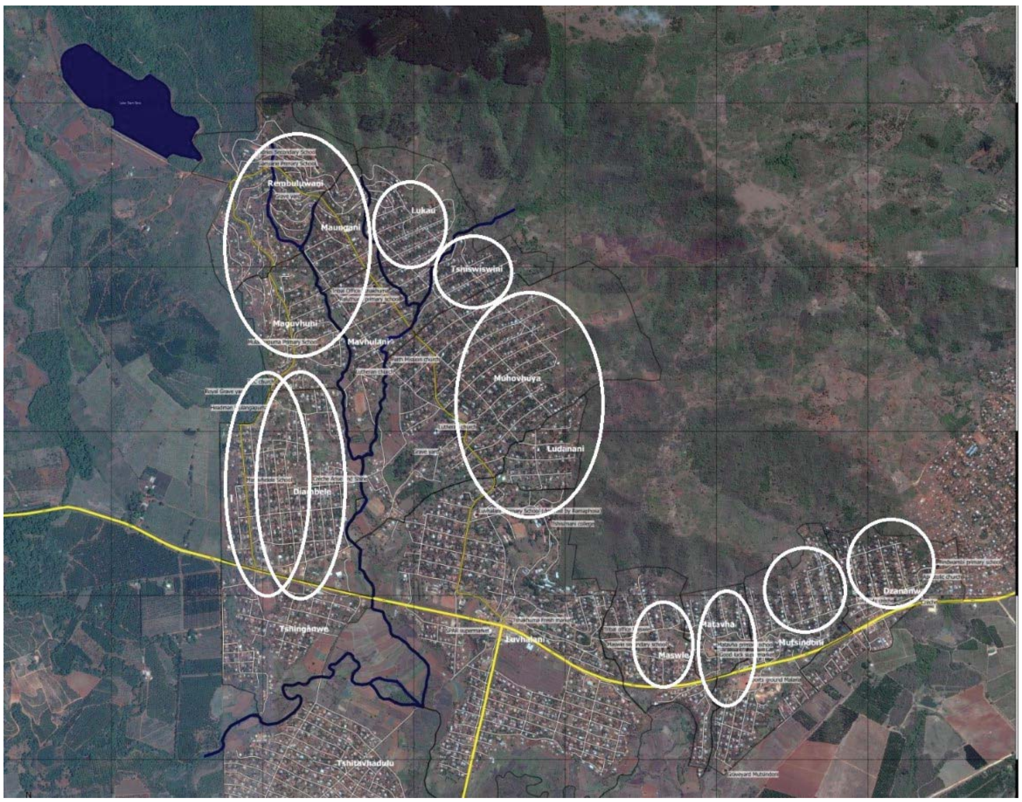

Figure 26 Map of Tshakhuma and 9 sections with the 11 self-supply water systems in the MUS project (source 't Hart, 2017)

After this, Tsogang, with inputs from IWMI, prepared a report on the initiatives, commitment and resources that the community had brought in to build their own water projects. The report was shared with WRC, district and provincial government departments of water and agriculture, and the Limpopo Provincial Premier's Office. All stakeholders were happy that the community of Tshakhuma, without waiting for the government to deliver water services, had gone that far to provide and maintain their own water systems.

In the meantime, one section present at the meeting, Luvhalani, decided to withdraw; they preferred continuing independently from outsiders. Another section present, Tshitavhadulu, was at further distance at the foot of the hills and used water from boreholes; the MUS project decided to exclude. This meant that 9 sections with 11 schemes continued in the MUS project: Dzananwa, Mutsindoni, Matavha, Maswie, Muhovhoya 1 (private), Muhovhoya 2, Tshiswiswini, Lukau, Thondoni, Mulangapuma-1, and Mulangapuma-2. These comprised 2360 households (64% of the total number of households) who had contributed to the capital investments and were members of the 11 schemes (see **Figure 26**).

5.2 Steps 1, 2 and 3. Introducing and establishing the MUS Forum; partial diagnosing; and envisioning solutions

7 February 2017

Tsogang organized a mass meeting with the DWS official and 45 participants, many of whom knew the earlier ‘Adopt a River’ project, to provide feedback about the meeting and site visit in October and about the positive response by officials. DWS clarified that the MUS project is about partnerships with communities that are already doing things for themselves and not rely on the government for everything; it supports people to develop more, because they are ready. The MUS project builds on what already exists. The project’s action plan for further diagnosis of each of the 11 systems and the establishment of a MUS Forum was also clarified.

21, 22 and 23 February, and 21, 22 and 23 March 2017

Tsogang visited all 11 communal systems interested in the MUS project, interviewing committee members and observing and measuring the quantities and quality of existing infrastructure. This included the type and sizes of pipes used and GPS information for sketches of the systems. The Tsogang facilitator also discussed potential solutions of upgrades and repairs.

As detailed in Tsogang’s 11 profile reports and the IWMI base line (2017), there were both differences and communalities in the systems. Also, there were remarkable strengths, for example managing pressure over long distances up to 3558 m; mostly yard connections, so protecting to vandalism and to outsiders who don’t contribute; collective initiative in which the likely future pressure by neighbours to share any available water supply was an incentive to organize from the onset). But some of the weaknesses were:

- Matavha and Mutsindoni shared the same source, which was weak. Elsewhere water resources were generally available. Some systems tapped into two sources
- Intakes were unprotected, so were potentially washed away by floods, and were easily contaminated by animals, or blocked by debris
- Only two systems had a pressure/filter box (Muhovhoya private system and Lukau)
- Storage by 5000 litres jojo tanks was often the limiting factor. The number of jojo’s varied from zero (Muhovhoya private system) or one (Maswie) to five. This required rotational water distribution. Tshiswiswini was an exception with six functional jojo’s, partly donated by DWS and politicians in 2010, and had continuous supply
- Some jojo tanks lacked a concrete slab stand. Some jojo’s were not properly secured
- There were leakages in the main pipe line and reticulation pipes because of: low-quality materials and loose fittings; unburied pipes so exposure to sun; and tampering and damage by playing children, porcupines, cars, or road construction works
- There was an over-reliance on voluntarism. The envisaged contributions of ZAR5, ZAR10 or ZAR20 for stipends of the operators were rarely collected
- Instead of keeping a fund available for repairs, all systems, except Mulangapuma 1, relied on ad hoc contributions in case of breakdowns, which caused delays

- There was no record keeping and transparency on how the committees used contributions. This fed mistrust and hesitation to contribute money. Only Thondoni and Mulangapuma 1 kept records
- In the only privately-managed system (in Muhovhoya) the above-mentioned problems were addressed. Water services were good but the price was high and not everyone paid
- The water quality was poor because of contamination and debris in the intakes and ineffective or no use of chlorine in the storage to purify
- Maswie had a different design: the communal gravity system with one 5000 litres jojo collapsed because the source was weak or because the low-quality buried main line collapsed, or because of another, unknown reason. Downhill of the community the municipality had installed a borehole in 2015 but this was never used. The municipality had promised to connect a pipe line of 467 m to the high site above the houses where the storage tank had been, but this was never realized
- And, last but not least: not everyone was included in the systems. In some cases, the distance was too far. Or households did not contribute to the capital costs. For some this was a choice because they had alternative options, including the municipal system and own boreholes, or they doubted that the initiative would succeed. In other systems, in which the water supply of the system was just enough to satisfy existing users, they refused new members. However, for poor households the initial capital costs were and remained too high

27 March 2017

Tsogang organized a mass meeting to provide feedback about the above-mentioned system profiles, and to reiterate the nature of the MUS project as a partnership to support existing water systems, in which Tsogang facilitates. Participants wondered whether they were expected to contribute. It was clarified that Tsogang worked under the Water Research Commission and that the precise contributions of the project to Tshakhuma and the community were to be discussed during the participatory designs.

Tsogang also underlined the importance of establishing one structure for the MUS project because engaging with 11 committees at once was, obviously, problematic for them. This Forum would serve as the link between the project and community, and would report back to the community and account for all the resources used. Gender balance and good representation of the tribal authority, the municipality, water committees, and farmers and all sections of the community were crucial. It was agreed to have one executive committee consisting of one main representative per system. Accordingly, participants raised hands to give names of potential candidates, which was followed by somebody seconding the candidate.

Tsogang also informed the meeting of the planned Participatory Rural Appraisal Activities in April 2017 and requested everyone to attend.

28 March 2017

The newly selected MUS Forum met to elect its executive committee members, independently of Tsogang. They also filled Tsogang's forms about expertise in respective fields, and need for further capacity development, with the following proportion of positive replies about past training of the various sub-components in these fields: organizational training (65%); agricultural training (52%); health training (45%); bookkeeping training (22%); and project management training (2%).

5.3 Step 2. Continued diagnosis

11 and 12 April 2017

The participatory mapping of the community, houses, roads, and water infrastructure was organized in three groups at three different sites. The three maps were later translated into one big participatory map representing all participating sections of Tshakhuma.

On 11 April, Mutsindoni, Mathava, Maswie and Dzananwa, represented by one or two persons per section, drew their map. One participant commented that Tsogang already had the information asked. On 12 April, Lukau (4 participants) and Tshiswiswini drew one map, and Muhovhoya, Mulangapuma, and Thondoni drew their map.

12 May 2017

The PRA continued with a Venn diagram on formal and informal institutions in Tshakhuma, diseases and community needs. Seventeen women and fifteen men attended this meeting. Tsogang continued transect walks for verification, further refinement and rectification of information found.

28 June 2017

A meeting with the MUS Forum was organized, also attended by Tsogang's civil engineer. The participatory maps were combined and verified and refined. The GIS map was also presented and finalized; participants appeared well able to read the screen and detail the precise reticulation. The engineer asked the participants about their main technical problems and listed those.

5.4 Step 3. Envisioning solutions

7 August 2017

Based on the above-mentioned diagnosis, Tsogang suggested and discussed the following potential solutions at a mass meeting with the MUS Forum, tribal authority, ward representatives and others.

Source protection and development

- Fence water sources and spring eye, and protect with concrete and stones to prevent pollution
- Cover water sources with good shade net to prevent foreign materials leaves from falling into the source
- Build boxes to serve as a filter for dirty materials
- Replace low class HDPE pipes with good quality HDPE pipes and bury them, and connect with the right fittings

Storage development

- Increase the storage capacity of small community water schemes by adding more jojo tanks to the existing 5000 litres tanks bought by the water users of each system
- Cast a concrete slab to serve as the base for jojo tanks
- Protect the jojo tanks site with fences

Reticulation and other

- Replace damaged control valves and other fittings to prevent leaks
- Include households that are not part of community water schemes, and dig and bed trenches for the reticulation
- Encourage the Department of Health to supply chlorine used to purify the water
- Build both technical and project management knowledge in the community through capacity building programmes, including operation and maintenance

For the allocation of the 20 household jojo's, that were to be installed on concrete slabs, the MUS Forum chair adopted the following procedure. She asked all sections to write names of the really poor, lifelong sick, and crippled people. This explicitly included those who were NOT in the current systems. Some members first disagreed claiming that the project was there thanks to them so that they should be the ones to benefit. Members of the Muhovhoya private system had even mainly proposed the names of own family members. However, the chair continued and took the names to the royal office. Taking the example of her own system, Mulangapuma – 1, she left the final choice of beneficiaries to them. The ones who were selected by most of the tribal representatives received the jojo. She proposed that the same procedure was followed for the other sections.

4 and 5 September 2017

Tsogang visited all systems to further assess and verify existing systems and discuss the identified possible solutions with community members. This confirmed the above-mentioned general solutions, which were specified per system as needed.

An issue arose when discussing the site for new storage in Muhovhoya. Storage was still lacking in the private system there. However, the MUS project's support was meant for the community as a whole, so the envisaged storage should be built on a communal site and should not primarily benefit the owner of the private system. So the MUS Forum identified a new site on communal land and one, and later two sources for that system. The new system was meant for those who were not connected to the private system before and customers of the private system (who could be cut-off if they did not pay) but preferred a – cheaper – communal system. Some interested new users committed to buy materials for the reticulation to yards and committed to provide labour. The owner of the private system entirely withdrew from the project. His decision was confirmed in the section's community meeting with the headman ('*nduna*'), also in writing in a letter of 17 September 2017. So there remained two systems in Muhovhoya for the MUS project: the existing communal system and a new system.

Further, on 1 October Tsogang and the MUS Forum wrote a letter to the Makhado municipality to ask permission to reticulate and use the borehole of Maswie. After several follow-up reminders and visits and with support from DWS, a confirmation letter was issued.

5 October and 15 November 2017

At the next two meetings, Tsogang presented the findings from the participatory design and the field visits to all 11 systems, and proposed interventions. The latter were based on the discharges measured and an assumed 2% growth in population. A bill of quantities was compiled as well. There were slight differences in amounts between the systems, depending on local specificities such as distances of storage and length of main line, quality of existing works (for example, concrete slabs and well tied jojo's), or other (for example, it was suggested that Thondoni would not need extra jojo's). For Maswie, the borehole was to be reticulated and connected to three new jojo's at an elevated site and connected to the existing reticulation.

When IWMI asked participants at that meeting on 15 November about their views on the process up till then, participants appreciated the participatory process ('in the beginning there was no light, but now we see we get somewhere', 'there is no way to go back anymore', 'by sharing we learn from others'). They confirmed the need to discuss, without hurry. They highlighted the communal interest, not just personal, benefits.

After visits by an engineering consultant for Tsogang, the works were also detailed as drawings in the report Draft Design Information for Tshakhuma and the Book of Drawings by January 2018. The total proposed budget was ZAR 942 464, including the 20 household jojo's. In all interactions, Tsogang and the MUS Forum emphasized that these were *drafts* only without any commitments, as final outcomes depended on the next step 4.

5.5 Step 4. Planning and fitting the financial framework

5.5.1 Final designs and costing

In the following months, this proposal was submitted and discussed with the funders: the Water Research Commission and African Water Facility. At this overall project management level, there was an attempt to allocate the funding more equally among the communities while also considering costs of opportunities, and to a lesser extent number of people benefiting. The other issue was how to compare needs in functioning self-supply systems as in Tshakhuma with needs in public infrastructure that is too small or dilapidated or with needs for first-time access as in other communities.

The question on work arrangements, community-led construction was even more obvious than in other communities: the people in Tshakhuma would continue implementing the upgrades of their own construction. In no way would outside contractors have a role to play. The other final decision to take by the Water Research Commission and African Water Facility was whether the works should be voluntary or remunerated with stipends. For all communities, it was agreed to align with national programs and pay a modest stipend of the same amount that the Extended Public Works Program applies: ZAR90 per day. Accordingly, Tsogang subdivided the scope of works into daily tasks. For example, six meters of trench digging of 70 cm depth and 50 cm width is one task of ZAR 90. Backfilling of that stretch is ZAR35. For Tshakhuma, the total stipends were budgeted at ZAR 7754 per system, plus ZAR 14,000 stipends for the 20 household jojo's so a total of ZAR 99 300.

However, the finalization and approval of the list of materials took long in Tshakhuma. When WRC screened the list for the specifications, it found ambiguities in the description of the materials, so the specification process had to start over again. Ultimately, the budget for the materials was reduced to ZAR 602,544, including the 20 household jojo's. So, with the ZAR 99 300 for stipends the total budget for Tshakhuma was ZAR 801,844.

5.5.2 Formalizing contracts

A plan for financing and clear contractual arrangements was drawn up in line with the requirements of the Water Research Commission at national level and the African Water Facility at international level. Workers would be paid once works were done, inspected and approved. For such payment, the MUS Forums had to be formalized by registering as a Primary Cooperative under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005) under the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries. This structure also enables bidding for government tenders or donations. On 22 September 2017 the Tshakhuma Multipurpose Primary Cooperative was registered with the CIPC branch in Thohoyandou.

In addition to registration as a Primary Cooperative, a bank account needed to be opened, co-signed by Tsogang and three MUS forum members. Other requirements were a tax clearance certificate (with annual renewal). The MUS Forum chair already had a South African Revenue Services identity certificate, which could also serve as tax clearance certificate for the Cooperative. A Broad Based Black Economic Empowerment Level One certificate (by CIPC and signed by Commissioner of Oaths, also for annual renewal) was also needed.

5.5.3 Memorandum of agreement

A Memorandum of Agreement between Tsogang and the community implementers on roles, responsibilities, plan, process and reporting, was explained, agreed and signed. The final version specified the stipends at ZAR 99 300 and the broad works to be done as above, but without clarity on the final list as yet, also because materials still had to be tendered. It was signed on 1 April 2018 (see details above in chapter 2.6.2.3). Tsogang signed a Contractors Risk Insurance policy against fraud and theft with Smit & Kie Insurance Company of ZAR 4000 per community.

5.6 Step 5. Implementing procurement and construction

5.6.1 Procuring and delivering materials

The amount for materials for Tshakhuma was more than ZAR 500 000, so WRC's tendering procedure for procurement was more complex than in the other five communities. The preparation process started in a similar manner, so the Supply Chain Management prepared the bid with specifications ('specs') of all materials to be supplied, including transport to the community. As mentioned, ambiguities had to be clarified. This was then evaluated by the Bid Evaluation Committee. The WRC Board needed to approve this expensive procurement, which is normally done at the start of the new financial year of 1 April, but it was still possible in this later case. On 20 July 2018 the bid was advertised in the government tender bulletin and in national treasury's e-tender publication, for a 21-day period. In addition to the requirements of having a local presence, registration at the national suppliers' data base, and a tax certificate (and optional BBBEE for extra points), tenderers also had to submit three reference letters showing that similar tasks were well performed.

Work design and drawings for Tshakhuma are attached as **Appendix 4**

After evaluation and adjudication of the dozens of bidders, WRC held discussions with the winner MT2K to further clarify the list. On 26 November 2018, Tsogang also met with this supplier and together they went to see Tshakhuma's MUS Forum chair (not inviting the other MUS Forum members) to further clarify and adjust the list. Finally, from 1 December onwards, the materials were delivered. This was done in batches, which required repeated checking by Tsogang and the MUS Forum chair and one MUS Forum member who volunteered as the coordinator. With further delays due to the December holidays, weather, and electricity outages, delivery was only finalized on 17 January 2019. Materials were safely stored at the headmen's homes. A local car owner transported workers and materials to different sections of the community, at symbolic allowance.

Tsogang's signing off on final delivery triggered WRC's payment of the supplier. The supplier's price was ZAR 888 797. Comparing the supplier's price with maximum prices of the materials on-the-shelves in local shops by then, and 2% addition, Tsogang estimated an amount of ZAR 661149.62, which represents a substantive mark-up of 34%. This underscores the case made for local procurement, as in section 2.7.2.2.

Thus, more than a year had passed since the draft lots had been submitted to start step 4 up to step 5's delivery of procured materials. It took time for the WRC to divide the budget among the six communities; arrange agreements; to clarify the bills of quantity; to undertake the long procurement procedure for due diligence; and the supplier needed further clarification of the list.

The main problem felt was the lack of clarity and transparency by the entire MUS Forum. The problem was *not* so much the time lapse as such. Similarly, the problem was *not* the reduction of the budget between the draft list of materials that had been discussed with the MUS Forum and the final list as ultimately decided by WRC. Tsogang had always been clear that there is not much money and that the submitted lists were *drafts*. But promises about money remain delicate, so clarity is even more important. Or in community member's words: 'If you have 5 cents and the community one cent, be clear what the 5 cents do'. This lack of clarity was compounded by the fact that only the chair of the MUS Forum was informed about changes in the list of materials, and not the entire MUS Forum. Other MUS Forum members expected the chair to give such answers, without her being informed either. When people start asking questions or raising doubts, if not worse, local project leaders become vulnerable.

Obviously, the task of the implementing agent as mediator, in this case Tsogang, is complex: negotiating bottom-up proposed solutions, out of indefinite needs, with the highest decision-making levels. Then, once higher-level decisions have been taken, the same agent has to communicate these decisions again back to the local levels. When proposals are partially rejected this is an intrinsically embarrassing task. However, local project partners are the most vulnerable; they bear the brunt with regard to any lack of clarity on these decision-making processes.

5.6.2 Community-led construction

5.6.2.1 Training, recruitment and organization of works

As for the other MUS project communities, Tsogang prepared construction work by a four-day technical training to the MUS Forum from 16-20 April 2018. Four men and five women participated. Themes included reading and interpreting drawings, identifying different types of pipes, pipe laying, excavation and back filling process, checking the scope of work against materials requested, Occupational Health and Safety and First Aid.

At the start of the works, the Tsogang facilitator and the MUS Forum re-calculated the budget available for the remuneration of skilled works and the stipends of semi-skilled works. By reducing prices for labour, money was saved for local adjustments and unforeseen expenditures, for example for transporting or carrying materials to the – sometimes very-distant water sources in Tshakhuma.

For semi-skilled works in the communal systems, the MUS Forum chair explained her approach as follows. She, together with a MUS Forum member who became a coordinator and volunteer messenger (so delivering letters with a signed note by the receiver confirming that the letter was delivered) endeavoured to maintain the project as 'one – Tshakhuma'. In this way, they would operate as a group so that they can learn from each other's section's situation. Also, the works in the different sections were quite different, as some sources were distant and others not. By working as a group moving from one section to the next, the tasks would be equally divided. Thus, she selected one leader from every section and first they discussed among themselves on 30 January 2019. Then, each leader was expected to mobilize five volunteers in the way that he or she liked; that was their task.

For the skilled builders, the leaders decided to only work with builders with a certificate. Each was invited to give their price for each of the works, and they took the average as the flat rate price. So ZAR700 for pressure box; ZAR500 for the slab of jojo's; and ZAR 300 for fencing. The total costs for skilled labour were estimated at about ZAR 30 000. So, about ZAR 60 000 was left for semi-skilled work. The MUS Forum chair took minutes and the leaders signed. As she was 'finding her way through the project', she realized the importance of having such minutes to be able to remind everyone as needed.

On 1 February, the 10 leaders plus their 5 volunteers plus the MUS Forum chair met in a mass meeting, with 61 participants in total. It was confirmed that they would work as a group moving along all sections, starting with the triple-M (Mutsindoni, Maswie and Matavha). A starting time was given between 7.30 and 8 hrs. As they were volunteers, workers were free to leave when they wanted. A volunteer took care of transport of workers and materials at some compensation for fuel. Rules and sanctions were agreed upon as well and written in the minutes: no quarrelling, no gossiping but respect. If somebody ignored the rules s/he would first be spoken to. If that did not help, the tribal would be informed with a letter. (In practice, in one case, somebody had been spoken to, but it could already be solved). In the 1 February meeting they also first invited youth to apply for jobs as builders, but there was no one. So then three older builders came forward (for the fencing others were recruited).

During the works the names of those who worked were noted on a sheet that the MUS Forum chair had seen in Khalavha. There were 30 women and 31 men. In Maswie, for example, it took 2.5 day to dig 300 m. There is no rock there, but the soil is hard. However, it appeared challenging to work with such a large group, especially because some people were not so interested and it was hot.

Once all works in the month of February had been done, the leaders estimated that it was about one third of all works, so they asked Tsogang to pay one third of the ZAR 60,000 available for stipends. They decided to divide that over all persons who had worked. Thus, they shifted from payment by task to payment per person per day. In this way, the weaker persons such as elderly who 'work from their hearts as hard as they can' still got the same stipend. This turned out to be a daily rate of only ZAR 37. Tsogang paid the ZAR 20 000 in their bank account, and the signatories withdrew cash and put in envelopes for everyone. The workers signed when they received. (It would have been easier, and also safer, if everyone had a bank account).

The MUS Forum chair kept the royal kraal informed about progress. The importance of this was confirmed by the following event. In a tribal meeting in Lukau, one person raised his hand, exposing that the rumours had been that there would be ZAR100-105 per day for this. But they only got ZAR333 for 9 days. They suspected the money to be in the chair person's account. The headman ('*nduna'*) kept quiet. Later, when the MUS Forum chair met him and explained all details, the *nduna* admitted: 'There was a spirit near me not to respond so I kept silent. So good that I did. They might have killed you'.

In subsequent sections, this approach of working together with five persons from each section was given up. Each section recruited mainly from within that section. As payment was only done when the given set of works was finalized, payment risked being very late, especially when works were delayed because of rains. To accelerate payment, the headman of Matavha pre-financed payment to seven people who had worked very hard. Or communities contributed spontaneously.

5.6.2.2 Results

Preparing for step 6, the use phase, Tsogang organized training from 18 to 22 February 2019 in a conference venue near Tshakhuma on scheme operation for the MUS Forums of all three Vhembe communities (Tshakhuma with 5 men and 5 women; Khalavha with 2 men and 3 women; and Ha Gumbu with 5 women). Topics included knowledge of environmental health and community hygiene practices, water quality, climate change, operation & maintenance, and basic bookkeeping.

In Maswie, the main pipeline from the borehole to the three new big jojo's storage was installed and a concrete slab was built as the base for these jojo's. However, it took about half a year before the municipality came to open the pump house and connect to the new reticulation and storage system, and even added more storage.

The further works, organized by section, progressed slowly. All household jojo's were distributed to the agreed households, and slabs were constructed. The upgrades of the sources took especially long where the sources were far and where vehicles could not come, so heavy loads had to be carried. Further during the implementation of works, it became clear that some materials ordered for one section had to be shifted to other sections to fill gaps there. Tsogang and the coordinator kept track of these movements. In Mutsindoni and Matavha, the shared water source appeared weak indeed. Alternative sources had to be explored for better water supplies.

In Mulangapuma, the MUS Forum insisted on an engagement with the community of Mulangapuma-2 before any installation of new jojo's to avoid the problems faced in the past with jojo's that had been given to Mulangapuma 2. However, the Tsogang facilitator at the time ignored this request. The MUS Forum took events in their own hands, and the facilitator was re-assigned.

Last but not least, Tshakhuma attracted major political attention, up to the Minister of Water and Sanitation. On Mandela Day 18 July 2019, both the mayors of Makhado Local Municipality and Vhembe District implemented the national services by helping in the construction of a filter box. They also engaged in an open, direct dialogue with representatives of the other five demonstration communities and researchers. As documented in chapter 9, this significantly advanced a national recognition of self-supply and opened up new debates on the roles of government and other support agencies to support self-supply. Similarly, the MUS Forum chair spoke with the Minister of Water and Sanitation, and gave a key note address at the WRC international conference's award-giving event.

5.7 Conclusions for supported self-supply at scale

Tshakhuma made a clear case, up to the highest national levels, of the existence of considerable local technical knowledge, organizational capacity and financial willingness and ability to pay that directly contributes to the achievement of a range of government goals: everyone's right to affordable basic water services, food security, nutrition and local economic development. Tshakhuma's fresh fruit market provides a market pull for the latter. However, without collective contributions for operation and maintenance, the sustainability may be at stake. Further comparison with strengths and weaknesses of private ownership and operation, as in Muhovhoya, will be insightful. Other potential weaknesses regard water quality for the 3-5 litres per person per day needed for drinking and the risk that those who cannot afford the initial investments in construction are left behind.

The MUS Forum in Tshakhuma made very clear that self-supply does not exclude government, on the contrary: self-supply is seen as being 'on behalf of government'. After all, 'we as the people ARE the government'. 'We are together'. Even stronger, self-supply is yet another reason for government support: 'we first did our own thing and now invite government for further support'. 'We are ready'.

The experiences of the MUS project shed the following light on what support could be provided at even larger scales, so anywhere where communities invest or consider investing in communal self-supply.

Technically, support for infrastructure can be light-touch, and focus on providing additional materials. The challenge is to avoid wish-lists. In line with the principle of 'meeting each other half-way', government or other support agencies can require users' to share in the costs of the materials. This would also avoid new dependencies. Materials should be locally procured. Subsidies for materials could focus on inclusion of everyone in ways that align with local safety net arrangements.

The project framework (step 0) would stipulate criteria and conditions for allocation. One condition could be the establishment of a committee or task team that ensures transparent book keeping with proofs of payments to all member water users. Other managerial conditions can include (training in) roles and responsibilities for maintenance, repair, and asset replacement. The project framework may further include technical guidelines, if not conditions, on safe pressure and storage management, source protection, quality of materials, etc.

So steps 1-3 and 5 would be largely community-led. It may provide sufficient due diligence when governments, NGOs or other support agencies just broadly announce the detailed program framework as in step 1; conduct a technical field visit to the system to check the identified need, or advise as needed (step 3) and hold a post-construction monitoring visit (at the end of step 5).

Moreover, government remains responsible to ensure that 3-5 litres per person per day are safe for drinking. Expertise on water quality assessments, source protection, or point of use treatment will inform the most appropriate local measures.

Both technical and managerial issues of collective maintenance and repair and drinking water quality concerns can well be addressed in exchange visits and meetings local technicians (including women) to discuss problems encountered and solutions may be most effective. Manufacturers of self-supply technologies can attend.

This type of support to self-supply is also the lesson learnt from the experiences in the MUS project's second community with self-supply, Khalavha, as detailed in chapter 6 below.

6 Khalavha

6.1 Step 0. Selecting

Khalavha, Ward 32 of Thulamela Municipality, is situated 30 km north-west of Thohoyandou, along the R523 tar road (see **Figure 27**). It has 163 households and a population of about 800. Khalavha was proposed as a potential MUS demonstration community at a meeting with the Limpopo Department of Agriculture and Rural Development in Vhembe district. The community was also on the proposed list of Vhembe District Municipality. On 18 May 2017 the extension worker of the Department of Agriculture, Tsogang, and IWMI made an exploratory visit to three sites, including one section of Khalavha, Thondoni, with its communal gravity scheme for self-supply benefiting some 90 households. They met with the two initiators of the scheme.

Khalavha was selected because of its initiative for self-supply and accessibility for visits. Also, improved access to water was expected not only to improve wellbeing but also to generate more income. The community has fertile soils. The rainfall is high as the warm air of Thohoyandou rises and hits the hills as rain. This feeds mountainous water sources and streams. Situated along a main road, this market outlet is already used for the sale of rainfed avocados and litchis. Better water infrastructure would further enable irrigation for higher productivity and more sales. The existing municipal system was unreliable and the population was growing. This already triggered the development of communal gravity piped systems across the community.

Khalavha has five sections. Each section has a headman (‘*nduna*’) who reports to the higher tribal authority for Khalavha, Musanda Vho-Takalani Mpfuneni Tshivhase, who, in turn, reports to Chief Thovhele Kennedy Tshivhase. Since 1994, the tribal council also includes a few women. Since a couple of years, civic committees have been constituted which are federated into one civic. Block and ward committee members elect a Ward councillor, who reports to Thulamela Local Municipality. The community has electricity. Among the five sections of Khalavha, the MUS project focused on Thondoni section.

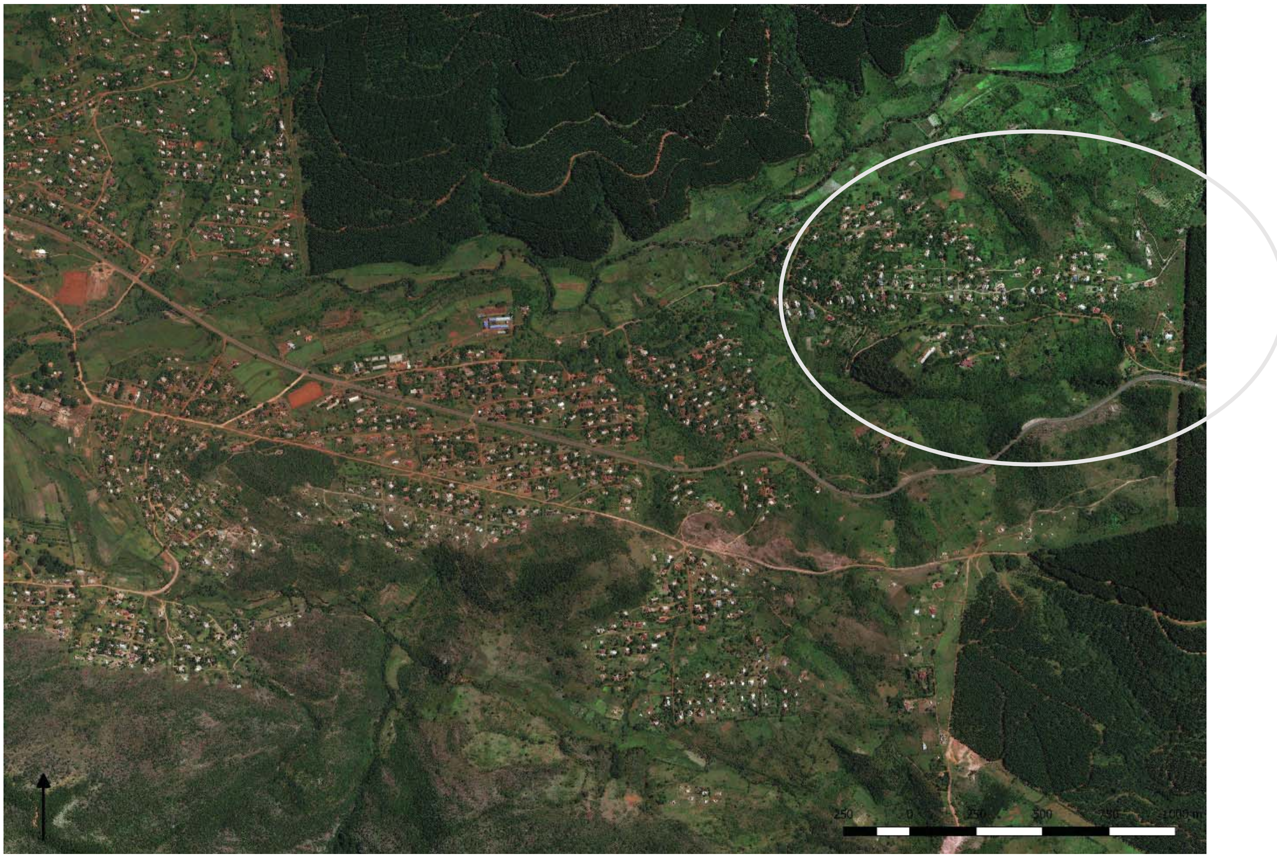

Figure 27 Khalavha with Thondoni section circled

6.2 Step 1. Agreeing to collaborate: introducing and establishing the MUS Forum

On 31 May 2017, the Tsogang facilitator, IWMI, the provincial, district and local representatives of the Department of Agriculture and Rural Development introduced the MUS project at a meeting with the authorities of Khalavha community, including the program director of the civic, the Vhavenda representing the tribal authority, many block representatives and a ward committee member. A total of 33 persons participated (21 men, 12 women). The ward councillor could not attend and was later informed of the meeting.

The Tsogang facilitator explained the criteria for establishing a MUS Forum, including equal women and men representation from Thondoni section. There was no objection to leave the election process in Thondoni to a later moment, as it was said 'we know each other'. The five men and seven women appointed are all 42 years or older. Without youth, the long-term sustainability may be at risk.

On 2 June, Tsogang assessed the skills and training needs of the new MUS Forum. They filled forms on skills and training needs for institutional social development, financial management, project management, technical skills and health and hygiene. The exercise highlighted very limited earlier training.

6.3 Step 2. Diagnosing

6.3.1 Site visits and base line assessment

During the exploratory site visit in May and another site visit in June, the two 'local engineers' showed Tsogang, IWMI and partners the communal system that they constructed in 2010. On 10 July, Tsogang staff, including its engineer and the two local engineers visited the site again to further check the water resources, pipeline, storage, reticulation and the system's multiple uses. This showed the following.

The spring is in an in an area called 'Lanare' (buffalo). Surrounding areas were taken by the Entabeni Tree Plantation of Komatiland around 1979/1980. The various households who lived in that area were removed to make way. A land claim for some form of compensation has been lodged. The source lies in an area that used to belong to a neighbouring community. However, no one ever objected, and there was no need to ask permission of anyone when the local engineers decided to construct a small weir to divert a perennial stream to their 5 km long pipe. The pipe goes through a valley and then up again to serve the households on top of the hills.

The material of the pipe was not good, but people were unable to afford a higher price. Also, the first part is 100 mm diameter and the next part is 50 mm; that difference is too big. Operation and maintenance is intensive. After rain, debris of the intake gets in the pipe and clogs. All parts have to be disconnected again to clean it. Fittings and clamps can get loose and there are leaks. The pipe is not buried. When the pipe was damaged by a veld fire, the Entabeni Plantation assisted with material to repair.

There are 15 street taps but some pipes end as simple bends to stop water (but they may be left open and waste water). A few households have yard connections. Some 90 of the 163 households contributed to the purchase of the pipes, but it is difficult to prevent other households from using the communal taps as well.

The reason for constructing a communal gravity system for self-supply was the irregular water supply from the municipal system. That system pumps water from the downstream Nzelele river to a concrete and fenced reservoir on top of the hills. The system was improved after 1994, but with the expanding population and growing demands the supplies were insufficient for most people. Moreover, the water supplies were unreliable and could be limited to once or twice a week or every two weeks, especially in the dry season. Also, in the upstream part water flows too fast to serve the households on top of the hills. This system has both street taps and yard connections. The municipality discouraged productive water uses.

As the base-line assessment found, the result is that virtually everyone accesses two or more water sources. For almost one fifth open streams are the most important water source. In Thondoni, there are no individual boreholes. In other sections there are very few; they also share or sell water. Half of the households irrigate their homesteads; another one third practices rainfed agriculture. Crops are maize spinach, beetroot, tomatoes, onion, cabbage, okra and calebash. Water is also re-used, especially for fruit trees; avocados, litchis, mango, papaya, banana and macadamia. Just over one third keeps livestock, primarily poultry (IWMI, 2017).

6.3.2 Participatory mapping and further rural appraisal

On 12 June 2017, community members engaged in the participatory mapping of the community and water resources, first drawing a large map on the ground. The map was later translated on paper. The exercise showed new elements to participants, including the precise lay-out of intake and pipes of the communal scheme. Later, the map also served to indicate the site of the new storage.

On 26 June, the existing formal and informal institutions were assessed. These included a Water Committee (6 women and 6 men) since 2017 to assist the operator of the self-supply system. It was also supposed to collect R5 per household, but this failed. The community also had a burial society, home-based care and social clubs to support each other. Chronic diseases prevailed and people got treatment from a mobile health facility that visited once a month. There was some crime in the area and the community established a Community Police Forum and Youth Committee that work closely with the local police station to combat crime in the area. The community first reports to the Tribal Authority to discuss these civic cases before referring them to the police for further investigations.

Various government departments supported Khalavha, including the Vhembe District Department of Agriculture. For example, the Natural Resource Management Division Thulamela worked on terracing and mulching to stop the alarming land erosion as a result of growing cultivation on the slopes. A farmer committee functioned as link between the department and the community. The Expanded Public Works Program was also active.

The needs assessment revealed the following needs in order of priority: refurbishment of communal system as there is insufficient water and pipes are weak, roads, markets, community hall, library, factories, shopping complex, sports centre, clinic, and street lights.

All this collected information was reported back to the MUS Forum for their confirmation.

6.4 Step 3. Envisioning solutions and prioritizing

As for the other communities, the MUS project envisaged donating 2500 litres jojo's to 10 poor indigent households. However, initially, the MUS Forum had misunderstood this targeting and wanted to take the jojo's for themselves and also to give one to the headman (*nduna*). In order to rectify, on 25 July, Tsogang organized a mass meeting with the MUS Forum, block structures, ward committee members, ward councillor, tribal council members, civic, and water committee to explain the targeting criteria of the "poorest of the poor" unemployed, pensioner or child headed families. A new list was proposed, verified, and endorsed by all participants. Thus, 10 household jojo's with concrete slabs, were included in the scope of works.

On 8 August, Tsogang and the MUS Forum organized a mass meeting in the Thondoni section, including the Tribal Authority, civic, Farmers Group, and ward representatives to identify communal solutions to improve the water situation and as demonstrations for upscaling. As the Thondoni section is well organized, the main support identified was materials and tools and equipment to install and maintain the materials, with the goal to also enhance productive water uses. Participants expressed their commitment to provide labour.

The materials proposed were:

Source:

- Fence against animals
- Build a cement brick separation box to sieve and increase pressure

Conveyance main line:

- Use big, high quality HDPE pipes to increase the volume of water conveyed
- Prevent leakages by using strong fittings (couplings, nylon adaptors, clamps)
- Install air valves to reduce air accumulated inside pipeline because of undulating terrain
- Use galvanised pipes to cross dongas and valleys
- Bury pipes

Storage:

- Install and fence 5 x 10 000 litres jojo tanks

Reticulation:

- Install proper communal taps and increase their number to ensure access by all 163 households

These proposed solutions were checked and confirmed by Tsogang and community members in a follow-up visit to all sites. Work design and drawings for Khalavha are attached as **Appendix 5**

On 6 September, a meeting was held to discuss and approve Tsogang's further detailed design with calculated discharge and based on the demographic forecast. This design also added a shade net (source); support structures where the pipe line crosses dongas and replacement of damaged leaking taps, so not necessarily the whole pipe line (conveyance), and yard connections instead of communal taps (reticulation). For the yard connections, households committed to help. Technical and water management training was to ensure sustainability.

6.5 Step 4. Planning and fitting the financial framework.

6.5.1 Final designs and costing

By end 2017 and early 2018 Tsogang further interacted, on the one hand, with the Khalavha community and on the other hand with the funders, the Water Research Commission and African Water Facility. At overall project management level, one concern was to allocate the funding more equally among the communities. Expected community contributions included storage and security. Designs, bills of quantities and estimated costs were refined, as in Work Design Books by March 2018. The above-mentioned agreed design was further checked and elaborated: the new intake would enable continuous flow for animals and downstream users; the length of the main line to be replaced was fixed as 1100 m; and a 500 litres jojo tank was added to the storage as sieve. Also, households promised to buy materials for their yard connections. Total material costs were estimated at ZAR 308 583. This was proposed to, and approved by the Water Research Commission and Africa Water Facility. Together with stipends of ZAR 66 850 (as below), the total budget for Khalavha was ZAR 375 433. However, changes continued to be made during the construction phase as well. Tsogang signed a Contractors Risk Insurance policy against fraud and theft with Smit & Kie Insurance Company.

6.5.2 Formalizing contracts

In parallel to the continuing negotiations on the final technical designs, a work plan with clear contractual arrangements was drawn up in line with the requirements of the Water Research Commission at national level and the African Water Facility at international level. For Khalavha's self-supply, it was obvious that community members would continue to implement construction. No outside contractors were needed. In the general discussions about all six communities on whether the works should be voluntary or remunerated with stipends, the latter was agreed. A modest stipend as in the Expanded Public Works Program would be paid: ZAR90 per day. Accordingly, Tsogang subdivided the scope of works into daily tasks. For example, six meters of trench digging of 70 cm depth and 50 cm width is one task of ZAR90. Backfilling of that stretch is ZAR30. For Khalavha, the total stipends were budgeted at ZAR 66 850.

Workers would be paid once works were done and approved. For such payment, the MUS Forums in all six communities had to be formalized by registering as Primary Cooperatives under Section 7 of the Cooperatives Act 2005 (Act 14 of 2005) under the Companies and Intellectual Property Commission (CIPC) of the Department of Trade and Industries. As well appreciated in Khalavha, this structure would also enable bidding for government tenders.

In addition to registration as Primary Cooperative with the CIPC (in Thohoyandou), a bank account needed to be opened, co-signed by Tsogang and two MUS forum members (one of the three possible banks was fully booked for four months to come). Other requirements were a tax clearance certificate (with annual renewal, arranged in November 2017 in the nearest SARS office in Lebowakgomo at over 200 km distance) and Broad Based Black Economic Empowerment certificate (by CIPC and signed by Commissioner of Oaths, also for annual renewal, for a BBBEE Level One, with 100 percent black owned and 80 percent black women). The lack of experience required explanation by Tsogang, also during district innovation meetings where all three Vhembe MUS Forums met. The process of registration as Primary Cooperative, registering a tax clearance and other certificates and opening a bank account took five months till December 2017 and required continuous support by Tsogang.

MUS forum members contributed costs for transport, registration fee of ZAR200 for a Primary Cooperative (with annual fees to remain registered), and other logistics for all registration as 'joining fees'. The MUS Forum included broad objectives of their business in their constitution: general construction, recycling, catering, and cleaning. Accordingly, in December 2017 the Phembani Community Project Primary Cooperative Ltd was registered. Tsogang also started using this structure for catering purposes of project or innovation forum meetings in Khalavha, also explaining how to invoice. This provided precious jobs for the Phembani Community Project Primary Cooperative, but was also a direct competition with another already existing Primary Cooperative specifically for catering in Khalavha.

Later on, the Primary Cooperative also successfully tendered for 5 percent of the budget for a community access bridge and for assignments by the department of health. Another Primary

Cooperative of Khalavha competed but lost. Because 'community' is part of the name Phembani *Community* Project Primary Cooperative, the civics summoned them to provide full information about any project budgets.

Tsogang distributed hard copies of a Memorandum of Agreement between Tsogang and the community implementers on roles, responsibilities, plan, process and reporting (see details in 2.6.2.3). This was agreed and signed on 1 April 2018. The amount for stipends was ZAR 66 850.

6.6 Step 5. Implementing

6.6.1 Procuring and delivering materials

As in the other communities, except Tshakhuma, the Water Research Commission proceeded to procure materials, following the national government procedures. Tsogang provided WRC with the names of hardware stores in Vhembe district that specialise in water equipment and materials. Within WRC, the Supply Chain Management prepared the bid for Khalavha and Ha Gumbu as proposed. Specifications ('specs') of all materials to be supplied, including transport to the community, were listed and evaluated by the Bid Evaluation Committee. A Request for Quotations (RFQ) was sent to the identified suppliers. The RFQ stipulated the conditions, in this case: having a local presence, a registration number in the national suppliers' data base, and a tax clearance certificate. A higher BBBEE status would give additional points. After receiving quotations, the SCM evaluated them on these grounds, plus, obviously, the price. The SCM's report was then given to the WRC's Bid Adjudication Committee. The winner was signed off by the Executive and informed.

In Vhembe, the winner was a black woman entrepreneur, whose enterprise met all BBBEE requirements. However, as soon as the bid had been awarded, she realized she had omitted the VAT of 14%, and still wanted to add that. That was unacceptable, so the RFQ process had to start all over again with bids coming in in June. Early July, Mathobo Holdings was selected. Tsogang further clarified the lots with him on 6 July. Mathobo Holdings got the purchase orders from WRC respectively on 12 July, and delivered all materials in Khalavha (and Ha Gumbu) between 18-22 July – 'even during the nights' as some people complained. For each batch, the Tsogang facilitator had to be present. Tsogang's final check and approval was on 31 July, so four months after signing the Memorandum of Agreement.

Materials were safely stored in Thondoni's new communal hall. Tsogang and local transporters assisted in transporting construction materials to the sites, either voluntarily or as a task for a stipend.

The supplier's price was ZAR 400140. Comparing the supplier's price with maximum prices of the materials on-the-shelves in local shops, and 2.5% addition, Tsogang found an amount of ZAR 287 470, which represents a copious mark-up of 39%.

During the innovation forum meeting with the other two MUS demonstration communities in Vhembe district in August 2018, they discussed their experiences with procurement. All communities favoured procurement by the communities themselves. This would promote the use of cheaper local available materials. It would also ensure that community members know where to get spares during operation and maintenance of systems. Participants felt side-lined by the MUS project's central procurement. They recommended that next tenders for procurements should be easier for local entrepreneurs to compete and to offer better service delivery at a reasonable cost. Savings from local purchase of materials could be used to build more infrastructure in the community.

6.6.2 Community-led construction

In preparation of the construction works, Tsogang gave four-day technical training from 23-26 April 2018 to the entire MUS forum of five men and seven women. Themes included reading and interpreting drawings, identifying different types of pipes, pipe laying, excavation and back filling process, checking the scope of work against materials requested, Occupational Health and Safety and First Aid.

As in the other communities, for the budget for stipends, it was tried to save money from works that could be done more cheaply. This gave some room for local adjustments.

Initially, the MUS Forum members did most of the works like clearing the site and digging the pipeline trench from the source to the new water storage tanks. With increasing workloads, more people were recruited. A meeting for the community and Tsogang was called to explain the need for further recruitment and decide on the criteria. For semi-skilled labour, there were more people interested than the 10 workers required for the digging of trenches, so the community decided to use yes and no pieces of papers. Those who picked up yes were recruited. The ‘no’s’ were encouraged to wait for their turn to come.

Skilled works included water source development, water storage (building and slab casting), and all fencing). Khalavha had various good local builders. They were asked to submit quotations. Three builders submitted quotations. After inspecting previous works, one builder was selected.

Works proceeded well in the course of 2018. In total, 639 person days of work were created, for 22 workers. Workers’ only complaint was that payment was late when some workers had to wait for other members to complete before works could be checked and submitted to Tsogang for Tsogang to pay the amount to the bank account of the Primary Cooperative. Once that was done, the two MUS forum signatories and the Tsogang facilitator could draw the money and pay cash to the workers.

Two men and three women of the MUS Forum received preparatory training for operation from 18 to 22 February 2019 (together with the other two Vhembe communities).

Just before construction, the design was changed. A small change was that the site for the five big jojo’s was moved closer to the houses for more safety than proposed during the earlier meetings. However, although the initial design was to only refurbish infrastructure and *not* build new infrastructure, a major change in the design was the construction of an entire new main line, side by side to the old pipes, and supported where it had to bridge valleys. So community members topped-up the budgeted costs for 1100 m pipe up with additional materials paid from the ‘savings’ of the stipends. They also improved and fenced the source. The 10 household jojo’s with slabs were installed.

The MUS Forum promised to pay for any shortage of materials, especially for the reticulation and yard connections from the new storage to households. They started to collect an amount between ZAR25 000 and 40 000. The new reticulation was to use the already existing municipal reticulation, as approved by the civic and without active involvement of the municipality. However, at the start of the COVID pandemic the storage was still unused.

6.7 Conclusions

The experiences in Khalavha underline the potential for upscaling support to self-supply at scale as found for Tshakhuma in the foregoing (section 5.7). Even stronger: communities can take their own decisions on the preferred design. In this case they preferred a completely new system in parallel to the other system. The long delays in the construction of the reticulation from the new storage to yards even warranted the back-up of the old system.

However, the second lesson learnt regards the reticulation to everyone's yards. In Tshakhuma this problem had already been solved in the design of self-supply to yards from the outset. However, in Khalavha, this appeared to be a stumbling block, in spite of contributions that had been made. There was also a problem in Ga Mokgotho, as documented in chapter 3. In step 3, water users in Ga Mokgotho expressed their preference for yard connections. Tsogang was available to support this technically. The increased supply might well have enabled this. Nevertheless, users' organization for yard connections did not materialize. The reason is not clear. As government keeps an important role in ensuring nobody is left behind, more attention is needed for this 'last mile of water provision': to everyone's yards.

7 Ha Gumbu

7.1 Step 0. Selecting

Ha Gumbu is situated between South Africa's most northern road, the R525, and the Limpopo River which is the border between South Africa and Zimbabwe. It falls under ward 9 of Musina Local Municipality. The entire community has over 1650 households and is growing. There are three sections, Gumbu-1, which is the largest section, Gumbu-2 and Gumbu-3 (see **Figures 28 and 29**). The traditional authority is Headman Johannes Mmboneni Gumbu, who reports to Chief Tshikhunda Malema. It is a hot and dry area with rainfall between 160 and 370 mm. However, the Limpopo River basin brings both fertile alluvial soils and abundant groundwater.

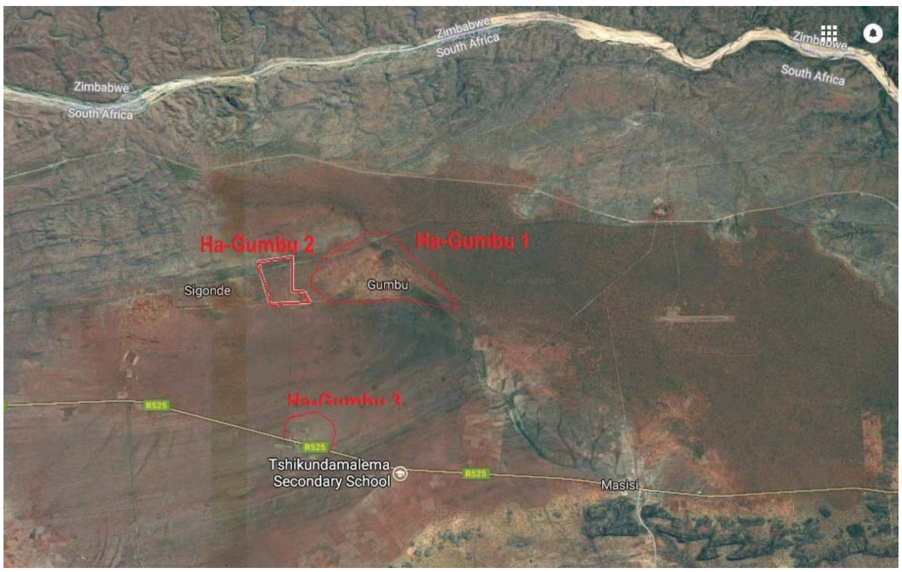

Figure 28. Location of Ha Gumbu between the R525 and Limpopo border with Zimbabwe

Figure 29. Lay out of homesteads and distant fields Ha Gumbu section 1

The Department of Water and Sanitation office in Vhembe District suggested the selection of Ha Gumbu as a demonstration community. On 1 June 2017, the Tsogang facilitator and IWMI visited Ha Gumbu and confirmed that it met all selection criteria for the MUS project. The project's goal to demonstrate MUS in diverse relevant settings was met because of widespread adoption of household boreholes for self-supply for both domestic uses and irrigation at the large homestead plots and distant fields. The number of households with boreholes was estimated at 96. Recent electrification that had reached 89 percent of the households (IWMI, 2017) boosted groundwater abstraction. Irrigated crops were okra, chillies, tomatoes, green pepper, green beans, cabbage and spinach in their yards. Produce is transported and sold to markets in Johannesburg. There was also a municipal borehole system.

7.2 Steps 1, 2 and 3. Introducing, diagnosing, and envisioning solutions

On 13 June 2017, Tsogang held a meeting with the authorities of Ha Gumbu to introduce the MUS project and conducted a site visit. The next day, a mass meeting was held to introduce the MUS project to all community members. The Tsogang facilitator explained the criteria for establishing a MUS Forum, including equal representation of women and men and of the different sections. The formation of the MUS forum was left to the community members. They selected five women and four men. A site visit was made, also to start exploring solutions.

The next day, on 15 June, the diagnostic Participatory Rural Appraisal (PRA) started. First, community members engaged in the participatory mapping of the community and water resources, first drawing a large map on the ground. The map was later translated on paper. The map also served for mapping solutions.

On 20 and 21 July, the diagnosis continued with an assessment of existing skills and formal and informal local institutions, health and other relevant community characteristics. This included the following history of the municipal borehole. After requesting the Vhembe district municipality, community members contributed money and labour to support the installation of a borehole system with diesel engine. They continued contributing to diesel. More recently, the voluntary pump operator got paid by the municipality. There is a hand pump adjacent to the borehole and one in the section of Ha Gumbu near the main road. The Tsogang facilitator summarized the diagnostic findings and presented those in a meeting. Possible solutions came up for further discussion.

On 7 September, Tsogang discussed the proposed solutions with the MUS Forum and took technical measurements, also confirming that the pump's discharge was sufficient. A draft Bill of Quantities was compiled as well. On 4 October, another site visit and meeting with the MUS Forum was conducted, now also with Tsogang's civil engineer. On 6 October, the further refined findings were reported back in a mass meeting, and priorities were discussed. This led to the following final proposal of solutions that aimed at ensuring that everyone has access to water within the standard distance of 200 metres as set by the South African government.

Refurbishment of the municipal borehole

- Increase the storage capacity and pressure by expanding and elevating the storage tanks. This should overcome the limited existing difference in height. The two 10,000 litres jojo's were only four metres above the ground. One option was to add three 10,000 litres jojo's at the existing site of the jojo's and lift all jojo's over another 8 metres, so up to 12 metres above the ground. The other option was to locate more storage at the slightly more elevated site in Ha Gumbu

- Fix the dilapidated iron roof sheets of the pump house and fence it

Extension of the reticulation

- With more storage and more pressure an additional 600 metres reticulation with communal taps would reach 100 new households in this expanding community
- Alternative ways of transporting water than carrying on foot were considered: 'hippo rollers' or wheel barrows

Rebuild and connect the cattle trough

- Rebuild the unused, dilapidated cattle trough next to the pump house and connect to the adjacent hand pump

Refurbishment of the existing hand pump

- Inspect and repair the faulty components of the existing dysfunctional hand pump

Household jojo's

- Unlike other communities where the household jojo's were allocated to the most vulnerable, the proposed allocation in Ha Gumbu was to hand out the MUS project's ten household jojo's to households owning their private boreholes. More storage would save them electricity costs of often switching on the pump. It would reward private initiative for self-supply. Based on the same rationale, 26 more jojo's were proposed

Agricultural support

- Supply farmers with seedlings, equipment and fertilizers to support self-initiated irrigation

Tsogang committed to contact Vhembe District Municipality for permission to work and extend the municipal borehole, refurbish the trough and repair the hand pump. Tsogang submitted the request on 1 October, together with the same request for the Maswie/Tshakhuma borehole (see 5.4 above). After repeated reminders, they obtained such permission. By that time, the Vhembe District Municipality informed Tsogang of their plan to replace the diesel engine with an electric motor.

7.3 Step 4. Planning and fitting the financial framework

As for all other communities, by end 2017 and early 2018 Tsogang further interacted, on the one hand, with the Ha Gumbu community and on the other hand with the funders: the Water Research Commission and African Water Facility. In Ha Gumbu as well, the community strongly preferred own construction instead of any contractors. The same arrangements held for Ha Gumbu: the payment of a modest stipend of the same amount as the Expanded Public Works Program applied: ZAR90 per day, for the subdivided scope of works into daily tasks, with the – communities' well memorized – standard daily task of six meters of trench digging of 70 cm depth and 50 cm width. For Ha Gumbu, the total stipends were budgeted at ZAR 57 830.

The above-mentioned design that the community proposed was discussed and finalized. The option to locate storage elsewhere, the support for agriculture inputs and the additional 26 jojo's for borehole owners were rejected. The number of household jojo's distributed remained 10, as in other communities.

Works design and drawings for Ha Gumbu are attached as **Appendix 6**

Tsogang estimated total material costs at ZAR 281 805. This was proposed to, and approved by the Water Research Commission and Africa Water Facility. This amount, with stipends of ZAR 57 830 as below, brought the total budget for Ha Gumbu at ZAR339 636.

As for the other communities, the MUS Forum was formalized into a Primary Cooperative; a bank account was opened; a tax clearance certificate and Broad Based Black Economic Empowerment Level One certificate were obtained. Accordingly, on 21 December 2017 the Gumbu Dishume Primary Cooperative Ltd was registered. This process of five months required continuous support by Tsogang. Tsogang also using the Primary Cooperative for catering purposes.

The Memorandum of Agreement of the Primary Cooperative with Tsogang (as detailed in 2.6.2.3) was signed on 1 April 2018.

7.4 Step 5. Implementing

7.4.1 Procuring and delivering materials

The procurement for the materials for Ha Gumbu went together with the procurement of materials for Khalavha as above (section 6.1.1), and ended with Tsogang's final check and approval on 31 July. Materials were stored in the chief's house. The supplier's price was ZAR 339993.83. Comparing the supplier's price with maximum prices of the materials on-the-shelves in local shops, and 2% addition, Tsogang found an amount of ZAR 252985.33, which represents a substantive mark-up of 34%. MUS Forum members in Ha Gumbu agreed with the other MUS Forums' preference for local procurement.

7.4.2 Community-led construction

In preparation of the construction works, Tsogang gave the same four-day technical training as in the other communities to the MUS Forum, from 7-11 April 2018. Four men and five women participated. Themes included reading and interpreting drawings, identifying different types of pipes, pipe laying, excavation and back filling process, checking the scope of work against materials requested, Occupational Health and Safety and First Aid.

For the budget for stipends, a recalculation was made to save money from works that could be done more cheaply. This gave more room for local adjustments, in particular adaptors, joints, saddles and elbows, and testing.

For the semi-skilled works, the MUS Forum took up the jobs. Further, a meeting was organized in which 10 women and 10 men, all from Ha Gumbu 1, were appointed, based on the picking of cards with either 'yes' or 'no'. For the skilled works local welders and builders were recruited. They also supervised pipe connections. The Tsogang facilitator supervised the overall works. In this way, 592 person days of employment were created for a total of 31 workers in Ha Gumbu.

The works progressed in the next months, as follows. The ten household jojo's were installed. The cattle trough was replaced. The hand pump was examined and quotations were asked for the broken pieces. However, without response from Limpopo, artisans from Gauteng had to be recruited.

For the extension of the reticulation, trenches were dug and pipes were laid in two directions: one for 12 standpipes serving 44 households and one for 76 households. So the initial design was changed by adding a second line to the early design and reaching 20 more households. Valve boxes were also installed.

For the refurbishment of the municipal borehole system, the pump house was fenced with a lockable gate; the corrugated iron sheets were mounted; and the pump house was painted. It was challenging to get four big jojo's on 12 m high solid steel stands. This increased the total storage to 40,000 litres. In the meantime, in the course of 2018, the engine of the municipal borehole had broken down. So the refurbished storage and extension had to be tested with another household borehole.

Anticipating ultimate use, Tsogang held training from 18 to 22 February 2019 in a conference venue near Tshakhuma on scheme operation for the MUS Forums of all three Vhembe communities. Five women from Ha Gumbu participated.

A contractor living near Thohoyandou had been appointed by the Municipality to replace the broken diesel pump that should reach all three sections. Allegedly, this assignment costed ZAR 2.3 million. On 14 January 2019, he visited Ha Gumbu. He had put an advertisement to recruit a local Community Liaison Officer for this project. After shortlisting and interviewing, he had appointed such an Officer. A volunteer project steering committee that included the water committee, the ward committee and council, and the tribal authority was also established. Thus, this project set out to replace the engine by an electric motor; repair the damaged pipes and taps; and install boreholes with reticulation in Ha Gumbu 2 and 3. This was only finalized in April 2020.

Hence, it was impossible for IWMI to evaluate the user satisfaction and impact of a *functioning* upgraded municipal system. However, the process adopted and the use of the household jojo's was evaluated, as presented in the following section 7.5. Ha Gumbu still offered the opportunity to better understand individual investments in multi-purpose household boreholes for self-supply, both as the only fall-back option during the break down of the municipal system and as user investment for irrigated produce for consumption and sale. The findings of that in-depth survey (Magombeyi et al., forthcoming) are presented in section 7.6.

7.5 User satisfaction about the process of community-led MUS

7.5.1 Method

In November 2019, IWMI conducted an in-depth survey in Ha Gumbu with two aims. The first aim was to assess community members' views on the MUS project and their satisfaction as far as it had come by then (as reported in this section 7.5). The second aim was to better understand private self-supply and the relation between self-supply and the municipal communal borehole with a focus on the conceptualization of intra-community differentiation as steps on the water ladder (see 7.6 for findings).

The sample consisted of a random selection of 26 households among all households with own boreholes and 26 households sampled from all households without own boreholes. Without other water sources in Ha Gumbu, the latter entirely depended on borehole owners for any water.

The uses of the municipal borehole before it broke down were assessed through oral recall, and respondents' expectations of the future use of the new electric borehole shed some light on likely impacts, in this case, as a result of both the MUS project and the municipality's upgrades.

7.5.2 Past use and management of the communal system

Respondents' views of the pre-project period and the MUS project's process were the following. When the municipal communal borehole was working, only one quarter of the respondents used water exclusively for domestic uses. All others also used for domestic and other purposes, such as – in order of frequency – livestock 'to keep the animals healthy', watering of trees (which includes Ha Gumbu's typical small flower shrub), irrigation of vegetables, or brick making. The water committee (or civic) and operator collected ZAR5 per month for diesel and bought the diesel. Water users with any complaints went to them. Repairs were the responsibility of the municipality.

Most respondents, both those with and without an own borehole saw important advantages of the municipal borehole when it was still functioning. The most often cited advantage was the low cost, perceived as free or for just R5 per month for diesel. So there was 'no trade-off between buying water or buying food'. Its open access for everyone was another advantage.

Disadvantages included the operating times (water was closed at night) and reliability (supplies were sometimes interrupted because of repairs, without informing the community). However, for most respondents, the far distance was the main advantage. This held especially for those at more elevated sites where water hardly reached because the pressure from the two jojo tanks on the short stands was too low. Moreover, in the extensions there was no reticulation at all. Only few respondents had to walk further to obtain water from neighbours than they used to walk to the municipal system. Respondents with own boreholes kept using the municipal system as secondary source, but, as one respondent admitted, without contributing to the communal diesel or repairs.

A necessary disadvantage according to some respondents were the restrictions on use, even though restrictive rules were not always followed. Everyone should first fill one drum at the time and it was forbidden to connect hose pipes to the communal taps. Children were not allowed to play with the taps. Livestock watering and irrigation were forbidden. Yet, people wasted water or used for 'unnecessary household decorations', leaving no water for others. Also, animals licked and contaminated the taps, when they were not kept at a distance. Overall, a respondent without own borehole found that the communal system made them 'feel that the municipality cared for the community'.

7.5.3 Evaluating the MUS Forum and participatory process

The survey elicited respondents' views on the MUS project. All were well aware of the MUS project and its main construction works, citing: the big communal jojo's, extension with new taps, and the individual household jojo's. Note that the refurbishment and fencing of the pump house and refurbishment of the animal trough were hardly mentioned.

Most respondents attended at least one of the above-mentioned meetings. However, 14 respondents did not attend any meetings, including 6 of the 10 household jojo beneficiaries. Most of them were not around; some were too old. These respondents had been informed by others. The meetings were appreciated for: being able to inform Tsogang, for example about the elevations in Ha Gumbu; to give technical suggestions; to express the feelings of the community; to see during the participatory mapping how the community looks on a map; or just to listen and be informed.

For the recruitment of workers, 20 respondents participated in that meeting. They indicated how 'yes' and 'no' cards were put in a basket to pick. Participants – and even those who did not attend but heard about this – thought it was a fair process. Only one respondent disagreed: 'those who really need the job may end up not getting it while those who don't really need the job get it'. Four respondents picked a 'yes' for digging trenches and backfilling. Being paid (of amounts between ZAR1100 and ZAR8000) was the most appreciated. One respondent appreciated that he had learnt new skills.

Only 7 of the 52 respondents said they did not know the MUS Forum and could not give the names of three or more members; all other respondents could. The MUS Forum's responsibility was seen as ensuring access to water which included: managing the project and checking it is implemented according to plan, supervising works, implementing construction, informing the community and reporting to the tribal authorities. The majority's view was that the Forum performed those roles well, including reporting back. However, in the eyes of two respondents, the project budget was not clear and questions, also about the stipends, were not properly answered. Another respondent noted about the meetings that the MUS Forum 'was always fighting'. Other respondents felt the MUS Forum should have pushed more so that water was finally flowing – but without clarifying what to push precisely.

In Ha Gumbu, the MUS Forum was also the face of the MUS project: 18 respondents had not heard of 'Tsogang' or they wondered about this 'company' or thought Tsogang worked with the municipality. Yet, many of them and all others had well noticed Tsogang. All appreciated the participatory process. As remarked, 'Tsogang involved the community', 'listened to our problems', 'used local knowledge'; 'yet, you can say if your community does not need a project'; 'the Tsogang facilitator was always there to inform and answer questions'; 'they took local workers bringing employment and teaching new skills so we can do ourselves and repair if there is a breakdown'. In sum, this 'shows that they care about the community'.

Two respondents expressed doubts. One concern was whether the steel of the new stands of the communal jojo's would be strong enough. Another doubted whether the materials that Tsogang showed immediately when they arrived and then took away, were the same as those that came back the following day for storing and installation. A few other respondents were disappointed about Tsogang because there was still no water flowing, in spite of the finalization of all works. For a long time, there had been no information on what was happening. These respondents seemed unaware of the municipality's pivotal role in the delays, well beyond both the MUS Forum's and Tsogang's power.

Comparing with what conventional contractors tend to do, one third of respondents preferred Tsogang's MUS approach: contractors do not involve the community and do not create jobs. One respondent also found consultants slower than the participatory approach. However, the other two third of respondents suggested that contractors tend to have more money, so they could have bought, for example, spare parts for the communal pump and fixed electricity. They are also fast as they work within a fixed period of time, and with highly skilled workers. So, probably, with contractors, there would have been water by now. These views confirm the lack of clarity that the delays to install the electric motor were due to the municipal contractors.

7.5.4 Expectations about future use

Questions about respondents' aspirations with regard to the future functioning communal system highlighted that most respondents wish 24/7 continuous flow during fixed daily hours. A minority preferred a strict rotation, for example for three days in the week, as the more realistic guarantee that everyone gets sufficient water.

Locks for the taps were unanimously welcomed to protect from children's play, theft of taps, damage by animals, and, for one respondent, to close off people who fail to pay.

Asked about a potential division of responsibilities between the municipality and the community, it was often mentioned that the municipality should pay the operator. Also, municipalities should ensure more materials for storage and extensions to reach all sections, and, as some mentioned, extend to yard taps. The community, in turn, should ensure proper use and maintenance of the system, so protect against any wastage of water and vandalism. Community members should sit together and discuss harmonious sharing of water in the reticulation lines and water from taps. A pump operator should distribute water reliably. Another suggestion was that people with own boreholes should be refused to use the communal system, except when their household boreholes are not working. The community should also contribute to electricity if needed.

With regard to repairs, only four respondents preferred that all repairs remain with the municipality because of the municipality's knowledge of pipes and connecting. All other respondents saw many advantages if bigger repairs would remain the responsibility of the municipality, but if the community were to take care of small repairs. The major advantage would be time saving, as the municipality takes long, or worse according to one respondent only: the municipality may take the money without finishing the works. Moreover, the community knows the local situation. The pump operator can ensure technical quality. This would also teach people new skills.

However, there are also risks to this, as mentioned in the following order of frequency. Technical skills are insufficient, which can make the problems worse. It is also difficult to collect money from everyone, especially from those who are poorer and from those who are close to a tap and get all water they need. Those with own household boreholes should also contribute as this is a secondary source for them. The quality of materials that are bought risks to be low. The water committee can also be slow. And one respondent flagged the catch 22 problem that 'the municipality will always say go and fix for yourself as you have fixed the repairs. This will make them not to be responsible for the repairs'.

7.5.5 Impacts of household jojo's

As mentioned, the 10 household jojo's of the MUS project were all given to households that already had their own borehole to save on electricity costs of frequently switching on. All 10 beneficiaries interviewed confirmed this as main advantage. Water is continuously available for continuous domestic uses. Eight of the ten households irrigated as well either from the jojo or with a pipe directly connected to the pump. Two households also reported an increase in irrigation thanks to the jojo.

However, one respondent who did not benefit from a jojo commented that the allocation of jojo's to community members who could afford investing in a jojo had not been fair: lot of deserving people did not get a jojo and left them suffering.

7.6 Intra-community differentiation in groundwater self-supply and sharing

7.6.1 Conceptualizing the water ladder

The survey explored a new conceptualization of intra-community differences as relevant for water development and management. A water ladder was compiled. The water ladder is widely used in the Water, Sanitation and Hygiene sector to represent subsequent service levels. South Africa's Strategic Framework for Water Services (DWAF, 2003) also refers to the water ladder to indicate both the need to ensure that everyone has basic access to water and people's aspirations to move up the water ladder. The Strategic Framework fully recognizes how climbing the water ladder meets people's multiple water needs.

The empirical findings allowed grouping respondents into five categories, based on the following variables:

- Aspirations of water users with regard to self-supply and the communal system once upgraded, as the desired next step on the water ladder
- Total volume for the different uses in litres per capita per day (lpcd)
- Time to fetch water for the non-borehole owners and duration of water provision in hours/day for borehole owners
- Monetary value of the total productive water uses in USD per month
- Water storage capacity of households in litres.

Accordingly, as indicated in **Figure 30**, three categories could be distinguished for the non-borehole owners: those fetching water with buckets and drums by foot (11 households); those with a piped connection from their neighbour's borehole (12); and those receiving water without monetary payment (3). For the 26 households with boreholes two categories were found: those wanting to increase storage (12) and those satisfied with current storage (14). Interestingly, storage appeared to be an important variable in the ladder steps.

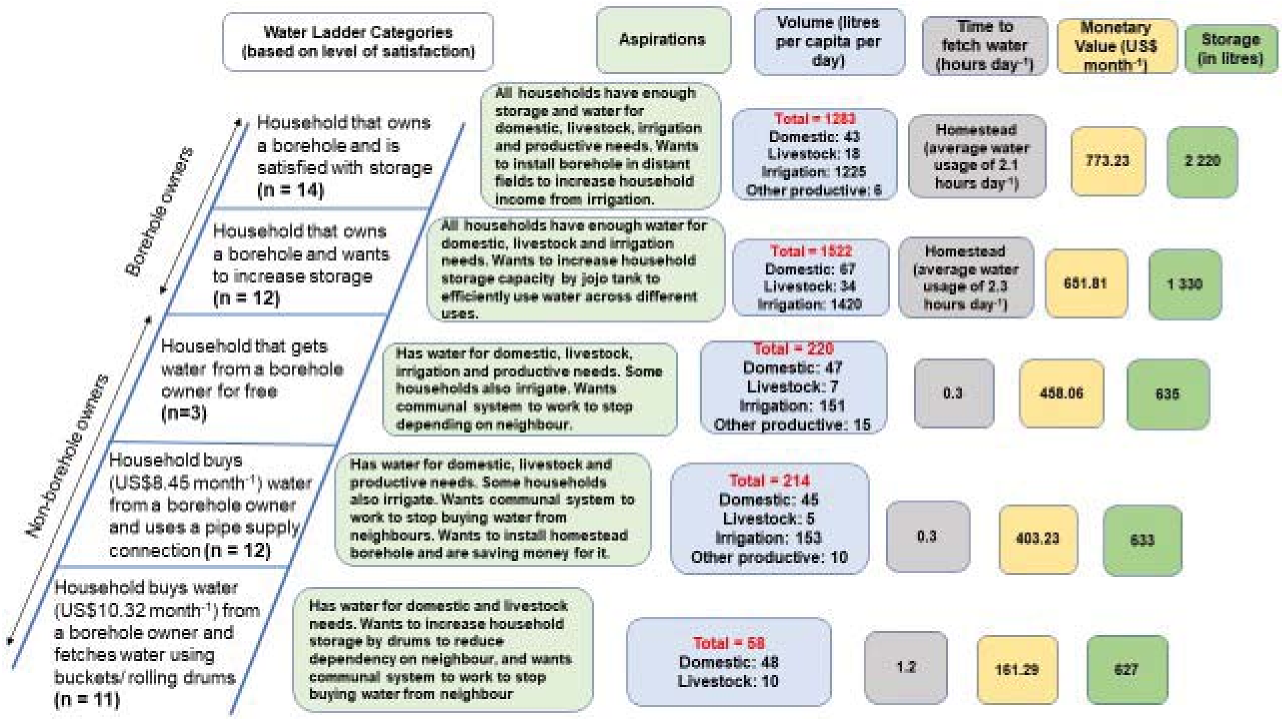

Figure 30 Water ladder of five categories of water users in Ha Gumbu (source – survey)

Of the 26 borehole owners surveyed, 12 households wanted to increase storage, while the other 14 households were satisfied with the current storage. From the households that wanted to increase storage, 67% and 33% mentioned that their primary reason for borehole construction was for domestic and irrigation uses, respectively, while the primary reason for those satisfied with storage (category 5) were 71%, 14%, 14% for domestic, livestock and irrigation, respectively. Water fetched and infrastructure was multi-purpose in 89% (n=52) of the households (**Figure 30**), while 11% of the households used water for domestic uses only. Even at the bottom of the ladder, most households used water for domestic purposes and livestock. Volumes for domestic uses were comparable across the ladder, ranging from 45 to 67 lpcd, but less than medium basic needs for survival of 100 lpcd (WHO, 2013). All other non-borehole owners and all borehole owners used water for livestock and other productive purposes. Domestic, livestock and irrigation are the most common combination, whereas non-borehole owners added other productive uses. However, the total volumes of water jumped most for irrigation, from at most 153 lpcd for non-borehole owners to 1 225-1 420 lpcd for borehole owners (**Figure 30).**

The following sections analyse the practices of each category in further detail.

7.6.2 Category 1: Households that buy water from a borehole owner and fetch water by foot carrying buckets or rolling a drum

Eleven households fell under category 1 (**Figure 30**). Households in this category bought water from neighbours. Most (90%) of respondents had at least two neighbours from whom they could buy water. Most households rolled a drum of water downhill along the slightly sloping ground. This required less effort than carrying buckets on the head or with a wheelbarrow, as other households did. In 82% of households women or young boys or girls fetched water on a daily basis. They made, on average, 10 round trips per week. The average time spent was 7.4 hours per week.

Average storage was 627 litres. Households used buckets to collect and store water on a daily basis. About a third (36%) of the households reported increased storage by at least one drum in the last four years. The primary reason for adding a drum and increasing household water storage was to reduce the frequency of fetching water from neighbours.

Households paid ZAR 160 (USD 10.32) per month for buying water from borehole owners. Most households (90%) borrowed money from one or two neighbours to pay for water. This money contributed to monthly costs of electricity for water pumping. Borehole owners sometimes allowed late payment, depending on their relationship, mood and will. The proportion of the households that sometimes requested a small amount of water, for example, one bucket of water for free as a sign of good will and or good relationship was 63%. This only happened one to two times per month, during times of emergency. For this, they depended on one neighbour who may or may not be the borehole owner from whom they buy water regularly. A small proportion of 18% shared their bought water with one of their neighbours for free, but this only occurred during emergencies, such as running out of water at odd hours of the day. In 63% of households, women were the exclusive decision-makers on buying, sharing and fetching of water.

The average category 1 water use was 58 lpcd. Most water uses were domestic and livestock. The proportion of households with livestock such as donkeys, goats, poultry and cows was 82%. Three households also used water for other productive uses such as brick-making, building own house and brewing local beer at their homesteads. No household practiced irrigation due to lack of water availability. The average monetary value of productive water uses was ZAR 2 500 (USD 161.29) per month.

Asked about advantages and disadvantages, no respondent reported any advantage of buying water from their neighbours, as they had no other choice. Most (90%) of the households reported challenges. In cases where they got free water initially, borehole owners started asking for money over time. Households sought to maintain good relationships with their neighbours by sharing poultry and livestock produce. Some households negotiated the monthly fee or a delay in water fee payment so they could manage their household finances between water and food security. The major disadvantages reported were unavailability of the borehole owner when water is needed; costs and efforts to buy water; the obligation to follow neighbours' rules even though they pay to get water; and the breakdown of the municipal borehole.

The primary aspiration was to meet their daily water needs for domestic and livestock purposes and to increase storage capacity in order to reduce dependency on the borehole owners. Households also reported that they would highly benefit from a fully functional communal system in near future, where they can get free water at more flexible times. This would end having to divide their money between household food and water security. With a functional municipal borehole, respondents envisaged to start small-scale homestead irrigation to eventually increase their food security. Over time, they could increase savings to acquire more storage and, ultimately install a homestead borehole.

7.6.3 Category 2: Households that buy water from a borehole owner and use a pipe supply connection

Twelve households fell under category 2 (**Figure 30**). These households had invested in a small diameter steel pipe buried underground to convey water supply from the borehole owner to a homestead standpipe, saving time and manual effort to fetch water. The general cost of the pipe connection varied between ZAR1200-1500 (USD 77.42-96.77) depending on the distance between the borehole owner and their homestead, and on quality of pipe material used.

The average household storage was 633 litres, while average time taken to fill the storage was 2 hours per week. The pipe connection had motivated a third of households to increase storage by adding two or more 210 litre drums in the last two years. This decision to add storage was made by both men and women. Estimated average homestead water use was 214 lpcd, while the monetary value realized from the water use was ZAR6 250 (USD 403.23) per month. Average amount spent on buying water from borehole owners was ZAR131 (USD 8.45) per month. This water fee is only to help with buying monthly energy (electricity) for pumping and excludes the capital costs for the construction of the borehole.

Less than half (42%) of the households practiced irrigation of crops (okra, chillies and beans) and trees (mango and papaya) at homestead. For others, borehole owners did not allow irrigation, but only water use for domestic and livestock watering. Estimated average irrigation water use was 6 750 litres per week. The proportion of households with livestock (such as donkeys and goats), and poultry was 67%. Other productive water uses such as house-building, brick-making and decoration of own houses were reported by 25% of households. The primary and secondary sources of income were social grants and sale of irrigation produce, respectively. Decisions on water use, payment and social interaction with other households were made exclusively by women in 54% of households and mainly by women in 26% of the households. These households still relied on non-piped water supply in cases when the primary borehole owner was unavailable. About a third of the households solely depended on one borehole owner for water, while two-thirds of the households depended on two more borehole owners. The proportion of households that sometimes (2 to 10 times a month) ask for water free from neighbours (with piped supply), mostly in times of emergency and sometimes borrow money from neighbours to meet their water needs was 45%. Households reported that in times when they have to fetch water using buckets and drums, it is mostly female and younger children (male and female) that go to fetch water.

Advantages included increased water use in 2019 compared to 2018 in 54% of the households, due to upgraded pipe connection and increased storage capacity. They built a house and increased irrigation and incomes from livestock, irrigation, and small enterprises. Conveying water via a pipe saved them time and effort to fetch water. Disadvantages included inability to obtain water at any time, money spent to buy water, maintaining cordial relationships with borehole owners, and the non-functional municipal borehole.

The primary aspirations of this category were to increase water for multiple needs, including domestic, livestock, irrigation and some small enterprises such as beer-brewing, brick-making and craft-making for decorations. Also, more water would overcome limitations on irrigation, which depended on the personal relationship between the borehole owners and non-borehole owners.

7.6.4 Category 3: Households that get water for free/exchange from borehole owners

Three of the 26 surveyed non-borehole owners fell in this category (**Figure 30**). One household fetched water by foot and rolling drums daily, while the other two had a piped connection from the borehole owner's yard into their homestead. Not having to pay money to access water was their major advantage. They used other exchanges to compensate for the water access, such as giving their land to the borehole owners for irrigation. Estimated average homestead water use was 220 lpcd, while the monetary value realized from the water use was ZAR7 100 (USD 458.06) per month.

The disadvantage was dependency on borehole owners and the need to maintain cordial relationships. Some borehole owners might stop irrigating the offered field, which would result in non-borehole owners feeling guilty to ask water for free. The households with pipe connections irrigated paprika and okra on a smaller portion of their homesteads to get an additional income and increase food, and water security. They were also motivated to install a borehole to climb up the water ladder.

The aspirations for Category 3 are similar to those of Category 2, except that Category 3 would like more independence from borehole owners to improving household food and water security for improved livelihood. A functional communal system would be the first step to providing independence and increased income for this category to build savings for installation of homestead boreholes with time.

7.6.5 Category 4: Households that own a borehole and want to increase storage

This category had 12 households (**Figure 30**). The average household water storage was 1,330 litres. About 75% of the households had limited storage, which prompted them to switch on the borehole more often to fill the storage for daily domestic uses. This led to water losses either through pipe leaks or overflowing of the storage. The storage of the other 25% households was over 2 000 litres. They had connected the pump to household storage tanks and used a direct pipe connection from the borehole to the irrigated field.

The proportion of households that had increased storage by adding at least one tank of 2 500 litres in the last four years was 17%. The primary reason for adding storage was to increase household water storage capacity, especially for daily domestic use, and to reduce the frequency of switching on their borehole and fetching water from neighbour's borehole when there is no electricity or when the borehole broke down.

For crop production, 92% used the more efficient drip irrigation, while 8% used the less efficient furrow systems. Half of the households had direct pipe connections from the borehole to the field, while the other half had pipe connection from the borehole to a storage tank and then to the field. Field sizes were large, an average of 2.9 hectares. With a higher frequency of pumping, water use was 1 522 lpcd. The electricity bill of ZAR370 (USD 23.87) per month was higher compared to that of category 5 with enough storage.

A small part (3%) of the large crop area yields satisfied own consumption, while the rest was sold. The households realized the second highest monetary value (ZAR10 103 (USD 651.81) per month) from the water use. The farmers complained they do not get fair compensation and sometimes they get nothing for the produce they market due to inefficient middlemen who come to collect the produce and sell to markets.

The reported aspirations of Category 4 were to increase household storage capacity by installing more storage to efficiently use water across different uses (domestic, irrigation, livestock and other productive uses) and to provide enough buffer should there be electricity interruption or borehole breakdown. This category also wanted the municipal borehole to be rehabilitated so that it could provide a secondary free buffer for domestic and livestock uses, and relieve them from providing water to non-borehole owners.

7.6.6 Category 5: Households that own a borehole and are satisfied with storage

This category had 14 households. The average storage available and satisfactory for these households was 2 220 litres. Twenty nine percent of the households reported to have increased storage by adding at least one 2 500 litres tank in the last four years, while 36% of the households added at least a 225 litres drum in that period. The primary reason for adding storage was to increase water storage capacity and reduce the frequency of pumping water from the borehole. The other reason was to guarantee water availability at the household even when there is no electricity, either due to load shedding or faulty power lines.

For crop production, about 71% of the households had direct pipe connections from the borehole to the field (average area of 1.3 hectares), while the other 29% had a pipe connection from borehole to a storage tank and then to the field. Overall, these households had smaller fields and used less water as shown by the reduced per capita water use (1 283 lpcd) compared to category 4 (1 522 lpcd) who had larger fields. Nevertheless, this category realized the highest monetary value (ZAR11 985 (USD 773.23) per month) from the total water use. An average of 1.3% of the agricultural produce was for self-consumption. The average electricity bill was ZAR300 (USD 19.35) per month, probably due to energy savings from availability of large storage, primarily for daily domestic uses, that reduces the frequency of switching the pump on and off.

The farmers also felt they do not get a fair compensation and sometimes they get nothing for the produce they market as the middlemen who come to collect the produce and sell to markets are unreliable and untrustworthy. One household-head said “The middleman can say, I did not sell the okra, because when I got to Johannesburg, the okra was had gone bad, but I would still want money for transportation.”

All households used drip irrigation to enhance water use efficiency, contributing to the overall less water per capita per day used compared to category 4. In addition, these households saved water and electricity as shown by reduced domestic water use of 43 lpcd compared to that of category 4 (67 lpcd). Having a homestead storage tank provided enough buffer for this category to further use more water across multiple water needs. In this way the households pumped once per week to fill the homestead tank compared to every day pumping for category 4 where there is no big storage, thereby saving an average of ZAR840 (USD 54.19) per year on electricity, the difference in monthly electricity bills between category 4 (ZAR370 (USD 23.87)) and category 5 (ZAR300 (USD 19.35)). Category 5 households had enough storage and water for domestic, livestock, irrigation and other needs from their homestead borehole. Their two aspirations were to install a borehole in distant fields and to have functional and stable markets to further increase household income from irrigation. Although these households were on top of the water ladder, their increased agricultural productivity did not necessarily provide them high and timely financial benefits due to inefficient transportation arrangement with middlemen and the weak and unstable markets. They would like to see efficient transportation to ensure their produce gets to the local, provincial and national markets on time, thereby reducing the currently high monetary risk. Similar to category 4, they would also like the municipal borehole to work and be extended in the community to provide a secondary free buffer for domestic and livestock uses, and also relieve them from providing water to non-borehole owners.

7.6.7 Discussion and policy implications

The foregoing insights in local practices have various policy implications for Ha Gumbu and similar settings elsewhere.

First, the water ladder underlined the importance of a functional municipal system especially for those at the lower steps. This would end their dependency on borehole owners and the restrictions imposed on water uses, and money saved could contribute to food security. Borehole owners would also benefit from a functioning municipal system by having a backup source when electricity or their borehole fails. Borehole owners also felt it as a relief if others would stop asking for water. This indicates that local water markets are a moral act rather than a profit-seeking business.

Second, improved storage emerged as an aspiration across all categories, except category 5. Policies should enable such additional buffer storage, for example with subsidies at the lowest steps and loans at higher steps of the ladder.

Third, self-supply should be further stimulated. Loans can support investments in borehole drilling and equipment. Electricity should be reliable (a few diesel pumps could still serve as backup during electricity outages). Self-supply considerably reduces overall demand on the communal system, so more water remains available for those on the lowest steps, including new community sections. Self-supply alleviates the burdens of sharing the communal system's scarce water, which would allow everyone to use water for livestock, irrigation and other activities, especially if there were also more street taps or even yard connections. In the long term, income gained would allow payment of water tariffs.

Lastly, groundwater irrigation could be improved by combining adequate storage and use of drip irrigation. This reduces electricity costs and increases crop income. Proximity to markets, reliable transport and stable prices (produce and inputs) will pull households towards starting irrigation or expanding existing irrigation to distant fields.

8 Conclusions local level community-led MUS

8.1 A generic step-wise process covers a continuum of co-management modalities

The six communities represented a wide diversity, but the six steps process appeared relevant across the board: initiating collaboration, diagnosing, envisioning solutions, fitting the financial framework and contracts, implementation, use. So the process is generic and widely scalable. Most planning processes follow similar steps. This also allows systematic comparison with current approaches, especially in Water Services Development Plans and Integrated Development Plans, as further elaborated in chapter 11.

The diversity of communities highlighted how the process is applicable in situations on a continuum, ranging from full self-supply owned by communities with yard connections to municipal borehole owned and operated by government with paid operators and energy provision. Obviously, the nature of each step and resulting forms of co-management differ. **Table 9** conceptualizes this continuum in a matrix for further testing.

Table 9 Matrix of project cycle six steps in two diverse examples of co-management modalities

	Support to self-supply		In between	Partial self-supply, e.g. new or refurbishment of borehole	
Steps	Community	Government	< >	Community	government
Initiating collaboration	Internal agreement to submit a request	Broad invitations with conditions		General request	Needs assessment and prioritization
Diagnosing	Rough design with request for materials	Check/advice on design, organizations, inclusion and water quality 3-5 lpcd		Participatory mapping, multiple sources and uses	Technical and institutional detailing of map
Envisioning solutions				Indicate sites for extension, storage and taps, land tenure,	Detailed professional engineering designs and costing

	Support to self-supply		In between	Partial self-supply, e.g. new or refurbishment of borehole	
Fitting the financial framework	Opening Bank account	Payment to bank account or direct delivery		Opening bank account for small works; monitoring contractors	Government financing arrangements
Implementing (materials, construction)	Local procurement Own construction	Monitoring visit to check works		Partial construction of reticulation Signing off on contractors' works	Main construction
Operating, using, maintaining	Own contributions	None		MoA on operating& maintaining reticulation and taps; community organization for fuel and operator and monitoring	MoA on functioning borehole; reticulation/taps; energy, pump operator

At one end of the continuum (left-hand columns) are the small-scale works mainly or fully owned by users, that local builders and artisans can construct and maintain, and often already do as full self-supply (piped gravity systems or reticulation with plastic storage tanks; small mechanized pumps; household storage). In Tshakhuma and Khalavha, the community kept taking initiative.

At the other end (right-hand columns) are the more complex works that do require higher, professional levels of technical expertise, such as larger-scale mechanized and electrical borehole and storage construction, major maintenance and repair, or interventions during disasters. Government often remains responsible for the 'bulk supply' of operation and maintenance of government-owned equipment; individual rural communities cannot handle that bulk supply. Self-supply in these cases is partial, for example for reticulation and yard connections. Users and government need to agree on these mutual responsibilities. In Ga Moela and Ha Gumbu, communities appeared willing to take up responsibility for swift small repairs of reticulation in forms of co-management, but municipalities should continue to ensure reliable bulk supply by maintaining or replace borehole equipment, and provide at least clarity on communities' contributions to pay the operator and/or energy source. The MUS project suggests that communities could have contributed more and even more could have been achieved, if there were more clarity on mutual roles and communication between municipalities and communities. Unmet promises about paid operators and diesel or electricity provided by government can stifle community initiative.

Related to this is the evidence-based distinction on what works can be done by semi-skilled labourers, with technical supervision and capacity building; what can be done by local builders; and what requires solid engineering expertise, also to manage risks.

An important issue is the flexibility in funding for design and construction needed. Flexibility is needed to enable tapping new opportunities or alternatives for unexpected, but surmountable obstacles.

A further unravelling on this continuum will enable further replication at scale.

8.2 Socio-technical facilitation is feasible

The above-mentioned change process of the project 'Operationalizing community-led MUS' generated evidence that community-led MUS is a viable, replicable step-wise process of planning, design and construction of water infrastructure with future users in the driver's seat. The type of socio-technical facilitation is well feasible, provided the implementing agent combines a – still quite rare – combination of facilitation skills and technical and engineering skills as required for the type of technologies. More research can refine the levels of skilled expertise available in communities and the more complex technical tasks for which external engineering expertise is required.

Usual other requirements as in any water infrastructure project, are financial support for materials and labour – but communities have incentives to reduce costs as much as possible to optimize value for money. They also contribute labour at lower costs, if not voluntarily, because labour meets the common good of their improved water supply as well. The conditions for financing of designs need to leave some flexibility in contingencies so that unforeseen opportunities and obstacles can be addressed.

As part of the facilitation process, community-led MUS requires tackling complex communal management, especially on users' collective fund mobilization and regulating, if inevitable yard connections to street taps. Also, wherever water resources are scarce and further storage development is no option, support is required to prioritize the allocation of the Basic Human Needs Reserve of at least 25 lpcd for all within communities, municipalities, districts and larger scales where the inequalities between the haves and have-nots are most pronounced. This can build on local existing water resource sharing arrangements.

Community-led MUS also requires, as in any water infrastructure intervention, measures for due diligence, transparent budgeting and spending, technical quality control and appropriate contractual structures and arrangements. However, the involvement of end-users as the ones most interested in good performance strengthens accountability for performance more than if implementing consultants and contractors are only accountable upwards.

Community-led MUS does not necessarily take longer than conventional approaches. Communities do need time to discuss and agree on issues, but they can act also beyond office hours and without long contractual procedures. Some remuneration of works accelerates construction. Indeed, administrative tasks in approaches with considerable outsourcing of tasks, such as formalization and contracting, tendering or procurement appeared more time-consuming.

Similarly, the costs made by the IA seem comparable to fees normally charged in water infrastructure projects. Further research on costing modalities, including costing of supervision of contractors, size of projects, and required levels of engineering expertise will shed more light.

As for any water services provision, external support should ensure no-one is left behind. Self-supply is not equal, although sharing of water is common. Also, productive water uses tend to be inequitable because only part of the water users engages in irrigation, livestock, or other productive uses. Public agencies, who are typically committed to leave no one behind, should target support especially at those who risk being left behind, while acknowledging others' aspirations to reach middle level services. Those who use more water should pay more; within schemes differential tariffs can be charged

Another important government duty is ensuring that 3-5 litres per capita per day is safe for drinking. It would be wasteful expenditure to treat all water to drinking water quality, while basic other domestic uses, such as bathing or laundry, can well do with lower quality than drinking water. A range of cost-effective methods exists. This includes source protection of intakes to avoid debris and animal faeces to enter the system; hygiene education to end infection of storage and pipes; or point of use treatment, for example adding one teaspoon of bleach water in a container of 20 litres and leave it settling for 30 minutes. Government, in particular Water Services Authorities maintain the responsibility for this health measure but can chose which method is most cost effective. This could be setting up sustainable, partly market-led supply chains of devices.

8.3 Community-led MUS has many benefits

An empirical assessment of the following benefits was only possible and confirmed in the two very different communities of Ga Mokgotho and Ga Moela and only immediately after construction. An impact assessment in all six communities after a longer time lapse is recommended. Nevertheless, across the continuum, the following generic benefits are partly proven and partly plausible.

Community-led MUS **improves livelihoods** by bringing more water more reliably and nearer to homes to alleviate burdens of domestic chores and livestock watering, and to enable irrigating or re-using more water for trees and crops, brick making and enterprises. Government's support to measures such as point of use treatment or filter boxes should ensure water quality of at least 3-5 litres per person per day for drinking and cooking.

Community-led MUS **creates jobs** when community members are remunerated for their works, as widely applied in employment generation programs.

Community-led MUS is **inclusive, with due attention.** Open invitations to attend mass meetings from the first introduction onwards reach everybody and give some voice to everyone in an open nomination process of a representative community-structure. However, especially in self-supply, those who could not afford contributing the initial capital costs or whose houses were too far, may be excluded. Also, the 'local engineers' were mainly older men. Inclusiveness should be fostered by encouraging and monitoring that no one is left behind in designs and that women and youth are included and trained, also in skilled technical works.

Community-led MUS is **cost effective** in the sense that it harnesses communities' existing knowledge, skills and investments in cash and kind in water infrastructure for self-supply and welcomes the cost effectiveness of multi-purpose infrastructure. Local procurement of materials can further reduce costs compared to more centralized procurement.

Community-led MUS is **performance-oriented in a common interest.** Where communities can allocate fixed amounts, they seek to spend cost-effectively for the common good. Serious, hard work in a community spirit is rewarded.

Community-led MUS **avoids illegal actions** by anticipating unplanned, if not illegal forms of 'partial self-supply', such as yard connections, so that the underlying felt needs and aspirations and willingness to invest to climb the water ladder to middle level services can be mobilized in the design phase so damage and conflicts are prevented. People's organization seems key for such organization of yard connections, but more research on this issue is warranted.

Last but not least, community-led MUS improves **sustainability** by:

- starting from the *localized* technical and managerial problems in the mix of public infrastructure and self-supply, so it 'starts with what is there, what we have and what we know, and move from there' (two government officials)
- following people's priorities in identifying *localized* solutions
- (potentially) procuring locally, to strengthen knowledge and contacts with local suppliers
- recruiting local semi-skilled and skilled workers for construction and developing their technical and managerial capacities. This encourages good performance, because 'workers themselves, their families and neighbours benefit from the result'. It triggers continuous care, preventive maintenance and protection against vandalism. 'We worked hard for it, so we will maintain well'. Also, labour may be provided flexibly and needs-based, partially or fully voluntarily, well beyond office hours. Newly developed local capacities by technical training and 'learning by doing' stay in the community for sustainable operation, maintenance and future upgrades
- strengthening community structures to lead the process from the outset and for future operation and maintenance, both technically and managerially
- and initiating and strengthening contacts with government agencies and suppliers (especially in case of local procurement) throughout the process.

In sum, in the words of community members, community-led MUS:

- Enables 'communities to do whatever they can do, and which is often easiest and simplest for government anyhow'.
- Makes government 'come low and rise up together'.
- **'Nothing about us, without us'**.

9 Innovation Forums

9.1 Introduction

In the project 'Operationalizing community-driven multiple use water services (MUS) in South Africa', Tsogang established innovation forums and held six meetings with each of the three demonstration communities in both the Sekhukhune District Municipality (SDM) and Vhembe District Municipality (VDM), and one joint meeting for both districts. The goal was: exchanging of experiences gained in newly applying a MUS approach and learning from each other. Two or more MUS Forum members of each community participated as representatives. This chapter synthesizes the substance and lessons learnt of the innovation forum meetings, based on IWMI's participation in the meetings, Tsogang's detailed reports, and a Focus Group Discussion with the Sekhukhune Innovation Forum meeting on 26 September 2019.

Moreover, MUS Forum members of all six communities also participated in district, provincial and national learning alliance meetings and policy dialogues (e.g. national learning alliance meeting in Polokwane 28 March 2018; National Policy Dialogue 27 March 2019 in Ga Mokgotho; Mandela Day Tshakhuma 18 July 2019; Presentations and Knowledge Tree Award Ceremony at the WRC symposium 11-13 September 2019). These events, including community representatives' inputs, are described in the next chapter.

9.2 Synthesis of the MUS Innovation Forums meetings

The innovation forum meetings were attended by the host MUS Forum and about three members of each of the other two demonstration communities in the respective District. At each meeting, attendance registers were signed, proposed agendas were adopted and minutes of the previous meeting (written in note books with stationery and files provided by Tsogang) were discussed and signed off. The need to always report back to the community was systematically underlined. Tsogang enabled catering. Dates, places, and key topics discussed are as follows.

Sekhukhune	
Date, place and participants	
13 July 2017 Praktiseer, hosted by LDA 9 women; 7 men	Inaugural meeting to establish the forum. Project background, purpose and expected results. Six steps. Project progress till diagnosis. SDM: technical department interested, but political arm not yet. Presentations by each community and challenges: Ga Mokgotho: illegal connections, volunteer operator, community extension. Phiring: low dam levels in 2016 and wish to access other source; storing and transport of vegetables; need for fencing. Ga Moela: hardly any water and sanitation services; access road; unfinished government projects. Election of the SDM MUS Innovation Forum chair and other positions. Selection criteria for beneficiaries of jojo's: poorest of the poor, orphans, people with disability, elderly people

	who stay alone and child headed families. Need to report back within the communities.
16 November 2017 Ga-Mokgotho 30 men/women	Roles MUS Forum. Infrastructure management and progress in each community: Phiring: PRA conducted; borehole municipal; Mohlatsengwane blockage; Vrystad two contractors unfinished; irrigation pipe leakages; unburied extension to livestock watering place. Ga Mokgotho: PRA conducted. Lack of clarity on ownership and management of water scheme, many leaks, damage, unreliable current operation by volunteer, illegal connections by operator (scheme was not designed for that; damages), preference for yard connections; need for an extension to 50 households without water so girls cannot attend schools. Ga Moela: proposing two reticulations and hand pump refurbishment. For all communities: letter to SDM for upgrades written by Tsogang and ward councilors but no answer as yet. Ga Mokgotho registered as Primary Cooperative; other two not yet. All prefer community-led construction. Proposed email and whatsapp communication.
29 January 2018 Ga-Moela	For each community: clarification and, as needed, adjustment of drawings/sketches of scope of work. Phiring: reservoir to be used by Leboeng; Vrystad: non-use of borehole; how to organize to influence, and malaria. Ga-Moela: reticulation design; Ga Pudi school board's refusal, so hand-pump; Tawaneng borehole. Ga-Mokgotho: need to solve operator problem with the help of Tsogang. Safe storing place. Memorandums of Understanding between Tsogang and Primary Cooperatives for community-led construction. By now all are Primary Cooperatives. Agreement on stipends of R90 per task and monthly payment. Bank accounts should be opened. Oral buy-in from SDM. Ongoing opening of bank accounts. Discussions: selection criteria for recruitment: being involved in the MUS project as others don't easily understand. Ga Moela: if forum members want to resign, they should do soonest. Safety clothing. Field visit: a traumatising water situation!
16 March 2018 Phiring 13 women 13 men	Confirmation scope of works and preparations in each community (Primary Cooperative, bank account, SARS, BBBEE certificate, storage for materials, selected households for jojo's). Proposed works. Phiring: storage borehole fencing; repair leaks within borehole house; unblock pipes at Mohlatsengwane section; pipeline to Vrystad section with valve boxes; repair leaks irrigation pipe (also in Malaneng and Mapareng) communities; connect water to livestock camp; new pipe from Setunyeng – dam levels are low now; repair hydrant standpipes. Ga-Moela: registered as Primary Cooperative, but behind on the rest. Chairperson and one member resigned. Innovation forum to assist in problem solving. Ga Mokgotho: all registrations finalized. Ongoing establishment of o&m principles. Scope of work: fence water sources; replace damaged pipes, extend reticulation to Sethogeng for 50 households, replace damaged

	valves; household connections to be done by community. Request to invite Tsogang to upcoming IDP meetings and include MUS. Announcement of addendum MoA. Recap of stipends, lots, and use of bank account. Upcoming training on construction. Advantages of MUS for local economic development. Field visit.
23 August 2018 Ga-Mokgotho 50 men/women	Progress on community-led construction. Ga Mokgotho: all almost finished. Lack of community contributions for household connections. Ga Moela: two main lines and two cattle troughs finished; storage, valves, and reticulation ongoing; hand pump yet to start. Phiring: fence and valve of reservoir and irrigation pipe leaks repair finished; rest ongoing. Discussions and lessons learnt: procurement of materials: local procurement is cheaper, e.g. of river sand. Cost-free storage went well. Transport costs within community paid from savings from stipends. Stipends for carrying. Recruitment of sufficient semi-skilled workers by yes/no papers in Ga Mokgotho and Ga Moela; interest in Phiring waned. Skilled workers submitted quotations and their previous works were checked. Skilled builders from Ga Mokgotho assisted in Ga Moela. Supervision and record keeping of works by Primary Cooperative and Tsogang with monthly payments upon delivery through bank account. General challenges: need for transparency on budget to avoid rumours among factions; household jojo's preferred for storage instead of rainwater harvesting; small changes in pipe tracks when soil is rocky; operators should be paid by municipality. Specific issues: Ga Mokgotho: tap committees manage communal taps: Vrystad unfinished municipal projects; Ga Moela: one municipal borehole needs servicing; bank cheques need same signature. Field visit to reservoir and cattle trough.
20-25 January 2019 Ga Mokgotho Capacity building for all 3 communities 10 men/11 women	Training by Tsogang on: environmental health and community hygiene, water quality, climate change, operation and maintenance, gender equality and book keeping. Participation by 3 communities enabled exchange.
4 July 2019 Ga Moela 16 persons (apologies from Phiring)	Reviewing the 27 March National Learning Alliance (good networking and marketing with funders or asking materials); updates on improvements, sustainability and challenges: in Ga Mokgotho (more water and good operation; procedures in case of breakdowns, locks and training; continuing improvements and extensions) Ga Moela (more water, troughs also for cow dung and laundry, need to arrange diesel and electricity,

	overspending. Still outstanding: Ga Pudi hand pump, hand-over to municipality for job revision of pump operator)
27 September 2019 Phiring	Updates on construction. Internal problems of MUS forum: some members only for quick own personal gain and, if not, they leave; conflicts chase people away; personality/competition issues; patience and informing all is needed. In Focus Group Discussion facilitated by IWMI on the innovation forum: one goal of internal learning and sharing for project implementation; reporting on progress to other MUS Forums. Other goal of (sustainable) platform to keep informing and writing letters and talk positively about MUS in engagements with municipality, SALGA, premier's office, extension workers and other officials to 'sell themselves' for materials or hand-over, further supported by chiefs' involvement. Cell phones important, but email or whatsapp group did not work. Minutes of meetings helped internal communication. Continuing collaboration with the municipality: attend IDP and their other meetings; make MUS project well known; identify champions in municipality; (continuously) invite/inform officials and ward committee/councillors; integrate in CPW/EPWP.

Vhembe

date and place	
19 July 2017 Makwarela hosted by LDA 12 men; 7 women	Inaugural meeting to establish the forum. Project background, purpose: encourage and support the indigenous knowledge in communities, mix it with a little bit of science and technical knowledge to improve services for sense of ownership and sustainability, including food security; job creation. Six steps. Project progress. Liaising with VDM taking time. Presentations by each community and challenges (Tshakhuma: 11 systems with help of Mr. Joseph Maphwanya; low-quality pipes; Khalavha: low-quality pipes, no reservoirs. Ha-Gumbu: new extensions without water; municipal tanks too low for pressure; late payment of vegetables marketed. Establishment of VDM MUS Innovation Forum and election of chair, secretary and treasurer. Selection criteria for beneficiaries of jojo's: poorest of the poor, disabled, elderly. Need to report back within the communities.
14 Nov 2017 Ha-Gumbu About 15	Roles MUS Forum. Progress in all communities including PRAs. Problem of communicating with distant Water Services Authority and Water Services Providers especially for Ha-Gumbu. Letter to VDM for upgrades written by Tsogang but no answer as yet. Tshakhuma registered as Primary Cooperative; other two not yet. All prefer community-led construction.

	Proposed email and whatsapp communication. Field visit homestead multiple water uses.
31 January 2018 Khalavha About 15	For each community: clarification of drawings/sketches of scope of work. Safe storing place. In two communities still Primary Cooperatives to be established and need for bank accounts and SARS certificate. Signing of Memorandums of Understanding between Tsogang and Primary Cooperatives on community-led construction. Agreement on stipends of R90 per task and ex-post monthly payment. Bank accounts should be opened. Money on account to be shared with community members. Service level agreements are still to be signed by VDM.
15 March 2018 Tshakhuma 33 men/women	Field visit Thondoni section. Progress report on bank accounts and tax clearance certificates. VDM signed the permission letter on 29 January to use the borehole in Tshakhuma and Ha-Gumbu and the spring in Khalavha. Explanation of delays in formalizing community-led construction, also in addendum MoAs between Tsogang and the Cooperative, and in procurement. Recruitment of workers by the MUS Forum 'as they know the dynamics of the communities very well'. Participants' request for timely training to not compromise the quality of works. Recap of stipends, storage, bank account to use for saving in stipends' money.
27 November 2018 Ha-Gumbu 12 women; 15 men	(date later than Sekhukhune because of late delivery of materials) Encouragement to continue gender equal construction. Progress: Ha-Gumbu: fence pump house finished; elevated tank stands and extended reticulation finished and await testing but borehole is broken. Rest ongoing. Khalavha: source protection (except fence), main pipe and 4 new jojo's plus fence finished; rest almost finished. Community contributes to household connections. Tshakhuma: delays in materials because of tendering process. Lessons learnt on community-led construction: delivery of materials was sometimes late at night. Transport was not budgeted, but paid by savings from stipends or, as needed, carried. Semi-skilled works mainly by Primary Cooperative members. Skilled builders recruited based on quotations and previous work. Primary Cooperative members and Tsogang supervised works and kept records of works for monthly payment; workers complained about late payment. Ward councillor, CoGHSTA, LDA, and all strongly support community-led construction: 'People learn project management. It saves money. The budget is small compared

	to other projects, but the impact can be seen'. Bank charges are too high. Budgets should contain contingencies. Report back to the community and transparency is important to avoid accusations of eating money. Municipalities may have equipment (e.g. crane by Eskom for Ha-Gumbu) that communities can use for free. Capacity building needs more time.
18-22 February 2019 MiruNzini Lodge Makhado 20 (Tshakhuma 5 women, 5 men Khalavha 3 women, 2 men Ha-Gumbu 5 women)	Training by Tsogang on: environmental health and community hygiene, water quality, climate change, operation and maintenance, gender equality and book keeping. Participation by 3 communities enabled exchange.
14 June 2019 Khalavha 12 women/ 15 men	Progress reports on construction as per detailed scope of works, challenges and solutions. Ha Gumbu: ongoing. Engine broke down. Others are digging a new borehole. What to do with left over materials? Inactive community because of individual boreholes. Khalavha: ongoing, in source protection one worker was paid without finalizing works. Tshakhuma: ongoing, challenge of distance to carry materials for intakes for filter boxes. Need for valve box in Mulangapuma 1.
25 September 2019 Tshakhuma 15 men, 5 women from Tshakhuma, Khalavha and Ha Gumbu, Vhembe District water official, LDARD	Purpose: both internal sharing and learning among the three demonstration communities and using this platform for dialogue with the municipality: better understanding Water Services Authority, presenting MUS project achievements, inviting (technical) feedback from municipality, and discuss future co-management, operation and maintenance. Introduction on community MUS project works. Site visits Lukau and Maswie. Feedback on technical perfection of intakes and storage and water quality. Maswie needs Memorandum of Agreement with municipality; communal vs existing household taps for livestock/irrigation.
26 September Visit MUS innovation forum to Khalavha, with representative from Tshakhuma and Ha Gumbu and Vhembe District water official	Purpose and introduction as above. Site visit source and storage. Feedback on completion of intakes and perfection of storage. MUS forum awaits response from SAFCOL on their letter requesting materials.

27 September Visit MUS innovation forum to Ha Gumbu, with one representative from Tshakhuma and Khalavha and Vhembe District water official	Purpose and introduction as above. Site visit to communal storage and household jojo beneficiary. Feedback on need to strengthen the steel stands. Awaiting finalization of electric borehole.

Vhembe and Sekhukhune Joint

13 December 2018 Tzaneen Total 80 Tshakhuma, 4 women, 5 men Ha-Gumbu, 5 women, 6 men Khalavha, 7 women, 3 men Ga-Moela, 4 women, 4 men. Ga-Mokgotho, 7 women, 7 men Phiring, 3 women, 2 men	Updates on progress in construction and training received. Challenges: delays; workers demand more money thinking that this is a government project; vandalizing of the new installed pipes (Phiring); transport of materials to sites; changes in design warranting re-allocation or buying of materials; household jojo's: storage preferred; houses too short for gutters to jojo's; politics influenced communities to not supporting the project by providing wrong information; illegal connections, also by voluntary pump operator; voluntary establishment of water systems, but expecting payment for labour when MUS gets in; lack of support especially from youth. Solutions/lessons: capacity development; constantly involving and informing others, also on where budget comes from, voluntarism; hold meetings on site, not in community halls; understand scope of work, designs, specification of material and budget allocations; sustainable o&m plan. Fascinating realization for the participants that they experience similar challenges.

9.3 Lessons learnt

The Innovation Forums appeared not only to serve a) the main goal of exchanging of experiences gained in newly applying a MUS approach and learning from each other. Importantly, the forums also served as b) platform for dialogue with the municipality and other government structures both to demonstrate the MUS approach from district to national level and to prepare future co-management with the specific district. Lastly, the discussions and evaluation served the goal of c) providing important knowledge both as opportunity for triangulation of local research findings and as guide for the translation of the different local experiences into generic, evidence-based lessons learnt for nation-wide upscaling. All goals were two- and three-way exchange and learning, improving the listening skills of everyone. The (voluntary) commitment, experience and wisdom of the innovation forum chair persons in both districts was key to this success.

The detailed achievement of these three goals is as follows.

Goal: exchange of experiences and learning

- In this two-way process in which everyone was learning, the innovation forum meetings enabled Tsogang to clarify the generalities of the MUS approach and challenges that applied to all communities, for example the step-wise approach, the formalization into Primary Cooperatives, bank accounts, SARS certificates, Memorandum of Agreement, procurement, and issues like labour recruitment, recording of workers, conflict management/jealousies, need for transparency, etc. This was important because as repeatedly mentioned by participants: *'In the beginning this project wasn't so clear, but now we understand'. 'Community involvement takes time. We need to be patient'.*
- Tsogang also continued developing specific capacities, for example, record keeping.
- Direct mutual exchange between the communities was also encouraged: experience gained in one community also directly benefitted other communities, especially by the dynamic chair persons in both districts or by experienced builders.
- This triggered a joint search for solutions. As remarked at the joint innovation forum meeting on 18 December 2018: '*It was very fascinating for the participants to realise that they are experiencing similar challenges. This has taught them to constantly strive for a better future by developing their communities to alleviate poverty'*
- Besides the many commonalities, participants were also struck by the differences between communities in accessing water. Forerunners in self-supply like Tshakhuma and in community organization like Ga Mokgotho became inspiring examples. On the other hand, there was the 'traumatising' water situation in Ga Moela.
- Gender equality was a cross cutting issue, reflected in the composition of the forums, as well as in the repeatedly raised principle that both women and men need, and can learn about the technicalities of water infrastructure and hydrology. This equality is already there for semi-skilled works. For semi-skilled and skilled work, women pioneers are encouraged towards longer-term equality.

Goal Platform for Dialogue with Government

- The contacts and common understanding developed in the goal above served the MUS project's purpose of *demonstration.* In all learning alliance meetings, also those held in communities, the MUS Forums of three, if not all six demonstration communities were invited. This strengthened the 'voice from below', not just from one incidental community, but with a common and coordinated voice that highlights generally experienced problems and solutions, as well as locally specific ones. The unswerving participation in both the innovation forum meetings and the dialogues by especially the official from the Limpopo Department of Agriculture and Rural Development provided an important and appreciated link.
- Further, for the local follow-up for sustainable operation and maintenance plans, it was fruitful to also organize joint visits with officials of the municipality and representatives of all three communities. Issues and solutions are general.

Research for a robust and replicable MUS model

- The innovation forum meetings enabled triangulating with local research findings from each of the communities.

- Insights from the debates and solutions across six communities and in dialogues at several tiers of government are key to generate knowledge and ‘package’ the project outcome as a robust, evidence-based generic, replicable MUS approach/model, and conditions under which it will work.

10 Learning alliances and national policy dialogue

10.1 Events

The third goal of the MUS project was the upscaling of lessons learnt and for more equitable and sustainable water services delivery, including informing and supporting the development of downstream investments into improved water use services. To this end, the MUS project team engaged in so-called 'learning alliance' workshops at district and provincial level (facilitated by Tsogang) and at national level (facilitated by WRC). Further, WRC organized two national policy dialogues. The details are shown in **Figure 31** below. These were well attended by the technical line departments (Department of Water and Sanitation, Agriculture, Land Reform and Rural Development, Cooperative Governance and Traditional Affairs, the Limpopo Premier's Office, Limpopo Research Forum, etc. Some municipal officials also attended, and Tsogang's direct engagement with the municipalities primarily focused on the above-mentioned MUS project's upgrades of municipal boreholes, so approval of upgrades and (ongoing and future) hand-over with increased fuel or electricity supplies for the extended reticulations. Joint site visits with municipal officials were made to that end from end 2019 onwards.

Vhembe District level	Sekhukhune District Level
2-3 December 2016 Thohoyandou with DM officials 17 May 2017 Nandoni dam 15 February 2018 Nandoni dam 6 March 2019 Thohoyandou WRC Road show 12 November 2019 Thohoyandou	15 May 2017 Lebowakgomo 13 February 2018 project introduction to the mayor of Sekhukhune District Municipality, 13-14 February 2018 Groblersdal 4 June 2018 Groblersdal 29 October 2019 Ga Mokgotho

Limpopo Provincial level	
Learning alliance meetings: 12 Nov 2015 Project launch Thohoyandou 28 July 2017 Polokwane Bolivia Lodge 28 June 2018 Polokwane Bolivia Lodge 28 November 2019 Polokwane Bolivia Lodge	Regular contacts/presentations: Limpopo Office of the Premier 2-3 Nov 2016 Limpopo Research Forum 10 November 2016; 21 June 2017; 30 May 2018; 16-17 October 2019 Limpopo Water Infrastructure Working Group: 11 August 2017

	Limpopo Coordination Committee on Agricultural Water: 7 Dec 2016 and regular updates
National level	
First national learning alliance workshop in Pretoria: 24 January 2019	
Second national learning alliance workshop in Ga-Mokgotho: 27 March 2019	
Third national learning alliance workshop in Tshakhuma 18 July 2019	
Fourth national learning alliance& presentation at WRC international symposium Sandton 12 September 2019	
First National Policy dialogue and field visits: 27-28 March 2018 Polokwane	
Second National Policy dialogue: Pretoria 12 March 2020 – postponed	
Reference Group: 2 February 2016, 23 February 2018, 27 June 2019, 6 March 2020	

Figure 31 Overview of learning alliance and policy dialogue events

10.2 Strategy: from obstacle to opportunity

The first step in upscaling community-led MUS in government structures and, hence, the first aim of these learning events was to raise awareness among government officials and others about the untapped potential of widespread community initiative and the feasibility to mobilize that initiative through community participation in all six steps of the planning cycle, as implemented by the MUS project. That, then, would raise the question: how can the six-step participatory processes be replicated widely, if not country-wide?

The MUS project's experience of the process of making the invisible visible for new future support resembled the subsequent steps of what FAO experienced in seeking to upscale multiple uses of irrigation schemes since the mid-2000s. By then both the WASH sector and the irrigation sub-sectors had started to realize that schemes designed for irrigation only were invariably also used for other purposes, which gave important livelihood benefits. As in **Figure 32** below, such awareness raising for future pro-active support required officials to change their perceptions and views. In the MUS project this same sequence held for both self-supply and people's multiple uses of public infrastructure, as follows.

Figure 32 Officials' responses moving from unplanned water uses as an obstacle to an opportunity (adapted from FAO, 2010)

- **Remove**: Officials who discover non-planned uses of public schemes designed for a single use, may try to categorically stop such uses. An extreme example was once cited (but not experienced in the MUS project's communities) that officials pull out vegetables in homesteads that are irrigated from a 'domestic' system.
- **Telling illegal**: in this response, officials do not remove, but try to prevent non-planned uses of public irrigation schemes or self-supply by emphasizing that this is illegal, usually in vain. In the MUS project, some partners did not openly judge these community practices as 'illegal', but they felt uncomfortable. One reason was that they found it wasteful to use water that should have drinking water quality for productive uses. Moreover, such productive uses by some would jeopardize the access to water for domestic uses by everyone. This highlights the importance of equitable water distribution and the water safety for the 3-5 lpcd used for drinking. The foregoing section 3.5 presents communities' different perspectives on how to deal with water scarcity, especially in sharing street taps. The next chapter discusses how government can take these particular concerns forward.
- **Turn blind eye**: realizing that it is almost impossible to prevent non-planned uses or self-supply, officials turn a blind eye, certainly when these uses do not harm anyone. This was the common perspective at the start of the MUS project. 'MUS is not new in South Africa and communities already do'. Participants in the learning alliances could also cite many examples of multiple uses or self-supply from their own experience.
- **Not my job**: officials may be tempted to pro-actively support non-planned uses, but lack any incentive to do so. Their job descriptions only refer to the single use of their departments, and there is no known policy support for self-supply. One wonders: if no one is going to appreciate these additional efforts, why make the effort?
- **Ad hoc help**: officials use their discretionary power in their local settings to enable non-planned uses and self-supply on an ad hoc basis. These are the individual champions in departments who always encourage communities' own initiative and any support for them, but may remain lonely voices. For example, the Limpopo Department of Agriculture and Rural Development mentioned cases in which they drilled boreholes for irrigation. They tested on water quality, which was safe. Then they put a sign board that this was potable water. The standard technical design book in South Africa (the 'red book') also highlights the multiple uses of water, but only focuses on water for livestock.
- **Recognize as economists would do**: in this response officials recognize and purposefully calculate the additional livelihood benefits derived from communities' initiative and investments in water infrastructure, and the cost-effectiveness of building on those investments. That is what any banker would do as well: appreciating the returns on investments. As elaborated in the remainder of this section, in the course of the MUS project, a 'critical mass' developed at district, provincial and national level up to the minister, who was convinced of the untapped potential of supporting self-supply and, in principle, also bought into participatory approaches across any infrastructure to mobilize that initiative. Seeing themselves as 'those already convinced', they started exploring how to realize the next and last step at scale.
- **Plan and implement** community-led MUS at wide scale, so institutionalize into existing government structures and planning frameworks, in particular the IDPs and Water Services Development Plans. Some emerging insights on how to do that are presented in chapter 11.

10.3 Lessons learnt

Two success factors behind this change in awareness were the 'seeing is believing' approach in the MUS project design and the strategic, evidence-based channelling of communities' lived experiences on the ground to the highest policy levels by the Water Research Commission.

As anticipated in the design of the MUS project as *demonstration* project, catalysing officials' visits to communities with operating infrastructure was most convincing, especially for self-supply. For example, the local engineering skills to manage pressure in kilometres of pipe lines over undulating terrain in Tshakhuma and Khalavha impressed. The buy-in into participatory planning and design in the upgrade of the NGO-funded scheme in Ga-Mokgotho also impressed. The diversity of the six demonstration communities also helped identifying important differences: from self-supply owned by community members on the one hand to municipality-owned and operated boreholes on the other. In all communities, communities had many ideas on next incremental steps for improvements, were adamant about own construction and realized the importance of a community structure such as the MUS Forum. The two participatory videos of Tshakhuma and Ga Moela further enabled bringing communities' real-life voices to the fore.

In the learning events, participants remembered and cited South Africa's initial experiences in the 1990s with widespread participatory approaches during the whole planning cycle. It raised the key question: how could this disappear as soon as local government got the mandate for water services provision? For example, at the workshop with Sekhukhune District Municipality (4 June 2018), the community of Sepaku shared how its well-functioning community managed water services got destroyed and even criminalized by local government. Indeed, communities' growing mistrust of municipalities aligned with the growing exposure of state capture and corruption in the water sector in South Africa, as in the Water Integrity Network's report in 2020. Comparison with the global search for alternatives helped in comparing and borrowing concepts such as multiple use water services and 'supported self-supply'.

The Water Research Commission's support and convening power was key in ensuring that evidence of these lived experiences travelled from the six communities up to the minister. WRC managers visited Tshakhuma and Khalavha end March 2018 and 'saw with their own eyes'. At the first national learning alliance meeting on 24 January 2019, other senior WRC managers were also present. WRC invited the Minister of Water and highest-level provincial and district colleagues, for a field visit in the national learning alliance on 27 March 2019 in Ga-Mokgotho. Even though not physically present, their formal support triggered a major jump in the above-mentioned responses towards developing a 'critical mass' that recognizes the untapped potential of community initiative.

A major next highlight was the national learning alliance event on 18 July 2019, Mandela Day, held in Tshakhuma. The mayors of both Vhembe district and Makhado local municipality assisted with constructing a concrete slab for the filter box. A unique dialogue was created between representatives of the six MUS project communities and these officials, supported by researchers. Moreover, in July, the national Minister of Water and Sanitation was attracted by the description of the MUS project in WRC's reports, and invited Ms. Florence Negondeni, chair of the innovation forum in Vhembe, to the Department's budget speech deliberations for a personal interaction. She also sent her message to the attendants of the 18 July event (see **Figure 33**).

Over the years with support from my department and the Water Research Commission, many successful pilot programmes targeted at the sustainable development of our rural communities have been initiated. Recently, the Community-driven Multiple Use Water Services (MUS) project brought water security to the communities of Ga-Mokgotho, Phiring, Ga-Moela, Tshakuma, Khalavha and Ha-Gumbu in Limpopo, using local expertise and energy at a fraction of the cost associated with conventional bulk infrastructure. The communities identified high yield wells in the mountains, contributed to the purchase of infrastructure to pipe water to the community, developed storage capacity and connected it to a reticulation system. More than 2 600 people benefited, assisting government to fill the backlog of the past in a cost-effective way.

This is an impact story that we can all be very proud of, these communities have proven to naysayers that participatory planning and capacity development are not too complex, what is possible when indigenous water wisdom is brought to the table. Community driven initiatives such as the MUS initiative illustrate that communities are not passive recipients of development from government but rather are active co-creators to the solutions that will yield the sustainable development of rural communities. The communities involved in this project organised themselves to contribute money and buy materials to start their own water supply schemes, which they operate and manage themselves ensuring services are reliable and sustainable.

Projects such as these challenge us as sector on our silo approach that is focused on single use from one source and Self-supply schemes present co-ownership and management opportunities from various stakeholders while contributing to effective management of water resources, provide support to municipalities to fulfil their mandate while ensuring reliable and sustainable services to communities.

The WRC led MUS Project has demonstrated the importance of working in partnerships to deliver cost effective reliable and appropriate water services to communities and highlighted that an enabling policy framework will catalyse more community driven solutions to sustainable rural development. MUS must be defined outside the framework of domestic or irrigation water supply projects to ensure specific considerations relating to planning, financing, designing, construction, operation and maintenance. The Department must take a lead in reviewing current policy and regulatory tools to enable and formalise MUS projects as alternative service delivery models for rural communities. Projects such as these can serve as international use cases for rural communities and help speed up the progress of development in rural communities.

It is initiatives like these that will propel us forward and ensure we reverse the image of South Africa as the most unequal country in the world in the 21st Century.

Figure 33 Speech by Minister Lindiwe Sisulu 18 July 2019 Mandela Day in Tshakhuma

Moving up to international exposure and dialogue, the MUS project became the ‘most exposed project’ in the Water Research Commission’s biannual symposium 15-17 September 2019 in Sandton, Johannesburg. The director of the African Water Facility, Dr. Wambui Gichuri received the MUS project outputs from Ms. Florence Negondeni in one session and commented on the MUS project in another session, with representatives of all communities, the Deputy Minister of Water, and representatives sharing experiences on self-supply and MUS from Ethiopia (including the community-management project) and India (on water assets in India’s massive Rural Employment Guarantee Scheme. The MUS project also received the Knowledge Tree Award for Community Empowerment. The project became part of the Africa-wide evaluation of the African Water Facility end 2019 and shared its footage of the participatory videos with the African Water Facility.

This prepared well to move to the last step: planning for community-led MUS. Especially the question ‘how to integrate community-led MUS in IDPs?’ required much further analysis and understanding of the entire policy and funding space of South Africa’s water sector. Whereas line agencies, especially DWS and DALRRD soon saw themselves as ‘the convinced’, engagement with (overstretched) municipalities appeared more complex. For example, the municipal staff of the Sekhukhune District Municipality were suddenly unable to attend the event in Ga Mokgotho on 29 October 2019, because of an unexpected other urgent meeting within the municipality. Also, on 12 November 2019 a district learning alliance meeting in Vhembe District Municipality was held in Thohoyandou. This had the ideal cross-level and cross-sectoral representation from the three Vhembe communities up to national policy directorate of DWS, but only one municipal staff member attended. However, municipal staff participated in the visits to all communities by end 2019, also to discuss hand-over.

In sum, as indicated in chapter 8, the MUS project was able to make the case for community-led MUS with its different co-management modalities. As indicated in this chapter, interest in community-led MUS grew from local to national level. The question became: how to align community-led planning and design of new infrastructure (or repairs or upgrades) with available technical, institutional and financial support at the aggregate scales of district level IDPs for millions of citizens and national government serving the entire rural population? The following chapter proposes some emerging answers.

11 Lessons for upscaling: integrating community-led MUS in government structures

11.1 Conceptualizing accountability in government structures

The conceptualization of the question on how to integrate community-led MUS in government structures can borrow from the accountability triangle (World Bank, 2011). This enables unravelling that question by mapping service delivery institutions and their mutual relationships across central, intermediate and end-users' levels. The triangle is between citizens (poor and non-poor), the state (politicians and policymakers) and service-provider organizations with managers and 'front line staff' (see **Figure 34**). Relations are defined as accountable if: 1) there is a delegation of, or request for an expected service; 2) there are financial or other rewards for delivering that service; 3) the service is actually delivered; and 4) the ability exists to enforce the expectation, which supposes; 5) that there is sufficient information about the service performance. **Figure 34** also highlights the national/central levels and the intermediate levels, which can be provincial, district or local municipalities in-between central and communities' local levels.

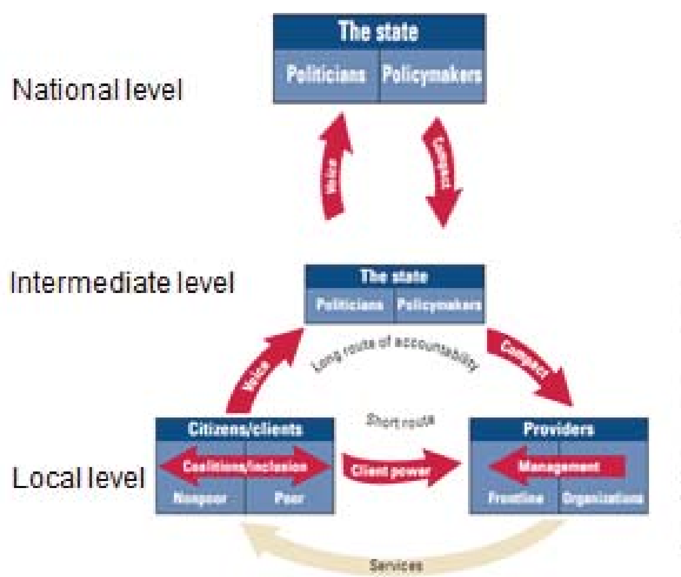

Figure 34 Accountability triangle (adapted from World Bank, 2011)

Long and short routes to accountability are distinguished. The long route has two legs. First, citizens hold their politicians to account. In South Africa, these are the elections, but also the above-mentioned frustrations and protests, which increasingly challenge the legitimacy of their elected politicians and their ability to deliver services. In the second leg, politicians liaise with the policymakers. The latter set the rules and shape the organizational set-up to provide those services.

Services can be provided through internal ‘compacts’ with own staff or by outsourcing through tenders with external ‘contracts’, or by combinations. Compacts and contracts clarify performance agreements and rewards. The ‘frontline staff’ on the ground who directly interact with communities has to deliver the promises and may have some level of autonomy or discretion. This ‘intermediate’ level (or ‘messy middle’) is to support the officials directly working with communities on the ground in the short route to accountability (depot managers, extension workers, institutional development officers, etc.).

The short route to accountability is the direct interaction between those front-line service providers and citizens. Citizens’ voice is mobilized in community-led planning, design and construction that leverages users’ powers, as in the MUS project’s six communities. Even for tasks that communities cannot do themselves, they can monitor performance of service providers. This echoes the Strategic Framework (DWAF, 2003, p 60): ‘A regulatory framework should recognise that consumers are in the best place to monitor the effectiveness of water services provision. Therefore, the most effective monitoring strategy for the sector is strengthening the voice of consumers. It is the responsibility of water service authorities to put in place mechanisms to facilitate, listening and responding to consumer and citizen feedback on the quality of service delivery’.

Thus, the question becomes: how can the current protests expressed in the long route to accountability be redirected to the short route to accountability? How can the national and especially the intermediate level institutions create the space for such stronger short route to accountability?

Answering this question requires a more granular analysis of processes at stake within the overarching existing structures and procedures, in particular the Integrated Development Plans and Water Services Development Plans. The post-1994 design and establishment of new unitary government structures and processes are rightfully hailed as one of the major achievements in the transformation from an apartheid state to democracy (World Bank, 2011). Integrated Development Planning (IDP) processes steer district-level integration of the many tasks at stake for often over a million inhabitants. Longer-term planning, including Water Services Development Plans and water master plans looking at five-year horizons also inform this process. The results of decision-making on IDPs are yearly and transparently communicated in widespread open sessions. Hotlines to high level officials exist and are used, as found in our interviews. As these structures are sound, the question becomes: what happens *within* these structures and procedures?

The scale of this question is a tall order, boiling down to the question ‘how can large sums of funding at national scale (earmarked for rural water infrastructure) be sub-divided into tens of thousands of small amounts that fit each different local condition according to communities’ needs? Moreover, how can these amounts open up the critical steps 1 to 4 to communities? This would address the main complaint found about IDPs in MUS project interviews and also other research (Monyai et al., 2020): community members can find IDPs a waste of time because only the already decided projects are communicated at the end of step 4. The critical steps 1-4 remain hidden.

The following section (11.2) confirms how the highest policy levels support a strong short route to accountability that in principle would include the planning and design steps. The next section 11.3 discusses how these policy intentions of participation and accountability are operationalized in the second leg of the long route to accountability: the service provision frameworks, that is fund allocation from treasury down to frontline staff. What, precisely, are the institutional barriers and opportunities in planning cycles from central financiers to the ‘intermediate level’ agencies in the province, district or local municipalities, and finally wards and communities and households? Why did community participation disappear since the 2000s and how can it be brought back?

11.2 National policies

11.2.1 Support to self-supply in the water sector

South Africa's Constitution, policies, legal frameworks, regulations and guidelines all promote active citizenship and people's participation. Self-supply is such active citizenship in the water domain. Self-supply is well recognized as an alternative model in the National Development Plan Vision 2030. This explicitly calls for a new funding arrangement to support self-supply of water.

The draft National Norms and Standards for domestic water and sanitation services (DWS, 2017) guide the Water Services Authority to provide support to investments in infrastructure for self-supply (clarifying that maintenance will remain the responsibility of the owner).

The draft National Norms and Standards include the following ***support***:

- The WSA shall advocate augmenting water use with alternative water sources, such as groundwater (springs, wells, boreholes), rainwater harvesting and stormwater harvesting
- The WSA shall assist with access to good quality products and services regarding self-supply
- The WSA shall make available an advisory service to households wishing to self-supply.

Specific *support on water quality* entails:

- Guidelines shall be provided to self-supply households regarding treatment and purification of alternative water sources for domestic and personal use
- Point-of-use water treatment systems and methods shall be advocated
- Users shall be educated in effective water use and hygiene, with a focus on water quality requirements and water conservation.

The Norms and Standards further oblige the Water Services Authority that, depending on its byelaws, 'The municipal by-laws shall be revised to allow for self-supply'.

The ways in which government's responsibility to provide support can be operationalized, and by whom, and at what conditions, are still open. One way is through the Municipal Infrastructure Grant (MIG). This would apply if support to self-supply enables meeting the basic quantities of water for all, and where, in a sense, better off users co-subsidize by sharing water with the have-nots (see chapter 7). 'We note that the MIG has 60 litres per capita per day as its design criteria, anticipating rising demands' (government official).

The Norms and Standards have two ***conditions***:

- The relevant regulations and protocols for groundwater and spring protection shall be applied
- Water use shall be metered or monitored for reporting and planning purposes.

Recognizing that metering is rare in low-income rural areas, the latter condition calls for other forms of monitoring. Such monitoring should align with water allocation legislation in the National Water Act (1998). Most water uses fall under Schedule One. This is defined as water 'for reasonable domestic use; small gardening not for commercial purposes; and the watering of animals (excluding feedlots)'. The NWA also stipulates that 'such uses should not be excessive in relation to the capacity of the water resource and the needs of other users'. No licenses are required. These uses are not monitored. Yet, monitoring is important to render water uses visible and protect against encroachment by water uses with a lesser priority.

Further, the National Water Act stipulates the prioritization in allocation of water resources. The considerations include: the need to redress the results of past racial and gender discrimination; efficient and beneficial use of water in the public interest; the socioeconomic impact of the water use or uses if authorised; or the failure to authorise the water use or uses. The absolute priority is for the Ecological Reserve and Basic Human Needs Reserve (whether self-supply or public services), meaning 'the prescribed minimum standard of water supply services necessary for the reliable supply of a sufficient quantity and quality of water to households, including informal households, to support life and personal hygiene' (DWA, 2013). Although the regulations set this volume at 25 litres per capita per day only, in poor communities, a significant number of people might not even be able to access this water resources because of competing other uses. So, it should be monitored who still lacks access to the water resources needed to meet basic water needs. For allocation of remaining water resources, the National Water Resource Strategy – 2nd edition (DWA, 2013) stipulates that the third highest priority (after the Reserve and international obligations) is 'accorded to the allocation of water for poverty eradication, the improvement of livelihoods of the poor and the marginalized, and uses that will contribute to greater racial and gender equity' (p. 47). This is even a higher priority than strategic uses, which is mainly electricity provision. Larger scale users (whether for self-supply or government schemes) within the community and elsewhere, up to national level, are obliged to obtain licenses and have only fifth priority.

11.2.2 Institutionalizing community organization

In the MUS project, the Primary Cooperatives were welcomed as the appropriate form of formalization. At medium-term, an assessment is recommended about their sustainability (including continuing fees and renewal requirements) for both operation and maintenance of the water infrastructure and for successful tendering for local government assignments.

Other forms of institutionalization are important. The national Department of Water and Sanitation has catalysed Water and Sanitation Forums to improve communication between communities and municipalities. Formal institutions can be Water User Associations (although they may need national endorsement by the Minister), and community-level Water Services Committees or Community-Based Organizations. Unfortunately, although self supply profoundly differs from service provision to customers, supported self supply can still be seen as competing with Water Service Providers in tendering processes. Especially, the Water Services Act 1997, sections 51 and 78 need to be revised. Service Level Agreements or other arrangements may also well meet the required formalization of community structures.

The Department of Water and Sanitation is already searching for appropriate institutionalization in step 6 of use and operation in compiling guidelines on 'The Use of Community Based Organisations in the Management, Operation and Maintenance of Groundwater' (Maunatlala, 2017). These draft guidelines explore various (paid or voluntary) options to appoint a CBO, also for a specific service, e.g. repairs. Benefits of CBOs include: good customer relations at local level; empowerment of local communities; ownership and responsibility to infrastructure; ability to identify problems and provide quick response; accountability and responsibility to local consumers. These benefits would also hold for surface schemes.

From municipalities' side, co-management of municipal boreholes for continuous maintenance, operation, servicing and repairs of the bulk supply needs to be strengthened. Past pilots with Service Support Agents and social franchising may well provide entry points.

11.2.3 Multiple use water services

As already mentioned in section 1.1.2.2, at policy level, the South African government is a global leader in recognizing and promoting people's multiple water needs, for example in the Strategic Framework for Water Services 2003 (DWAF, 2003). This framework also introduced the notion of 'climbing the water ladder'. However, volumes above the 25 litres per capita per day have to be paid. From 2003 onwards, the project Securing Water to Enhance Local Livelihoods (SWELL) demonstrated the first three steps of community-led planning and prioritization in 11 wards in Bushbuckridge, Mpumalanga, and organized national dialogues (Cousins et al., 2007). It was one of the countries of an eight-country research project on multiple use water services (MUS) led by IWMI, in collaboration with 150 institutions world-wide.

In 2011, the government's recognition that access to adequate water is not only a basic constitutional right but often also a prerequisite for the poor for their food security, economic growth, and improved livelihoods, was further recognized. The Department of Water and Sanitation issued guidelines in the 'Provision of water for small scale multiple uses systems. A guide for municipalities' (DWS, 2011). This document emphasizes the benefits of multi-purpose infrastructure, focusing on smaller-scale infrastructure for water at household level. The document also examines the funding streams, in particular the Municipal Infrastructure Grant that provides the core minimum of Free Basic Water.

The National Water Resource Strategy NWRS – 2nd edition (DWA, 2013 p 24) also promotes multiple use water services (MUS) by seeking 'to ensure a smooth integration of the provision of water supplies for domestic use and water for other purposes leading to economic production, particularly in rural areas'. The Strategy recognizes: 'Water for domestic supplies in rural areas is used for various household purposes such as cooking, washing, food gardening, stock watering and small businesses. If water is provided mainly for irrigation, it will also be used for domestic purposes, and if water is provided for domestic purposes, it will also be used for other purposes'. Referring to the department's above-mentioned implementation guidelines 'to better integrate social needs into the planning of new water resource infrastructure', the strategy envisages 'that all new water infrastructure is planned, developed and used as multi-purpose facilities, especially to meet social needs'. In all this 'A new approach to planning for community water supplies is required; one that considers and provides for the multiple water needs of the community. This may necessitate using water from a range of different sources. Policies are in place to facilitate cooperation between the DWA and local government in planning and developing multi-purpose water supplies for communities.

The National Policy Review (DWS, 2014) further operationalizes the NWRS – 2nd ed, with a focus on bulk raw water infrastructure. Planning for a single water use is seen as 'inefficient use of financial resources as additional, often much higher, financial resources are required to provide water to other water users, after the raw infrastructure had been provided'. It also emphasizes the envisaged adoption of a participatory approach 'to avoid conflicts over allocations to different purposes'.

Hence, the policies and laws are clear; the issue is how to operationalize the support? The MUS project was designed to explore answers.

11.2.4 Agriculture, Land Reform and Rural Development

The National Policy on Comprehensive Producer Support Development (DALRRD, 2020) supports individual or organized farmers, farm workers, or those in the value chain according to their priorities. Support includes the range of small- and larger-scale water infrastructure for self-supply. Further, it categorizes eligible beneficiaries based on wealth, gender and age and stipulates own contributions depending on that status. It calls for alignment with DWS, in particular on 'water allocations and licensing and water infrastructure development' (section 11.1).

The categorization defines (section 7.2):

- *Household Producer (Vulnerable):* vulnerable women and youth, child headed households, persons with disabilities, and households that qualify to be registered as indigents, and who produce for own consumption. Support to them is a grant.
- *Household Producer (Subsistence) they may* market limited surplus production with an annual turnover of less than R50 000. Their contribution is 10% of the subsidy.
- *Smallholder Producer:* a venture both for household consumption and income from agriculture activities along the value chain. Their annual turnover ranges from R50 001-R1 million per annum. They should contribute 20%.
- Other larger-scale categories who all have to contribute over 35% of the support provided.

Further, the policy envisages a Comprehensive Register of Producers that will serve as a prerequisite for accessing support from Government (3.2.3). DWS can use data on producers' water uses for the monitoring of self-supply by farmers. It can apply similar principles for other small-scale uses. The policy also recognizes that the impacts of climate change will especially affect dryland and smallholder producers, and that irrigation builds resilience (2.1.3c).

11.2.5 Other policies and programs

Water infrastructure can also be a component in other participatory policies and programs, aiming, for example, at nutrition, gender equality, general development, job creation, climate resilience disaster management, and local economic development. Overall goals and participatory approaches that enable communities to indicate their priorities are bound to identify opportunities for supported full or partial self-supply. In the case of partial self-supply, in-house capacities and/or collaboration with Service Support Agents is key for the continuous maintenance, operation, servicing and repairs of the bulk supply, for example municipal boreholes.

Collaboration with employment generation programs is particularly well suited for participatory water services. In this regard, global experience is telling. The world's largest rural water supply program is a MUS program but never intended to become a water nor a MUS program. However, the participatory nature and open funding earmarks of the program triggered massive MUS. This is India's Mahatma Ghandi National Rural Employment Guarantee Scheme (MG-NREGA). In this program, communities and local authorities decide on how to allocate the labour that government pays to realize the right to work, to create assets. Research showed that they most often opt for water and drought proofing assets, for a total value of USD 3 billion. Not surprisingly, in most cases, these were multi-purpose infrastructure, tapping into multiple sources, for example groundwater recharge (Verma et al., 2011). The MUS approach can be smoothly integrated in the Expanded Public Works Program or Community Works Program by involving communities from the planning phase onwards instead of waiting to involve them during construction. This is yet another way to implement existing policies and institutionalize community-led support to full or partial self-supply in existing structures.

This clear national support puts the question in even bolder relief: why is communities' involvement in the short route to accountability so limited? This question requires more evidence and debate. The discussions mentioned in chapter 10 and other interviews with officials gave some first indications. The following three sections unravel some of such barriers at central and intermediate levels as seemingly paradoxes, and explore how they are already overcome, or could be.

11.3 Overcoming the paradox of overlapping funding streams

11.3.1 The paradox: central financiers avoiding wasteful expenditures

At central levels, treasury and other funders seek to avoid overlap in fund allocation for good reasons; this could result in wasteful expenditure and 'double dipping' by people 'who are getting multiple forms of financial or non-financial support from the same or different institutions for the same purpose', as the draft National Policy on Comprehensive Producer Development Support of the Department of Agriculture, Land Reform and Rural Development defines. Hence, mandates should be well separated between different departments. Moreover, such siloes enable mobilizing specialist knowledge. For water, this is engineering expertise that needs to fit the size and type of water infrastructure. Further, as water is only one input to wellbeing, other types of expertise are needed as well: clean water without hygiene education still fails health goals. Irrigation without good seeds, fertilizers and markets remains sub-optimal. Lastly, clear mandates, with earmarked funding, ensure that financiers can hold mandated institutions responsible to implement government tasks, for which they receive funding. From this central perspective, silo-ed structures enable central treasury and other financiers to hold lower levels accountable.

South Africa's separation between the Water Services Act (1997) and the National Water Act (1998) typifies this separation. The legal frameworks designate implementation responsibilities and funding for subsidized water services for basic volumes (25 litres per capita per day) to municipalities as Water Service Authorities (WSA). Where District Municipalities are WSAs, they have an option, after undertaking a Municipal Systems Act Section 78 process, to contract a qualifying Local Municipality as a Water Service Provider. All other water uses are linked to other departments. As above, the Department of Agriculture, Land Reform and Rural development has earmarked funding to improve access to water for productive uses. Other income-generating water uses, such as mining and tourism also each have their own department. The Department of Environment considers environmental uses and water quality.

11.3.2 Overcoming the paradox: distinguishing engineering expertise and expertise on water dependent livelihoods

The paradox lies in the nature of water, especially water infrastructure, and the locking of engineering expertise in one silo. As the Department of Water and Sanitation underscores in its National Policy Review (2014), multi-purpose infrastructure is cost-effective and water-efficient. So, it is wasteful expenditure to construct one scheme for one use, another scheme for another use, and a third scheme for a third use, all in the same area for the same people who all share the same water resources.

Siloes are especially wasteful from an engineering perspective: the infrastructure is the same. Differences may be in volumes and needed availability (daily or intermittently) and in the site of use: homesteads, distant fields or other sites of use of the same water technology. Engineering expertise certainly crosses departments.

Expertise to turn a certain water use into a livelihood benefit (hygiene, agronomy, market development), which *is* specific to that single use, should not be locked within their specific single use siloes either. Other departments can well benefit from other department's expertise. For example, in Ethiopia hygiene specialists teach agricultural extension workers simple measures on how to keep open multi-purpose wells clean (protect debris from flowing in, especially in the rainy season; covers; hygienic lifting devices; etc.) (Mekonta, personal communication). General rural development departments can invite health specialists to promote point of use treatment devices. The South African government seeks to promote precisely such cooperative governance. In this way, water development and management is the bottom-up pull for needs-based integrated provision of government services.

In the commendable constitutional commitment to subsidize everyone's access to water that is safe for drinking within 200 metres from homes, one aspect is the *volume* of at least 25 litres per person per day, without major interruption. The other aspect is the safety of the 3-5 litres per person per day for drinking. There are a range of cost-effective methods to achieve this. Ensuring drinking water quality for other domestic uses such as bathing and laundry can well be a waste of money. Even in middle- and high-income settings, the global trend is to reserve one supply system for drinking, and catch rainwater or re-use water for other purposes. In low-income areas, governments can leap frog a need for one single supply infrastructure for all domestic uses, and apply the range of measures to ensure that the small volumes for drinking are safe.

Such focus on neutral volume, without a priori dictating a single use, also ends the discrimination that the paying middle-class has the right to use water made available to them in whatever way they want, whereas indigent 'beneficiaries' are often only allowed to use basic supplies for domestic uses. Yet, the large majority in all six communities, as confirmed in other literature, have other priorities: they used their water, even if well below 25 litres per capita per day, for both domestic and productive uses. These priorities should be respected. Thus, the type of water use is seen as a user's right, or, as a national DWS official called it: 'the least of my problems'.

Whereas the specific funding streams to subsidize access to these core minimum volumes are under the mandate of Water Services Authorities, users have to contribute for higher service levels. Or other funders can build on the core minimum and expand volumes. The above-mentioned

Comprehensive Producer Development Support of the Department of Agriculture, Land Reform and Rural Development (DALRRD) does precisely that at homesteads, fields and other sites of use (e.g. cattle dams). This policy also requires own cash contributions for support, except for indigent household food producers. For these other funding streams, low incremental costs to build on subsidized minimum supplies would generate high incremental benefits (Renwick, 2007).

11.3.3 Basic Human Needs Reserve in equitable local IWRM

The commitment for the Basic Human Needs Reserve in terms of *volumes* is also key in equitable sharing of water resources. As found in Ga Mokgotho and Ga Moela (section 3.5), inequalities in access to water to homesteads do not follow what an often-assumed sequence of first domestic and then productive water uses. Instead, volumes are determined by family sizes, water-dependent livelihoods and wealth status, own investments in household storage and other self-supply, and alleviation of chores, for example by nearby location of a tap or by the ability to connect pipes to communal taps to homestead yards, whether communities see that as illegal or legitimate or just have to accept. The Basic Human Needs Reserve holds across uses, communities, and regions. More research is recommended on communities' customary sharing of multiple water sources (for multiple uses mainly through multi-purpose infrastructure), what communities call 'the blinking of an eye'. Rural communities are probably the world's champions in Integrated Water Resource Management and nexus approaches, well before these global debates started in the 1990s. Community-led MUS harnesses these local sharing principles and practices.

11.4 Overcoming the paradox of accountable process

11.4.1 Financiers' needs for costed designs before final fund allocation

This accountability paradox is that infrastructure funding requires a technically sound, robust, and costed technical design that is checked and signed off by engineers. Only then can financiers make an informed final decision about funding and funding arrangements and monitor implementation. Conventionally, pre-feasibility, feasibility and designs are made without involving communities. Even stronger, participatory planning and design would raise communities' expectations before it is clear whether the design can be funded at all. Proper participatory planning and design demands voluntary time inputs from communities; understandably, this raises expectations even more. This risks further fuelling already widespread disappointment about past promises by the new democratic government, if not corruption allegations. If there is no funding after initial assessments, it is difficult to still manage expectations raised. In the words of a government official: 'we need to have the courage to go back to communities and tell the truth when money is not available'. Another high-level municipal official even ruled that no-one should talk about money until the funding was allocated. Paradoxically, this further incentivizes planners and engineers to minimize contacts with the community during planning and design phases.

These dynamics compound other reasons to exclude communities from the pre-feasibility, feasibility and design phase, and often even later construction. One reason regards the level of complexity and need for professional engineering expertise. Unfortunately, another incentive for such exclusion is that officials, consultants and contractors prefer keeping these paid jobs to themselves, instead of decentralizing to communities, as further elaborated in section 11.5 (WIN, 2020).

11.4.2 Overcoming the paradox: communicating and keeping promises

This paradox is overcome by clarifying from the start onwards the conditions and the process of support. Community-led supported self-supply is new in the water sector (but not in other programs, for example, in the Comprehensive Producer Support Development Policy), so type of support, procedures and communication need to be clear. Instead of raising expectations of abundant money as a Santa Claus, the types of government support need to be defined and own contributions required to negotiate mutual commitment. This holds for individual infrastructure projects, but also for programmatic support. In both cases, government institutions can adjust their internal organization and capacities.

11.4.3 Individual infrastructure projects

For individual infrastructure projects as in the MUS project, the project was fortunate to have funding to implement the entire project cycle plus already upfront an overall amount for construction materials and labour. As elaborated above in the guidelines for participatory planning (chapter 2), the MUS project still had to manage expectations by immediately highlighting: 'the project does not bring any big money'; 'we come as equal partners, meeting each other half way', or: 'we know what we have and what we do not have, and we work with what we have'. When asking community members about the performance of the NGO, the most cited answer was that the implementer was committed and 'kept its promise'.

In other or future cases, conditions for support can also include own contributions in cash and kind; or ensuring that no one is left behind, for example by mobilizing social safety nets. Sustainable organization for future operation and maintenance phase is a key condition upfront, so that the technology choice and design can be adjusted as needed. Communal operation and maintenance, without free riders, requires sophisticated forms of member organization, effective governance by a committee accountable to members, and operators that are accountable to both members and the governance structure, and rewarded for good performance. In communal systems with street taps, already existing or upcoming problems of individuals who invest in a yard connection needs to be addressed before funding is allocated. Addressing these issues requires discussion, capacity development and training. Also, handling public funds renders new leaders vulnerable to 'pointing fingers' by those who don't benefit or otherwise oppose, often as part of existing factions. Own contributions, including labour contributions that self-select poor women and men, appeared an effective reply. Moreover, project management and leadership training and transparent book keeping are required.

Amounts at any level can be fixed amounts, or ballpark figures, or open and negotiable. Funders can allocate money for the whole project cycle or funding can be split into funding for the planning and design phase and funding for implementation, or split in even more detailed tranches. Similarly, materials can be procured according to centralized procedures or locally by communities.

There will be blends: each step in the cycle can have different degrees of community participation, also depending on the co-management modality at stake. Representative community structures with the required expertise can submit a request and government can hand the money for implementation over to the community structure. Or users decide about the reticulation, the land tenure arrangements for storage sites and location of new taps. They can be rewarded, for example by priority services by the municipality. Or the community structure can sign off on the recruitment of skilled builders, or on the quality of materials delivered by suppliers, or payment of contractors upon satisfactory completion as innovated in the 1990s (Gibson, personal communication). The community structure is likely to need training in project management and book keeping. Much can be learnt from international experiences such as the Community Managed Project in Ethiopia, in addition to this MUS project. The African Water Facility also has experience with community-led sourcing of quotations that are advertised, for example, in the community hall.

Or communities get vouchers or a loan from government and buy materials with those funds. Or they bill their expenditures. Intermediate level support agencies can guide for due diligence. In other cases, just providing materials will do, as happened in the past through government's service centres with spare parts.

For equitably handling of public funding, transparent and accountable community structures need to be in place, and formalized. When community members are not aware of what happens with their financial contributions, they are less keen to contribute. Hence, transparency about funding received and spent, backed by recording and bookkeeping, is vital.

As mentioned above in 11.2.2, the type of fit-for-purpose formalization of community structures and contractual agreements with the municipality differs and should be an open choice out of various options. The bottom-line is that parties at both sides are free to engage or not, but both should *keep promises.* Indeed, the lowest-hanging fruit is managing expectations and keeping promises. Unmet promises of support hold users hostage in dependency syndromes. It paralyzes initiative. If promises are unfeasible, it is better to be clear and mobilize community's involvement otherwise, wherever users can and want to undertake action through voluntary co-management arrangements. Where some communities prefer waiting, other communities will *prefer* taking responsibility to provide for small repairs in the reticulation of boreholes, or to provide fuel, instead of passively waiting. Voluntary co-management can be applied instantly and temporarily so that government can take up responsibility again once it is ready. These experiences can inform intermediate-level and national-level policies.

Last but not least, community-led MUS requires socio-technical facilitation. This is a combination of social facilitation skills and technical expertise for the small-scale technologies at stake, including access to professional engineering expertise as needed for more complex technologies. Whereas government institutions may have both types of expertise, their combination is still rare. In all this, government arms, including municipalities, can either implement with own staff or outsource this job to those with the skills.

Re-organization from municipalities' side can build on earlier experiences, especially when they own and operate infrastructure. In the 1990s, the modality of Support Service Agents (SSA) worked well. Contracted by the Water Services Authority for major maintenance, they also mediate and mentor community committees and (paid) operators elected by the community for daily operation and repairs (Wall and Ive, 2010).

Lagardien et al. (2010) also examined the possibilities to involve communities (care takers and community-based operation and maintenance forums) in operation and maintenance of technologies, especially for sanitation (communal ablution facility; emptying pit latrines). Their guidelines suggest in-depth asset management. This includes: unbundling all operation and maintenance tasks; defining the required frequency (ongoing; ad hoc, daily; weekly; monthly) and defining and assigning responsibilities (community; municipality; joint responsibility); defining required materials and equipment; defining required skills and other selection criteria and process for a voluntary or paid job; and access to budget lines to ensure delivery of materials for small repairs.

11.4.4 Programmatic support

Support to community-led MUS can also be programmatic. For example, it can include affordable technology supply chains and technical capacity development, including water quality devices and measures. Exchange on the technical lessons learnt by local engineers as *they* experience, within the resources that are sustainably available *to them,* can avoid the huge efforts in the current trial and error approach of self-supply innovation. Women's inclusion would mitigate male monopolization of technical expertise.

Another option is the establishment of a trust fund for community-led MUS at municipal level. Ideally, a national hub for community-led MUS and supported self-supply in low-income rural areas (and possibly low-income peri-urban areas) would be established. Such hub would enable exchange among key stakeholders. Women and men water end-users and local technical innovators can champion the cause and the Water Forums that the Department of Water established may play a role. Technical experts and engineers in municipalities and line departments can share their experience in low-income areas. Private sector manufacturers and sellers in the supply chains of affordable technologies can assist. A hub can realize cooperative governance across governmental and non-governmental financiers, Water Services Authorities and other departments in particular the Department of Agriculture, Land Reform and Rural Development, or Expanded Public Works Program. Corporate sector partners that are most active in the rural waterscape, for example, jojo manufacturers, can further help reduce inequalities as their social responsibility and catalyse inclusive community institutions at the same time. Other corporate sector may implement community-led MUS as part of their social responsibility programs. Researchers can analyse, document and monitor as input into evidence-based learning processes. Experience from low-income rural areas in other countries, without the apartheid-era dependency on mechanized technologies and with advanced programs on supported self-supply, could also be useful.

11.5 Overcoming the paradox of spending for performance

11.5.1 The paradox: spending as performance in upward accountability

In bureaucracies across the world, treasury and other central-level financiers need clear, technically sound plans from intermediate level implementers before they can allocate funding. After fund allocation, it is widely seen as underperformance when implementers do not achieve the planned outputs for that period. Not spending money, and having to carry over or, worse, returning money to the central financer, is generally seen as weak, unrealistic planning. It also suggests that the intermediate and local level implementers do not need so much money. Bureaucracies' general logic is to inflate proposals and, once allocated, spend rapidly. This intrinsically favours expensive new designs instead of most appropriate designs. As the water sector depends on infrastructure and technical expertise, this does not prevent, and even encourages excessive new construction of the sophisticated but expensive large-scale centralized mechanized technologies, as developed for a minority paying urban middle class. Also, pre-feasibility, feasibility studies, and designs should be rapid in order to submit more legitimate requests for much funding. Expectedly, organization of such designs is most rapid with those closest to the funding streams. Similarly, once funding is received, spending pressure breeds quick spending. It reinforces liaising with known partners instead of opening up for new partners that may be fitter for the job. Both perverse incentives affect factual results-based performance. Moreover, factual performance is hardly monitored.

In 2005, a similar logic of spending as performance was found in South Africa's water sector: 'in reinforcing a top-down centralised approach and placing priority on expenditure and planning over the efficient and sustainable delivery of services' (Jones and Williamson, 2005). The joint ventures in the irrigation sector encountered the same fate, leading to extraordinary costs but scheme collapse in the communities (Van Koppen et al., 2018).

In South Africa's District municipalities, the council of elected representatives of the local municipalities' councillors, and the mayor who is accountable to the council take ultimate decisions on which project proposals to fund. They also appoint the technical branches, including the Municipal Manager, chief financial officer, planning division, operation and maintenance division, social development division for mobilization, IDP section that addresses queries by communities, regulation/police, etc. In the IDP process, the many broad problems diagnosed by communities in the IDP meetings come via their committee members to ward councillors, and to the local municipal council. However, responses to these needs, solutions and technical designs (steps 2 and 3) are mainly decided at municipal level; communities are not part of the solution. Further, pre-feasibility and feasibility studies and designs are typically outsourced. This is partly the result of limited in-house technical capacity in the neo-liberal reduction of the state and partly reflects the historical gap in technical expertise for the rural majority. The next step 4 of 'fitting the financial framework', or, as the so-called 'filtering' among the millions of basic needs that need to be matched with the available funding streams, which are always insufficient, and the appointment of those getting the jobs for implementation remains untransparent for communities and even for many officials.

Moreover, South Africa's sophisticated current technical expertise is hardly geared towards the affordable small-scale technologies that rural communities already implement and seek to improve for 24/7 access to water. Moreover, as interviews showed, the role of municipal or other departments' technicians and engineers, including those who do master that knowledge, is limited to screening feasibility studies and designs, whoever made them, on technical soundness. Water technicians and engineers in municipalities and other departments felt side-lined by democratically elected representatives (or central party level top-down interference in appointments) and pressure by their (political) superiors to accept even sub-standard designs. They are called for ad-hoc action and fire-fighting, wherever communities have taken to the streets, locked up civil servants or directly jumped to higher level officials to get their voices heard in the long route to accountability. Hence, their precious technical expertise is hardly used for appropriate solutions and overseeing the implementation of outsourced contractor or other assignments, let alone for the more detailed community-led diagnoses that include existing self-supply, and for the co-design of solutions. The well designed medium-term and longer-term strategic planning, including maintenance, in the water sector remains on paper only.

Moving yet another layer downwards, the logic of quick spending led to the emergence of the new class of ‘tenderpreneurs’. Invoking legitimate national principles of prioritizing 30% budget allocations to ‘locals’ and ‘the community’ and Broad Based Black Economic Empowerment, tenderpreneurs aggressively demand the assignment of tenders, irrespective of performance, or irrespective of what the rest of ‘the community’ wants. At the same time, as tendering is increasingly competitive, even competent tenderers tend to under-budget to win a bid. However, this backfires in the end when budgets are depleted but works are yet to be finished. This compounds a common tendency to use lower quality materials than promised.

Unfortunately, as also illustrated in chapter 4, the problem of rapid spending without monitoring of results trickles down into communities. A small elite is emerging with the few right contacts and the right knowledge about political procedures to obtain funding according to top-down defined needs that fit silo-ed funding frameworks. They become the gatekeepers and patrons for allocating public money. For example, at a general IDP meeting it was a complete surprise to MUS forum members in that same community to suddenly find a very expensive water project in their community. They also commented how the local leader of that project ‘just ‘personally chose and called beneficiaries of RDP houses, without any information, let alone a community meeting’. This rush for money not only destroys performance-based support. It also breeds local conflicts and erodes vital social capital for general community livelihoods and organization. Yet, internal organization is key for water management.

The logic of public spending as performance indicator, without checks and balances, also fuels allegations of corruption, if not real corruption, defined as the ‘allocation of public funds for personal gain’. Personal gains may include power in a political party. On the other hand: corrupt people have an interest in mal-functioning government structures. Given the central role of infrastructure and specific technical expertise required, the water sector is even more prone to corruption. Consultancy and engineering firms may well become passive or pro-active part of the corrupt deals that serve their interests (WIN, 2020). Corruption is rife, and widely exposed, in South Africa’s young state that replaces the intrinsically corrupt apartheid state, which used state funds to serve the interests of the white middle class minority, also in the water sector. Colluding interests between politicians and implementers led to systematic state capture (WIN, 2020).

Interviews alluded to corruption-prone actions at intermediate level. Engineers are put under pressure to inflate budgets for technical designs: ‘write a million – no problem because I sign’. Superiors can exert pressure to allocate tenders to allies (and voters) instead of the best bidder, which may, or may not be followed by kickbacks after approval. Candidates for political posts promise jobs to those who vote for the candidate: ‘don’t worry’. Contractors are forced, or remain unpaid, to bribe when municipal financial officers who pay contractors for completed works ‘can help’ by moving the contractor’s invoice at the bottom of the pile up to the top.

11.5.2 Overcoming the paradox: performance for service delivery in accountability downwards to end-users

End-users have the strongest interests in service delivery performance. Community-led MUS strengthens their voices, building on existing communication channels from ward committees upward. Community members highlighted the need for a stronger representation of community voices within municipalities. They also flagged the rapid turn-over of municipal officials, without adequate hand-over of responsibilities. Government's in-house technical expertise up to the front-line staff is the precious, longer-term source of support that should be groomed. Elected ward committee members and councillors can facilitate communication and serve as archives on past interactions, all with a focus on performance of water service delivery for all end-users, especially women. These are the channels to catalyse community-led MUS nation-wide bottom-up, and shift communities' frustrations in the long route to accountability to a well performing short route. This will contribute to holding their elected representatives bottom-up to account.

12 Conclusions

This report 'made the case' for community-led MUS as demonstrated by Tsogang in six diverse communities in low-income rural areas. Precisely because of local diversity in the two project's districts, and across South Africa, participatory processes are indispensable. The six steps, as in any project cycle, also apply for participatory planning, design and implementation. Yet, the outcomes of such process depend on infrastructure and hydro-geological and socio-economic conditions. Various co-management modalities were identified. Further comparative research can fine-tune such modalities for other parts of the country. As summarized in section 8.3, community-led MUS generates at least seven sets of benefits, with communities' call for 'nothing about us without us' as probably the most important one.

Chapter 10 indicated how the MUS project saw a shift in attitudes among government officials from ignoring self-supply and non-planned water uses towards recognition of the value of these local practices 'that happen anyhow' and recognition that community-led MUS builds on and mobilizes such initiative.

The next and last step is now the nation-wide upscaling of community-led MUS and its various co-management modalities. Chapter 11 proposes the World Bank's accountability triangle as the theoretical framework to unravel water service delivery. This helps unravelling how trustful relationships between communities and their representatives can be restored and how everyone's constitutional rights to water and food can be realized.

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Appendix 1:

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft Design information for Ga Moela

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

- FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

  A. PHIRING

  B. GA-MOKGOTHO

  C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

- MAKHADO LOCAL MUNICIPALITY

  A. TSHAKHUMA

  B. KHALAVHA

  C. HA-GUMBU

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Work Design, diagnosis report.

I. Description of the village.

Ga-Moela in Schonoord is a rural village situated on top of Leolo Mountains, the area falls under Makhuduthamaga Local Municipality's ward 14 and the Chief is Mr Moela Ntshitshimale. It is not easy to access the village because the road is in bad condition, very rocky and difficult to drive on. Ga-Moela is divided into five sections namely Mabusa, Tawaneng, Letlabela, Ga-Pudi and Moela with a total number of 108 households. The soil condition is good and fertile (red clay soil), community members plough maize, sorghum, beans, tobacco, pumpkins, butternut in summer and in winter tomatoes, cabbage, onions, sweet potatoes and potatoes. Almost all households practice livestock farming as community members own goats, cattle, sheep and donkeys in the village. Other households depend on pension, disability, orphan and child support grants from the government.

II. Current Water Resources.

1. Mabuza section.

The source is a Borehole equipped with a submersible pump and 2x 10 000 litres jojo tanks as the storage next to Secondary School. There is no water reticulation in the area, 23 households collect water from the three communal taps next to the borehole. Sekhukhune District Municipality is responsible for Operation and maintenance; it pays the pump operator and repair the system. The system is connected to the three households with yard storage next to the source and the remaining 14 households walk about a kilometre (1000m) to collect water. Water is used for domestic and farming related activities like processing their harvest and livestock. There are five gardens belonging to individuals within the area and lack of water for irrigation is a big concern.

2. Letlabela Section.

Letlabela section does not have a water infrastructure at all, there are 22 households in the area and all of them depend on the spring or seepage for water services. All households are electrified and very few households practice rainwater harvesting attached to their corrugated roofs. The spring is not properly protected; so community members share water with wild and domestic animals. Local people collect water with buckets, wheelbarrows and travel long distances to their houses. Water is used water for domestic and irrigation for their household gardens.

3. Moela Section.

There is a borehole blocked with stones, it can't be used anymore and the drought relief water project failed and the chief stored a tank at his house. This section depends on spring water for services, about 27 households collect water from it and does operation and maintenance. In winter the spring do not have enough water and members look for other alternative sources of water to meet their demands.

4. Tawaneng section.

There is a new water system built in 2016 and finished in December but the system has never been properly completed. The source is a borehole drilled in the fields, equipped with a submersible pump and using a generator to fill the 4 x 10,000 jojo tanks. The system only worked once after completion and community members collect water from the nearby spring. 40mm galvanised pipes were used for the reticulation and mainline because the area is too rocky. Five communal taps were built in the area but they are dry because there is no water in the tanks. After consultation with Makhuduthamaga Local Municipality regional manager, he said the system is not bad as people thought and what is outstanding is just a 20m pipeline and fittings to make the system work, the system is operational now and thanks to Municipality official co-operations.

5. Ga-Pudi Section.

Water resources available in Ga-Pudi are wells, school borehole and an old hand pump not functional. The ten households, one school and park exist in the area.

III. Water Quality test.

Tsogang water and sanitation gathered water quality samples for the two boreholes in Ga-Moela through Makhaduthamaga local municipality and Water Management System Management in Polokwane. The results are good, there is enough water to enable MUS to succeed in Ga-Moela for both domestic and productive use.

NB: See attached water quality tests results.

IV. Design horizon for domestic and productive use supplies.

Village name	Current popula-tion	Current House-holds	Design population (20 years)	Households at design life	Minimum water need (Litres/day)	Currently available source quantity (Q) (Litres/day)	Excess Q Available for MUS over minimum requirement
Ga Moela Mabusa	115	23	171	34	4 272	38 880	34 608
Ga Moela Ga Pudi	50	10	74	15	1 857	86 400	84 543
Ga Moela Letlabela	110	22	163	33	4 086	129 600	125 514
Ga Moela Tawanen g	175	35	260	52	6 051	129 600	123 549

V. Available water for Multiple Use Water Services, head loss and proposed pipe size and class.

Measurements at site									Selected		Calculated		
System	From	Elevation m	To	Elevation m	Elev Diff (H_d) m	Min H m	Q l/s	Pipe length m	Pipe dia. mm	Pipe Class	H_f m/100m	Total head loss m	Residual head m
Ga Moela Letlabela/Tawaneng	Borehole	1531	Storage	1606	75	10	1.5	900	40	9	3.8	34.2	109.2
Ga Moela Mabusa/Moela	Borehole	1673	Storage	1711	38	10	0.9	1000	40	6	1.5	15	53
Ga Moela Pudi	Borehole	1624	Storage	1654	30	10	1	500	40	6	1.8	9	39

VI. Proposed scope of works at the source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge. Tawaneng and Mabusa sections are fully serviced by Sekhukhune District Municipality. Sketches of each section are provided in Ga-Moela book drawing.

a. Moela Section.

- **Install the main pipeline from Mabosa/Moela borehole to Moela section**, the pipeline will provide water services to thirty four (34) households in the area. Activities to be conducted are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval to cover a distance of 1000m from borehole to a new identified spot, this is translated into 167 tasks of pipe laying in the area.

- **Water storage**, Mabosa/Moela borehole provides 38880 litres of water in 12 hours, the proposed storage system for Moela section is 3 x 5000 litres jojo tanks = 15 000 litres which is enough and meant to supply water to 34 households. Each household will have access to 441 litres per day which translates to 88 litres per person per day. Activities to be carried out include the following site clearing, dig foundation, transport materials, cast concrete slabs, erect steel tank stands, install jojo tanks with anchor ties, connect source pipe and delivery connections.

- **Reticulation Pipeline from the storage to Moela and Mabosa section**, activities are as follows, site clearing, mark tasks, dig trenches, lay bedding, connect pipes and backfill after approval to cover a reticulation system for about 2436m with is equal to 406 tasks of pipelaying with standpipes installed at RDP standard, 200m away from each households.

b. Ga-Pudi Section.

- **Refurbish an existing hand pump** in the area to provide water services to ten households, Safe Park project and a community crèche, workers will assist Tsogang officials to remove the pump from the borehole, inspect the pumping and valve mechanisms, replace defective components and reinstall pump to borehole. Borehole yield is not known because test are still to be conducted.
- **Tsogang to train community members on basic technical** skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional & Social Development. Capacity building will take place in the village using community resources like community halls and churches. Learners will be given food and provided with the necessary training materials like handouts, pens and note books.

c. Letlabela Section.

- **Install the main pipeline from Tawaneng borehole to Letlabela section**, the pipeline will supply water to 3 x 5000 litres jojo tanks to be installed. Activities to be carried out by workers are: clearing the site, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval to cover a distance of 800m which is 133 tasks of pipe laying from the source to the storage and valve boxes. Materials to be used are HDPE pipes, Galvanised pipes, stand pipes, concrete, fittings, control valves and taps.

- **Water storage**, Tawaneng borehole provides 64 800 litres of water in 12 hours, the proposed storage system in Letlabela section is 3 x 5000 litres jojo tanks = 15 000 litres meant to supply water to 33 households, so each will have access to 454 litres of water per day meaning each person will have access to 91 litres per day. The activities to be carried out by workers are: site clearing, dig foundation, transport materials, cast concrete slabs, erect steel tank stands, install jojo tanks with anchor ties, connect source pipe and delivery connections.

- **Reticulation Pipeline from the storage tanks to Letlabela section** covers a distance of 1821m translated into 304 pipe laying tasks to be performed. Activities are as follows: site clearing, mark tasks, dig trenches, lay bedding, connect pipes and backfill after approval to cover with standpipes installed at RDP standard, 200m away from each household.

- **Homestead interventions,** community members will identify members to be trained in brick tank stand construction, guttering fitment, tank installation and assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives agreed the area.

- **Tsogang will train** community members on basic technical skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional Social Development.

VII. Implementation phase, time frames and methodology.

The scope of works , installing the main pipeline, extend the reticulation, homestead interventions, capacity building, water storage development and hand pump refurbishment will be implemented over six months using community labour from Ga-Moela and officials from Tsogang for activities that require special skills and knowledge. Workers will be recruited from the community using a legal entity called close co-operatives in the village to manage the implementation at local level and pay stipends based on completed tasks with the help of Tsogang Water and Sanitation's supervision.

VIII. Procurement of Goods and Services.

Materials for the multiple use water services project will be procured in Limpopo Province using local suppliers in the area and nearby towns like Polokwane, Tzaneen, Burgersfort, Thohoyandou and Jane Furse. Purchasing will only take place outside the Province for things that cannot be found or procured in the Province. Ga-Moela orders will be placed separately from other villages and more than three quotations will be gathered using a shopping exercise. All the procurement documents including quotations and close co-operatives documents will be submitted to the Water Research Commission for the procurement process to begin.

IX. Project Costs including lots of material for each activity.

Below is a summary of costs to increase the availability of water in the village for domestic and irrigation, refurbish the existing infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small businesses.

		Ga- Moela				
Lot number	**Item**	**Material costs**	**Lots material**	**Stipend**	**Total**	**Remarks on Stipend.**
1	**Water Pipeline Material**	172 997	75 x 42.5 PPC Cement, 2x 19mm Concrete 3 cube Load, 20xY12 reinforcement, 1x Plastic Concrete Sheet,1xRed Oxide Paint X 10 litres, 1500x Maxi Bricks, 2x River sand 3 cubes load, 12x40mm to 20mm saddle, 25x 20mm elbow f/f galv, 15x20mm x 1m stand pipe galv, 15x20mm tap cobra, 10x40mm male adaptor, 15x20mm Valve Ball, 15x20mm Male adaptor, 8x 40mm Valve Ball, 24x40mm HDPE Pipe cls6 x 100m, 180xPipe Galvanised x 32mm, 50xPlumbers Hemp x 200g, 179x Pipe galv socket 32mm, 24x40mm x 40 mm coupling, 10 Air Valve, 20x Socket Red Galv 50x40mm.	108 300	281 297	1083 tasks x 100 = 108300.00
2	**Water storage Development.**	98 560	1xRiver Sand 3 cubes load, 0.5x19mm Crushers 3 cube Load, 7x5 000 litre Jojo Tank, 4x6m Height Tank Stand Galvinised , 30x 42.5 PPC Cement	18 000	116 560	2 X builder= 10000 , 1x Plumber= 3200 and 2x Labours= 4800
3	**Animal Drinking trough**	12 661	20 x42.5 PPC Cement, 20xY12 reinforcement, 2x River Sand 3 cubes load, 2x 19mm Crushers 3 cube Load, 1200x Cement Bricks	6 500	19 161	1xBuilder=4500.00, 1xBuilders Assistanr=1200.00 &1x Plumber =800.00
4	**Homesteads Interventions.**	31 794	10x2500 litres Jojo Tank, 10x gutters and fittings	7 000	38 794	1x Builder= 5000.00 and 1xAssistance= 2000.00 interventions
5	**Valve box**	15 046	1 x River Sand 3 cubes load, 50 x 42.5 PPC Cement, 2500 x Maxi Bricks, 24 x Brick force, 2 x Building sand.	10 360	25 406	Builder =7000.00 Assistance= 3360
6	**Hand pump**	6 840	Afridev Pump materials,	8 000	14 840	Plumber = 3200.00, Assistant= 2400.00
7	**Store room.**	9 000	1500.00 x six months	-	9 000	N/A
8	**Plant hire**	16 200	2700.00 x six months		16 200	N/A
	Total	363 097	-	158 160	521 257	

X. Please find below a drawing booklet for Ga-Moela

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02
LAYOUT DRAWING	00	1 OF 1	K1/12607/1-C03
VALVE BOX	00	1 OF 1	K1/12607/1-C04
STEEL TANK STAND	00	1 OF 1	K1/12607/1-C05
RAIIN WATER HARVESTING	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILS	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08
HOMESTEAD GARDENS	00	1 OF 1	K1/12607/1-C09
LIVESTOCK DRINKING TROUGH	00	1 OF 1	K1/12607/1-C10
HAND PUMP	00	1 OF 1	K1/12607/1-C11

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT DATE

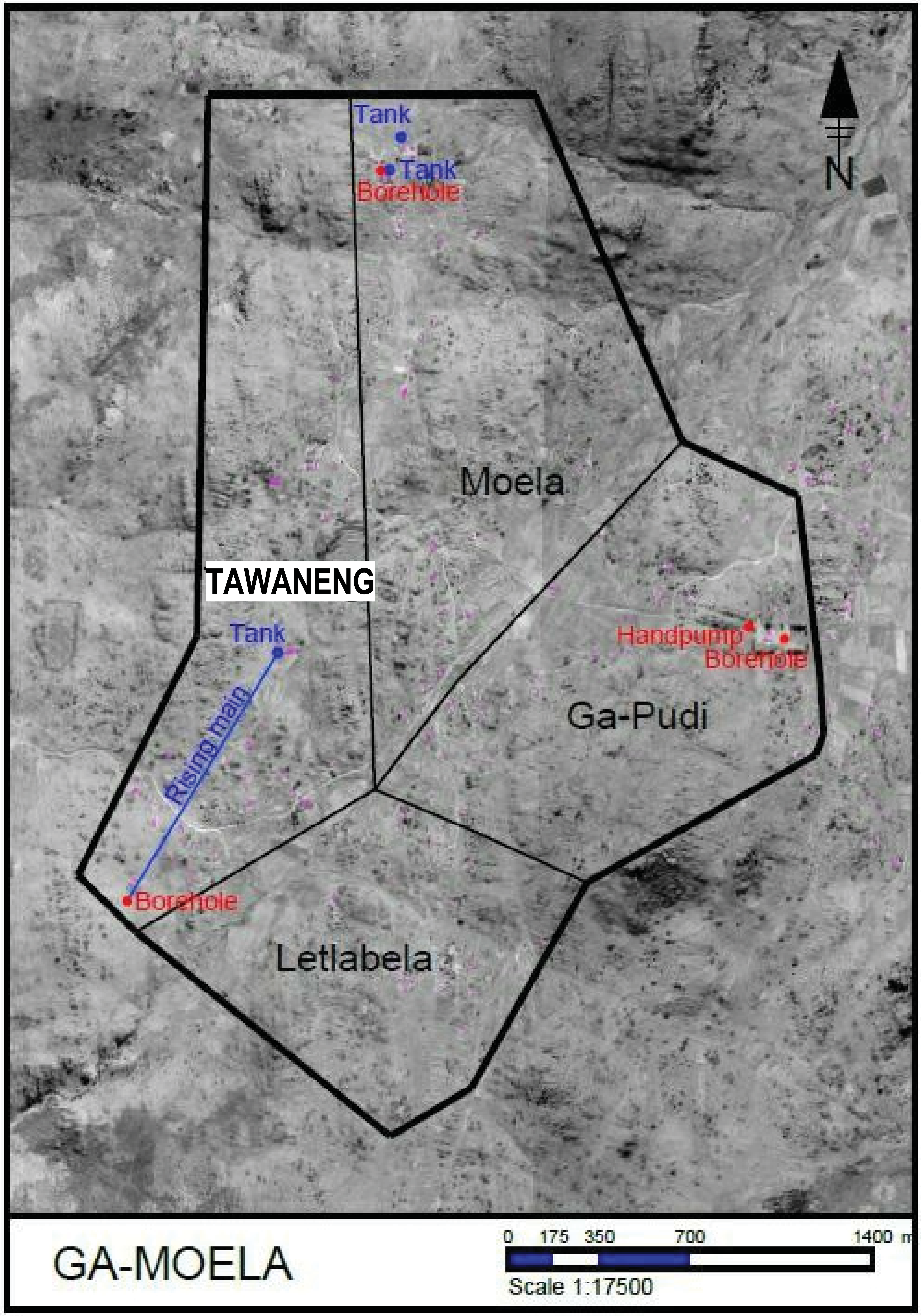
CONSULTING ENGINEER DATE

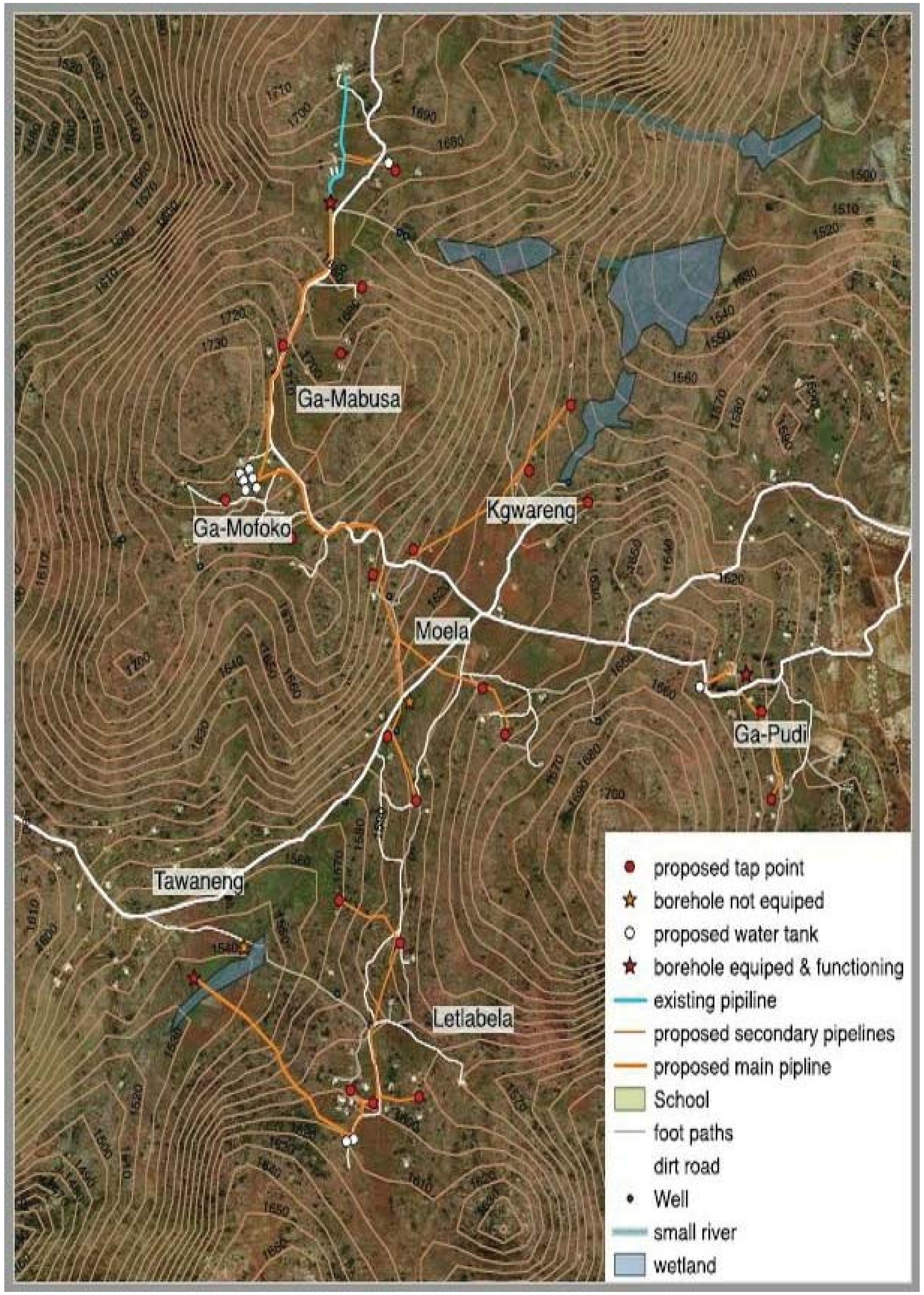
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01





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CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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PROJECT DESCRIPTION

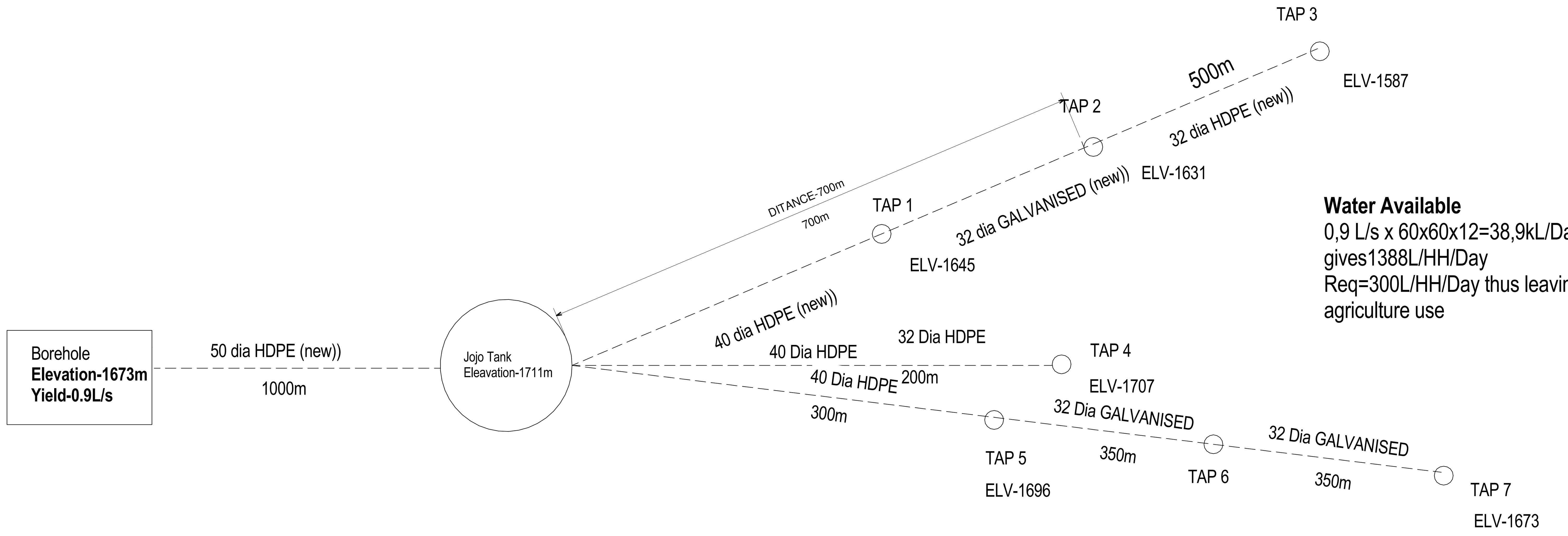
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION

LOCALITY PLAN

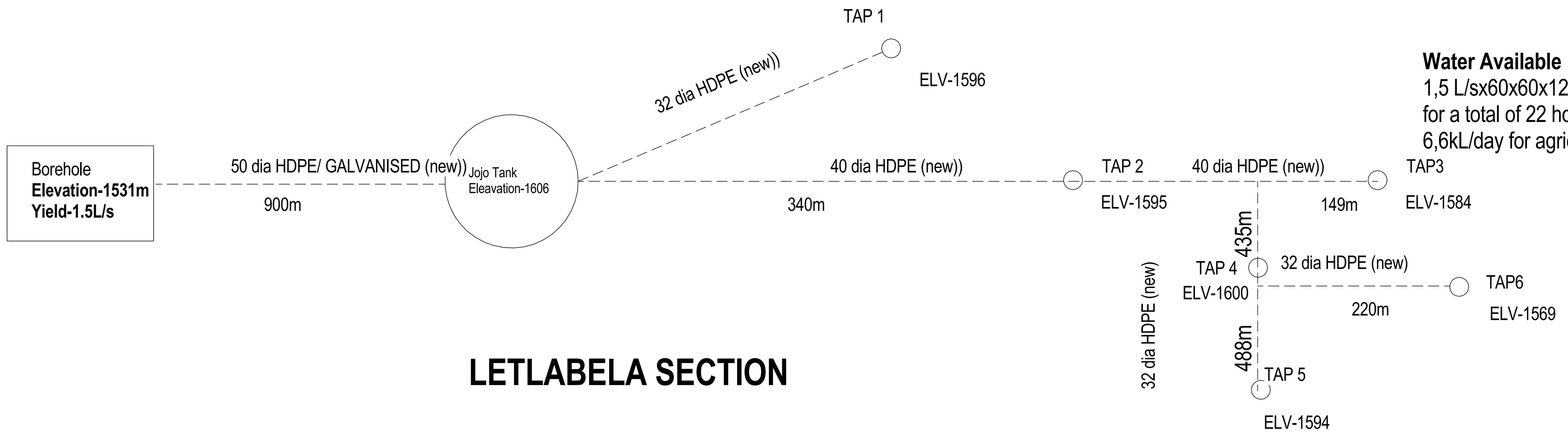
PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C02
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C02

K1/2607/1-C02



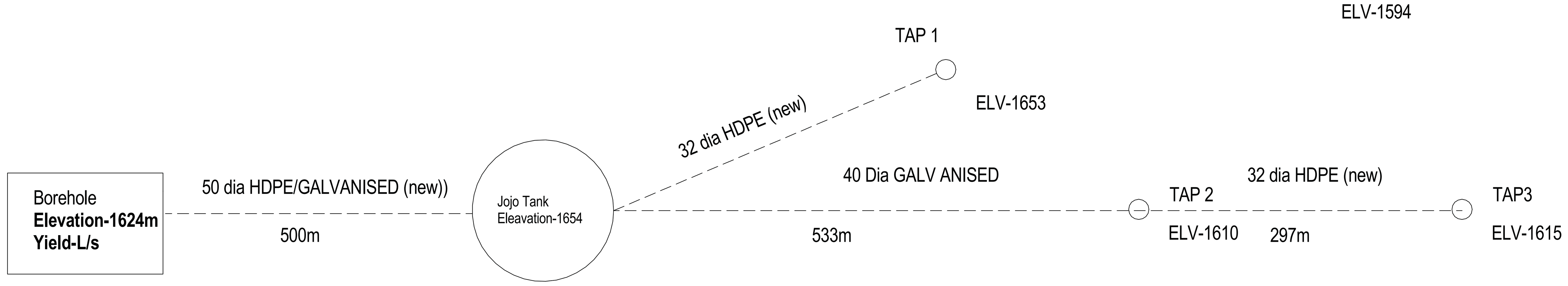
Water Available
0,9 L/s x 60x60x12=38,9kL/Day, that gives1388L/HH/Day
Req=300L/HH/Day thus leaving 30,5kl/Day for agriculture use

MABUSA BOREHOLE



Water Available
1,5 L/sx60x60x12=64,8kL/Day
for a total of 22 households, require 50x6x22= 6,6kL/day for agriculture use

LETLABELA SECTION



Water Available
1 L/s x 60x60x12=43,2kL/Day
For 10 households=4320 l/Day
Available for agriculture=40kL/Day
This is based on 12h of pumping, which is unlikely with the hand pump

GA-PUDI BOREHOLE

(10 housholds, 1-school, 1-park/creche, 3-taps)

REGIONAL WATER PROJECT
GRAVITY MAIN SIZES AND DESIGN FLOWS

Page 1

SUMMER PEAK DEMAND - YEAR 2017
RATE OF FLOW = 2 x AADD(60)/24/3600*1.5*1.1 l/s

RESERVOIR LOCATION AND PIPELINE ROUTE	LENGTH (m)	ELEVATION AMSL (m)	NUMBER OF PEOPLE SERVED	DESIGN FLOW (l/s)	DESIGN VELOCITY (m/s)	PIPELINE (Nom. dia.) & Class (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
HA-GUMBA Borehole Watertank	168	396 410		2.35	0.53	Class 6 75	14.00	0.70	410.70 410.00
Watertank A B	817 1174	410 382 398	1,140 300	2.61 0.69	0.41 0.16	Class 6 90 Class 6 75	28.00 12.00	1.69 0.50	410.00 408.31 407.81
A C	1643	382 401	300	0.69	0.16	Class 6 75		0.70	408.31 407.61
LUKAU Stream Watertank	400	926 836		3.50	0.79	Class 9 75	88.00	3.46	926.00 922.54
Watertank Village	661	836 462	1,260	2.89	0.85	Class 9 75	376.00	4.01	838.00 833.99
TSHAKUMA VILLAGE Borehole Watertank	1000	670 743		2.45	0.55	Class 9 75	73.00	4.47	747.47 743.00
Watertank Village	694	743 636	1,290	2.96	0.67	Class 12 75	0.00 107.00	4.40	743.00 738.60
KHALAVHA Stream Watertank	1800	1123 1091		1.10	0.56	Class 6 50	0.00 32.00	11.72	1,123.00 1,111.28
Watertank Village	2690	1091 889	546	1.25	0.64	Class 18 50	0.00 202.00	25.02	1,091.00 1,065.98

REGIONAL WATER PROJECT
PUMPSTATION, RISING MAIN SIZES & DESIGN FLOWS

SUMMER PEAK DEMAND - YEAR 2005
RATE OF FLOW = AADD(60)/24/3600*1.5*1.1 l/s

LOCATION OF PUMPSTATION AND RESERVOIR SERVED	LENGTH (m)	ELEVATION AMSL (m)	NUMBER OF PEOPLE SERVED	DESIGN FLOW (l/s)	DESIGN VELOCITY (m/s)	PIPELINE (Nom. dia.) & Int. Dia (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
LETLABELA GA-MOELA Reservoir	900	1531 1606		1.50	0.34	Class 9 75	75.00	1.62	1,531.00 1,529.38
GAPUDI GA-MOELA Reservoir	500	1624 1654		1.00	0.51	Class 6 50	30.00	3.07	1,624.00 1,620.93
MABUSA GA-MOELA Reservoir	1000	1673 1711		1.00	0.51	Class 6 50	38.00	6.14	1,673.00 1,666.86

PROPOSED WORKS

1. Construct valve box to protect valve at the storage as per drawing K1/2607-C04
2. Construct steel tank stand as per drawing - K1/2607-C05
3.Construct rainwater harvesting structures as per drawing- K1/2607-C06
4.Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
5.Lay new pipeline as per drawing K1/2607-C08
6.Supply water to identified homestead gaderns (10 square meter)as per drawing - K1/2607-C09
7.Construct livestock drinking troughs as per drawing K1/2607-C10
8.Construct Hand pump as per drawing K1/2607-C11

LEGEND

- - - - - - new water line
———— existing water line

No	DATE	REVISION	ISSUED BY

DRAWN BY	LM
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CHECKED BY	M.K.PHASHA

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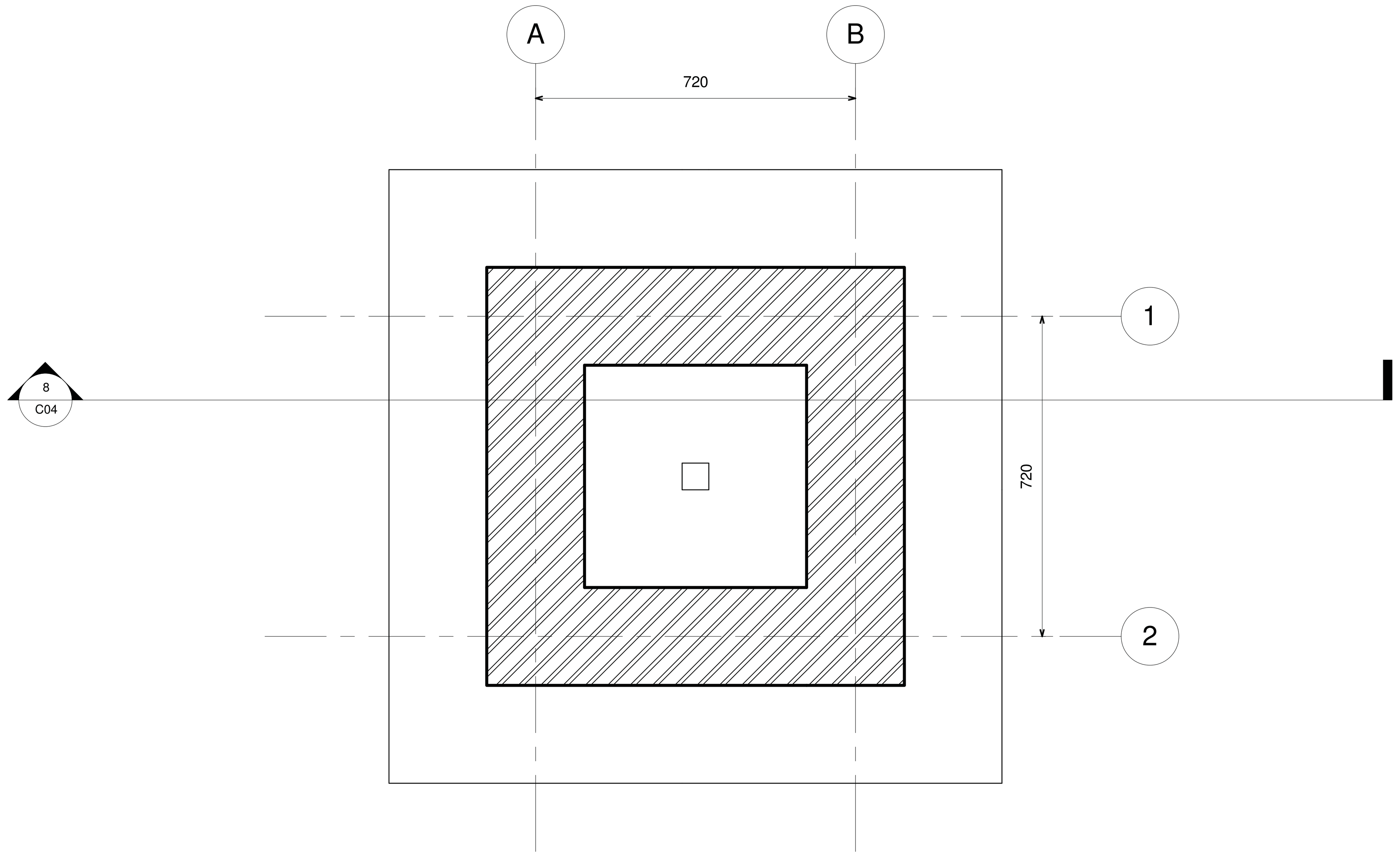
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

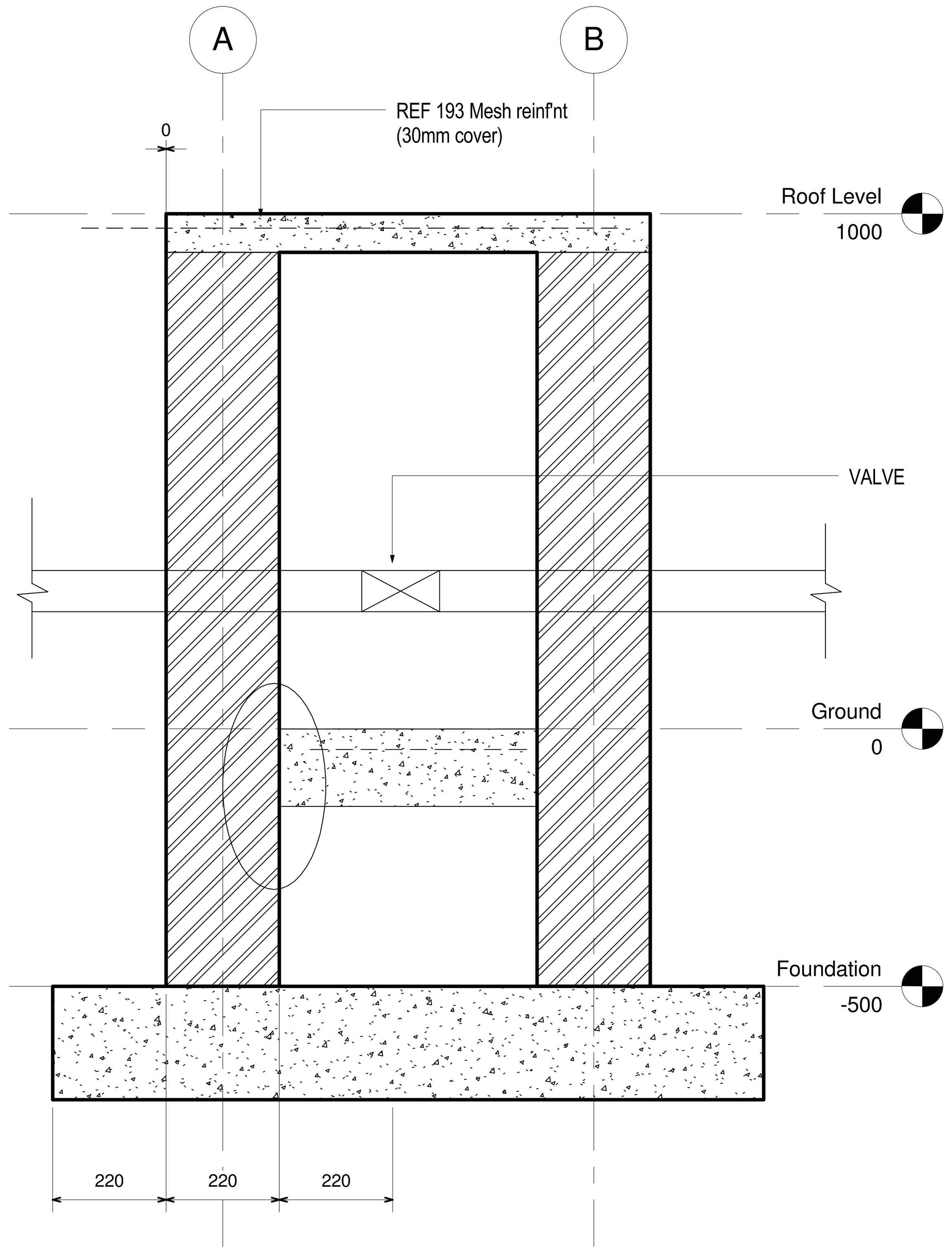
DRAWING DESCRIPTION
LAYOUT DRAWING

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C03
DATE	SCALE
JANUARY 2018	1 : 35
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C03

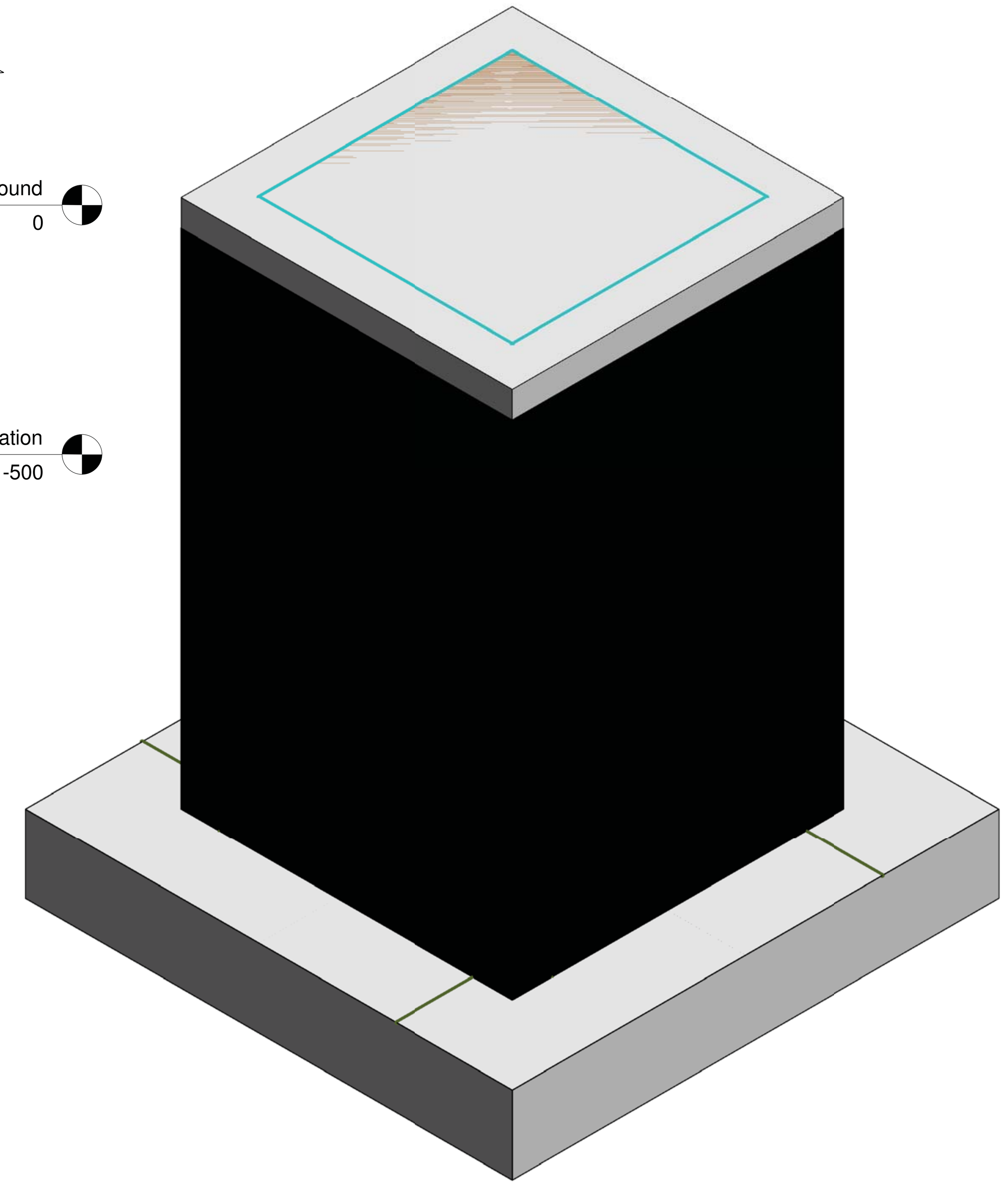
K1/2607/1-C03



6 00 Foundation (TOF)
1 : 10

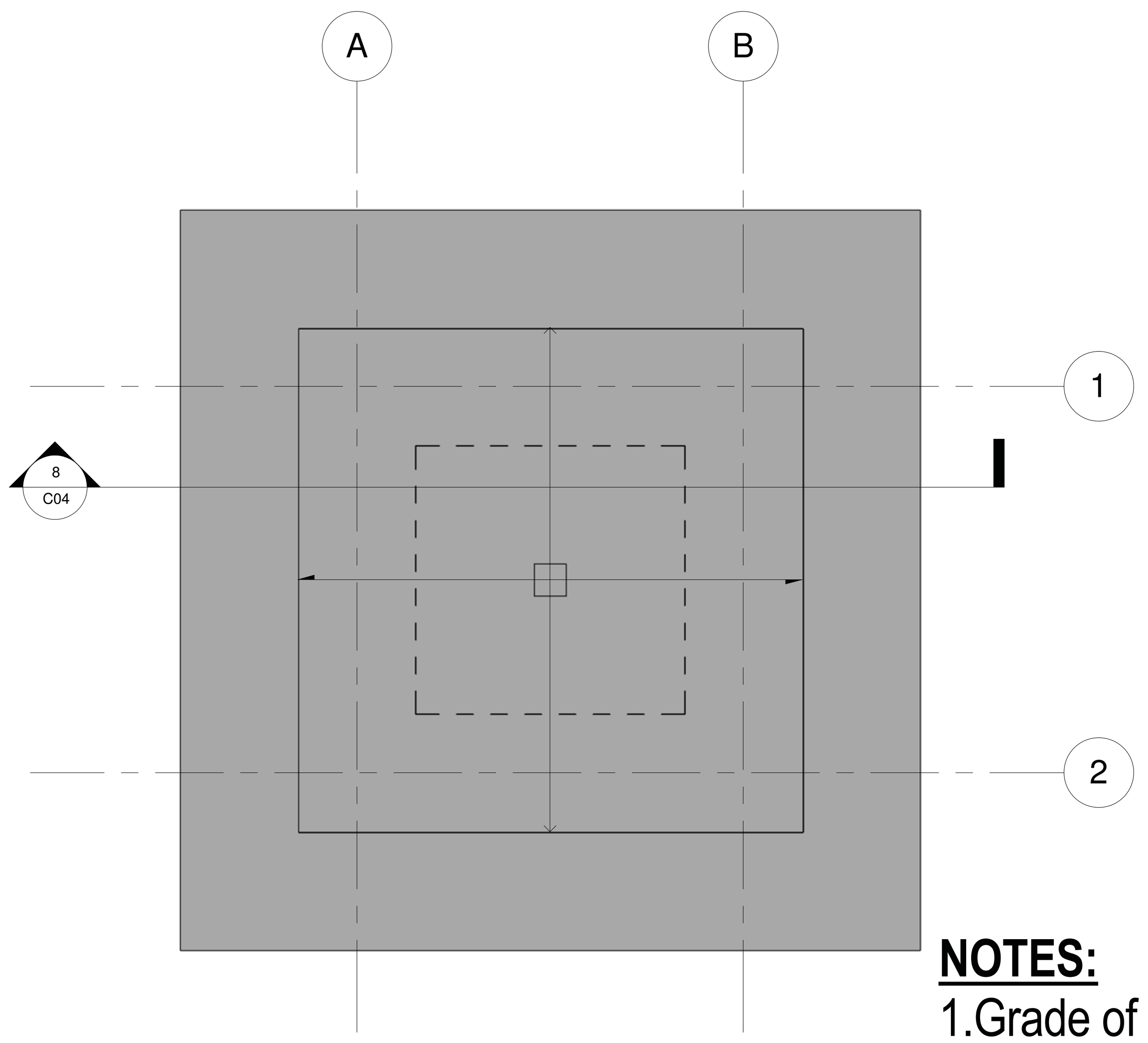


8 Section 1
1 : 10



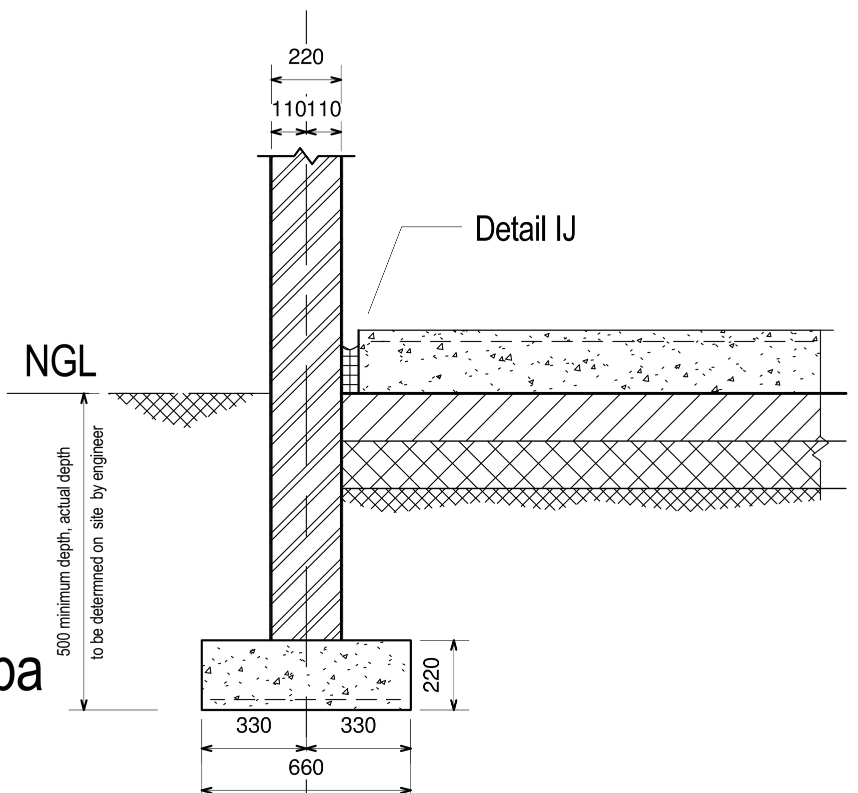
{3D}

7

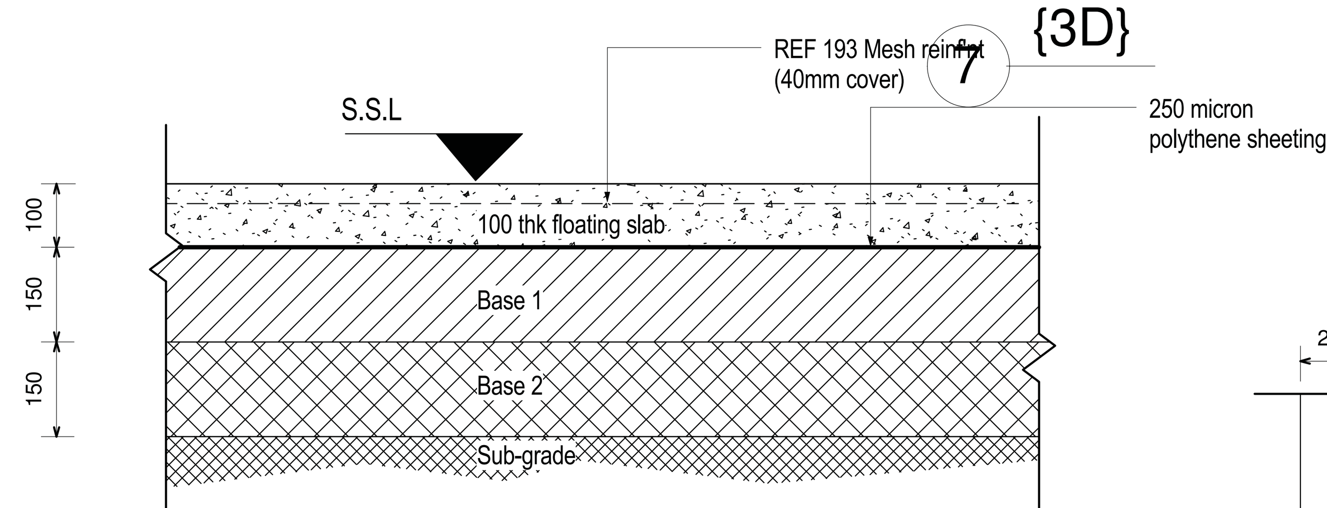


5 00 ROOF LEVEL
1 : 10

NOTES:
1.Grade of concrete to be 25Mpa
2.Floor slab thickness is 75mm

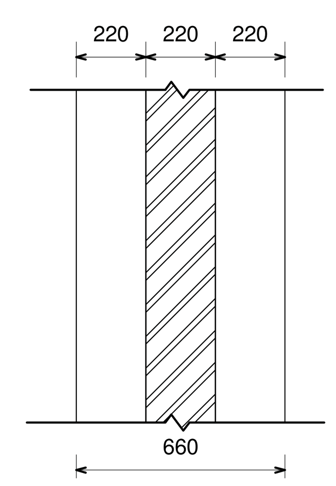


1 Typical cross section detail through external wall
1 : 20



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

2 Floating slab detail
1 : 10



3 Strip footing/wall plan detail
1 : 20

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

Owner
Enter address here

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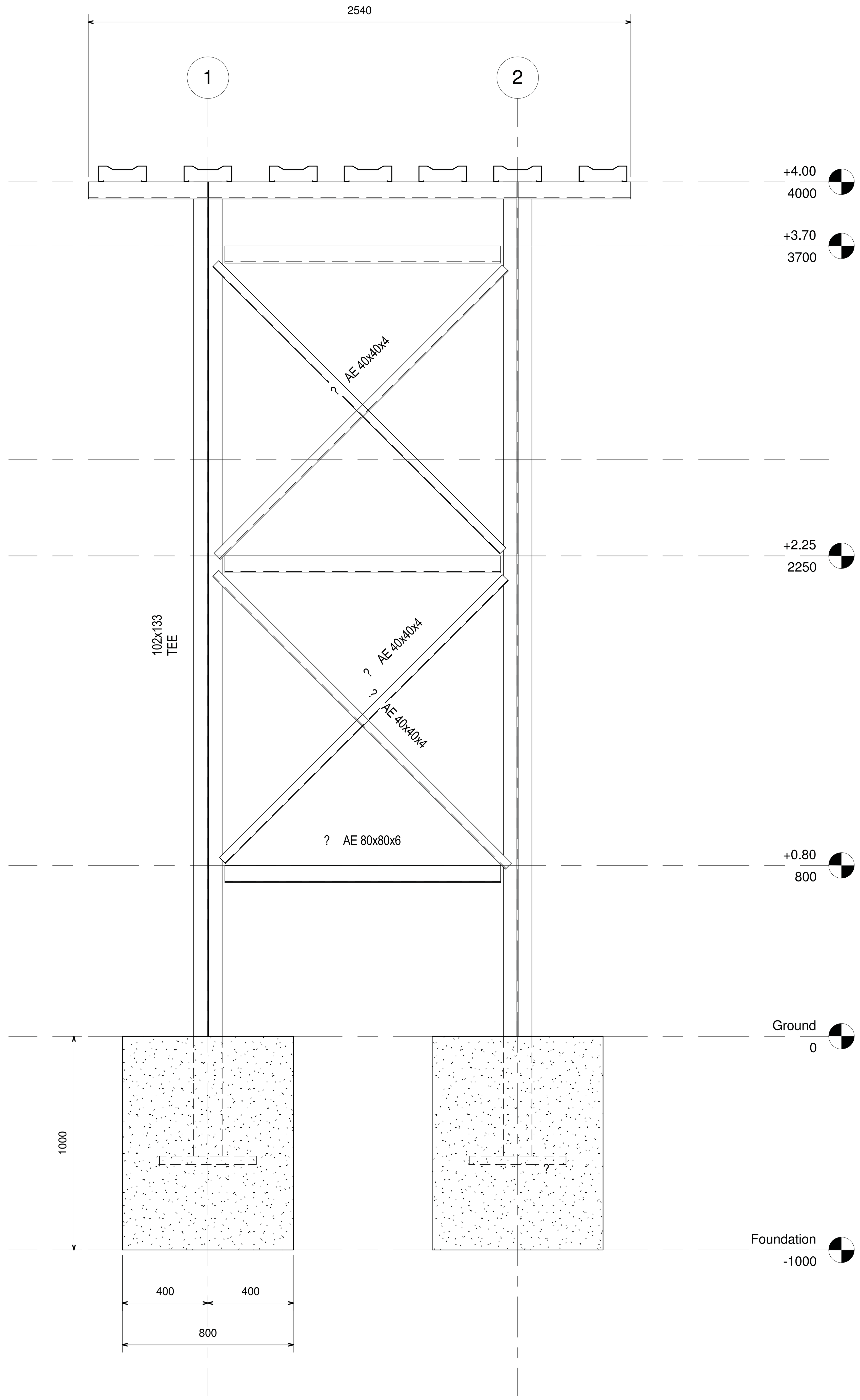
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - GA-MOELA

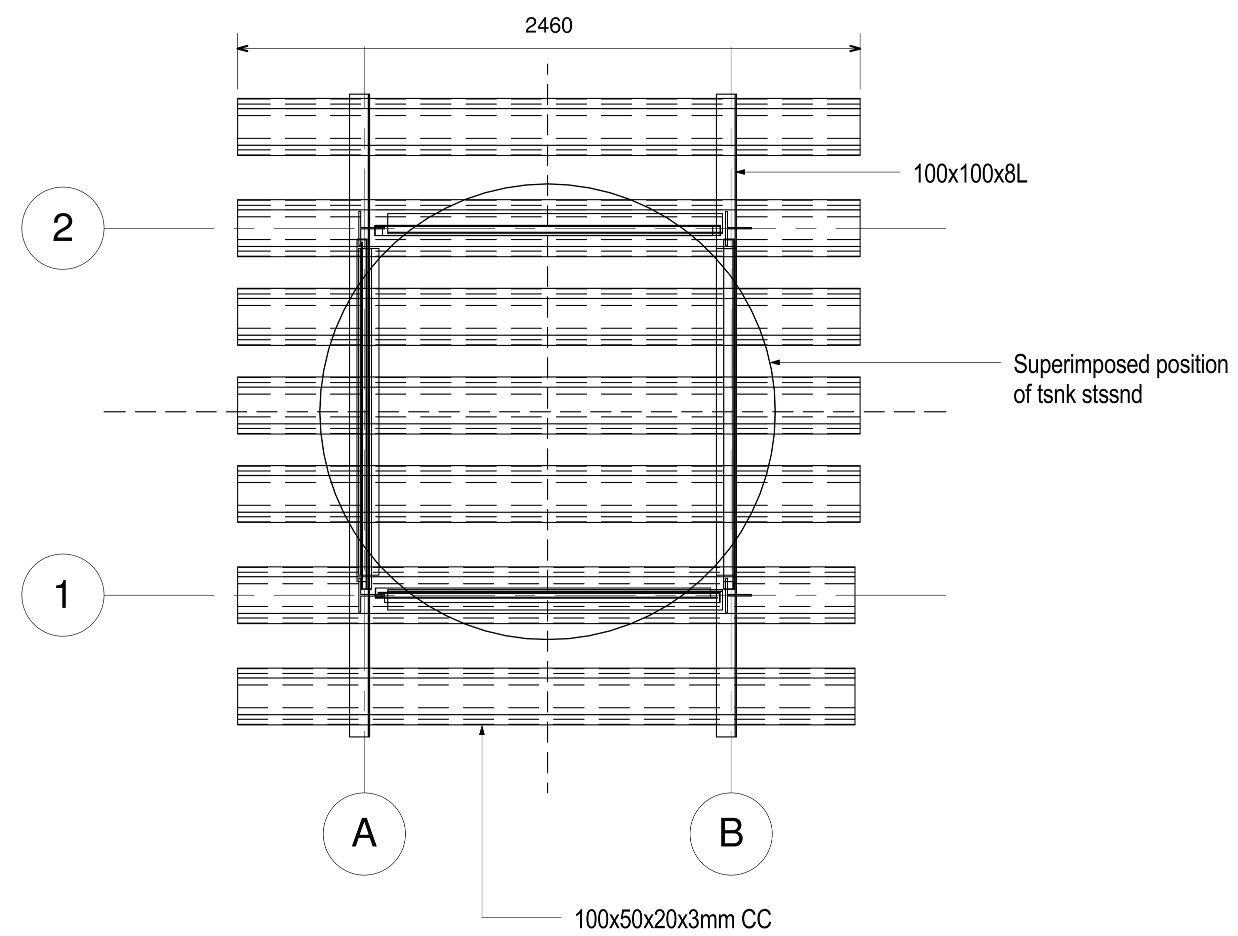
DRAWING DESCRIPTION
VALVE BOX

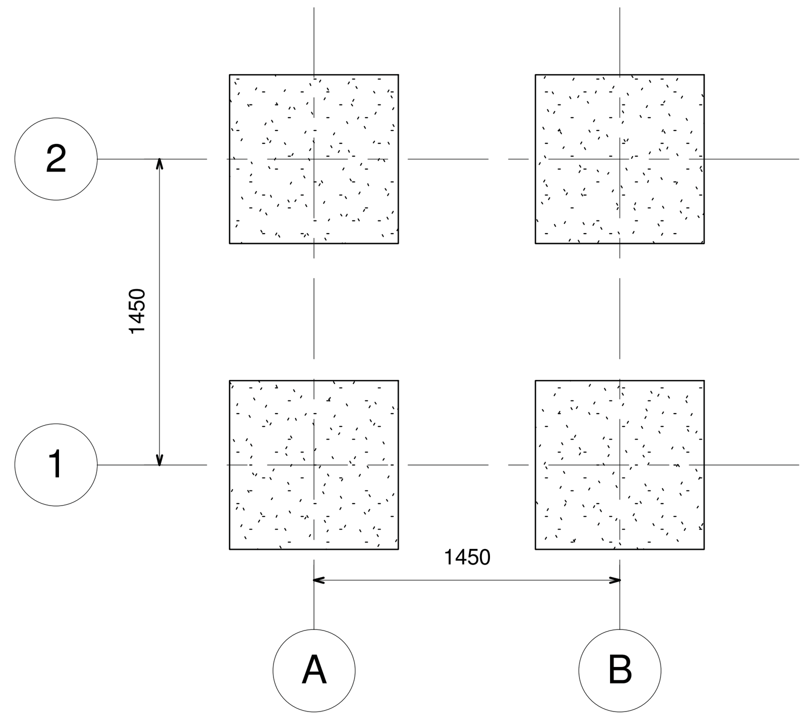
PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C04
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C04

K1/12607/1-C04



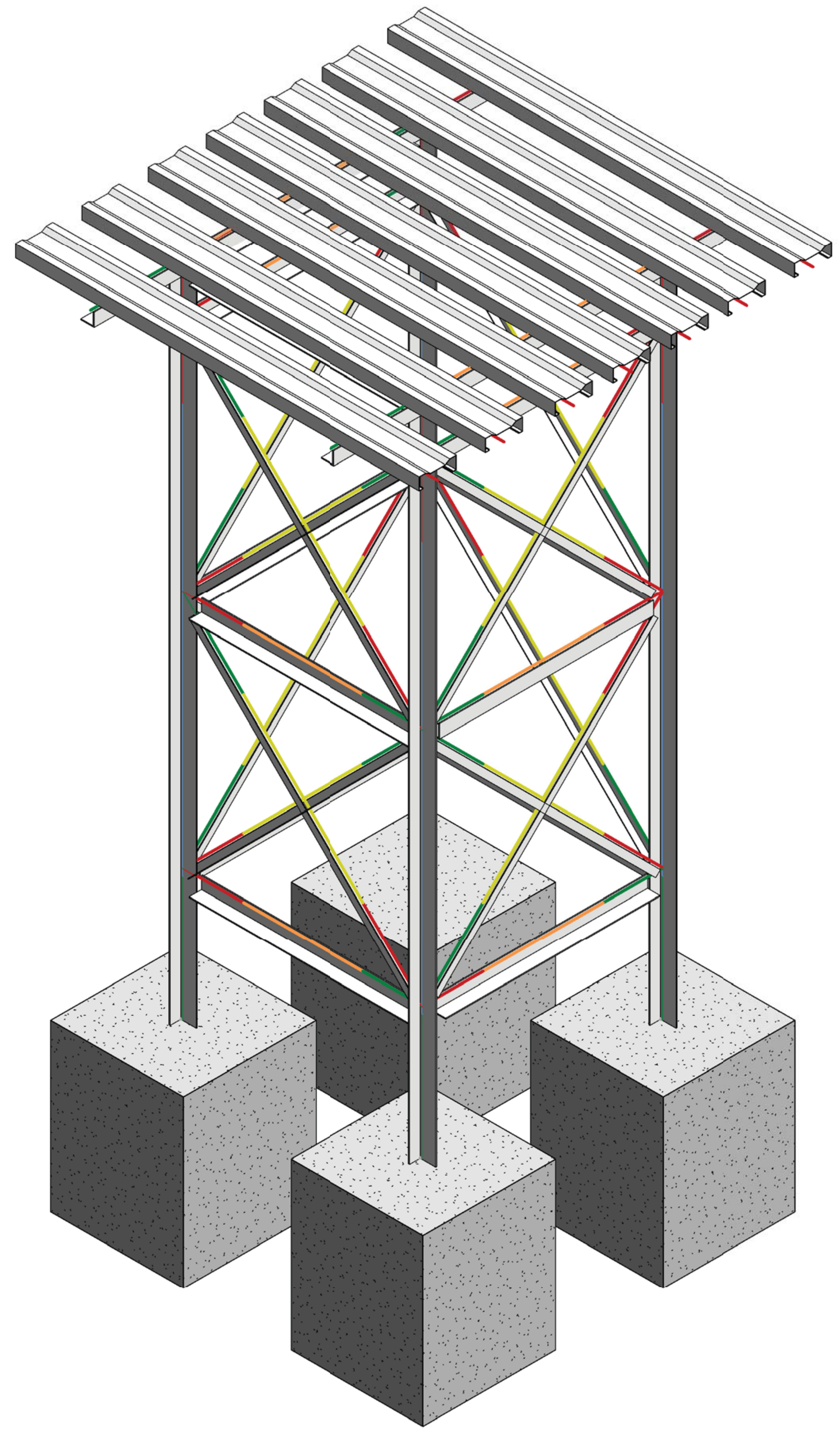
8 East
1 : 15





9 00 Eaves
1 : 25

6 00 Foundation (TOF)
1 : 30



7 {3D}

NOTES:

1.Grade of concrete to be 25Mpa

2.Water tank to be suitably held to position on platform using minimum 2 strands of 4mm galvanised steel wire fixed and looped through the bracket and the ear of the tank and the platform of the base

1 NOTES-HOUSE
1 : 10

BASE SCHEDULE		
TYPE	SIZE	QAUANTITY
	800 x800 x 100dp	4

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.PHASHA
DESIGNED BY	L.M
CHECKED BY	M.K.PHASHA

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PROJECT DESCRIPTION

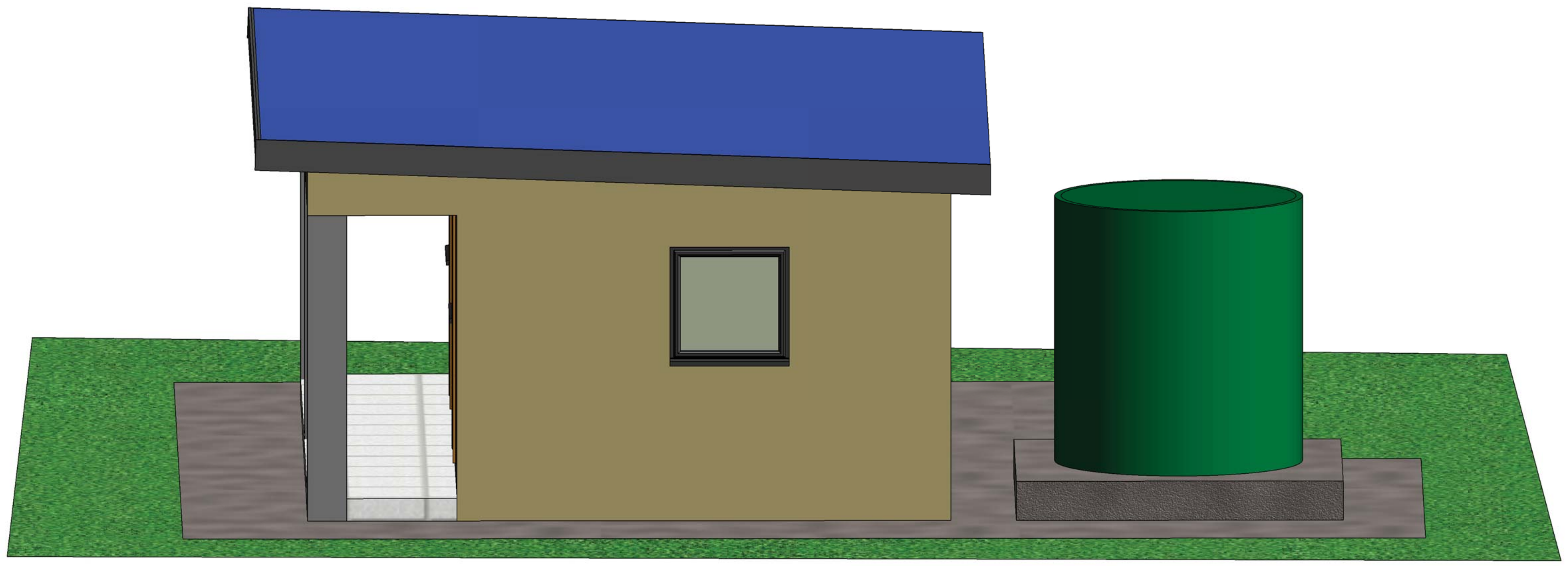
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION

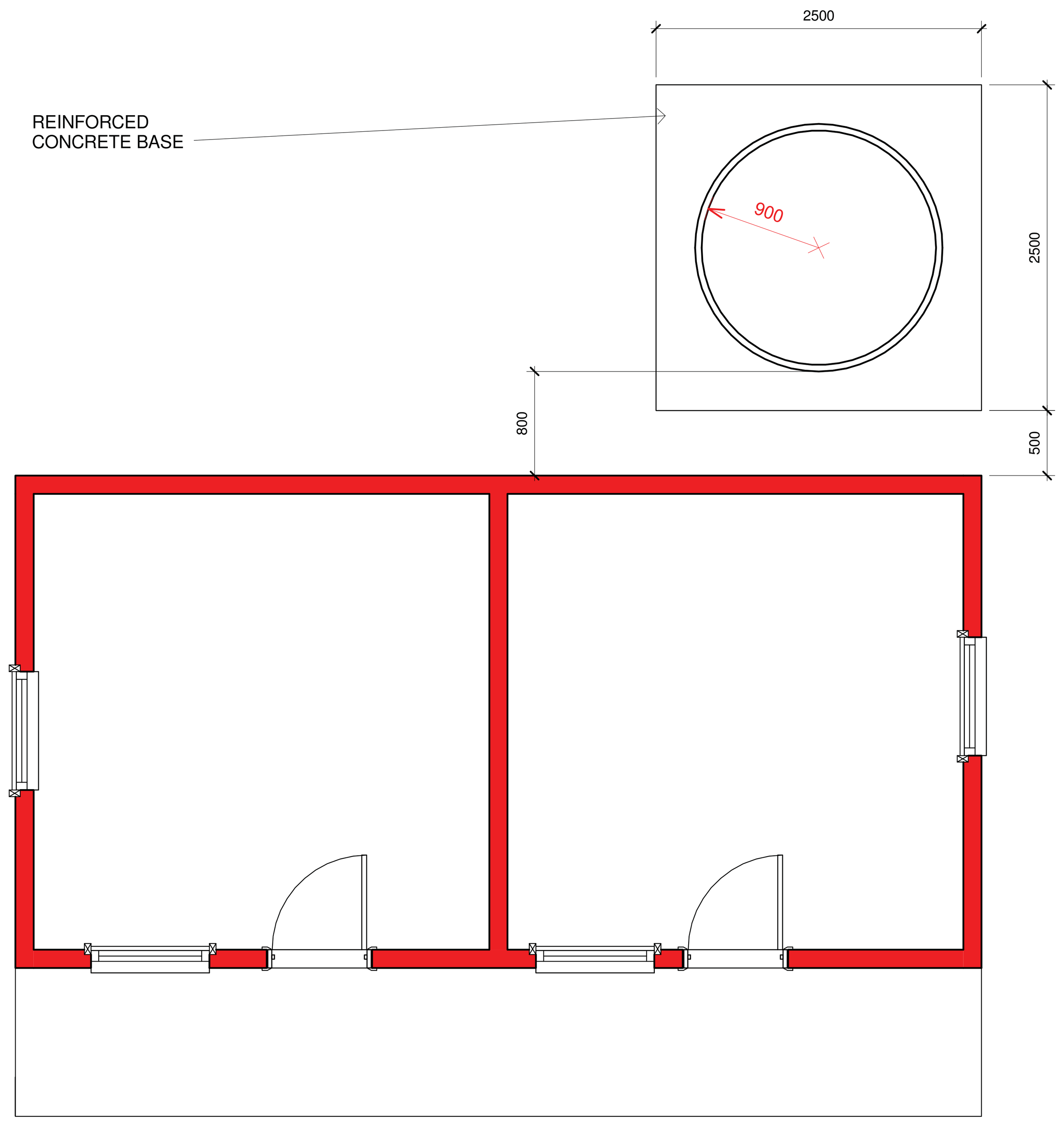
STEEL TANK STAND - TO CARRY 5 000 LITRE JOJO TANK

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C05
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C05

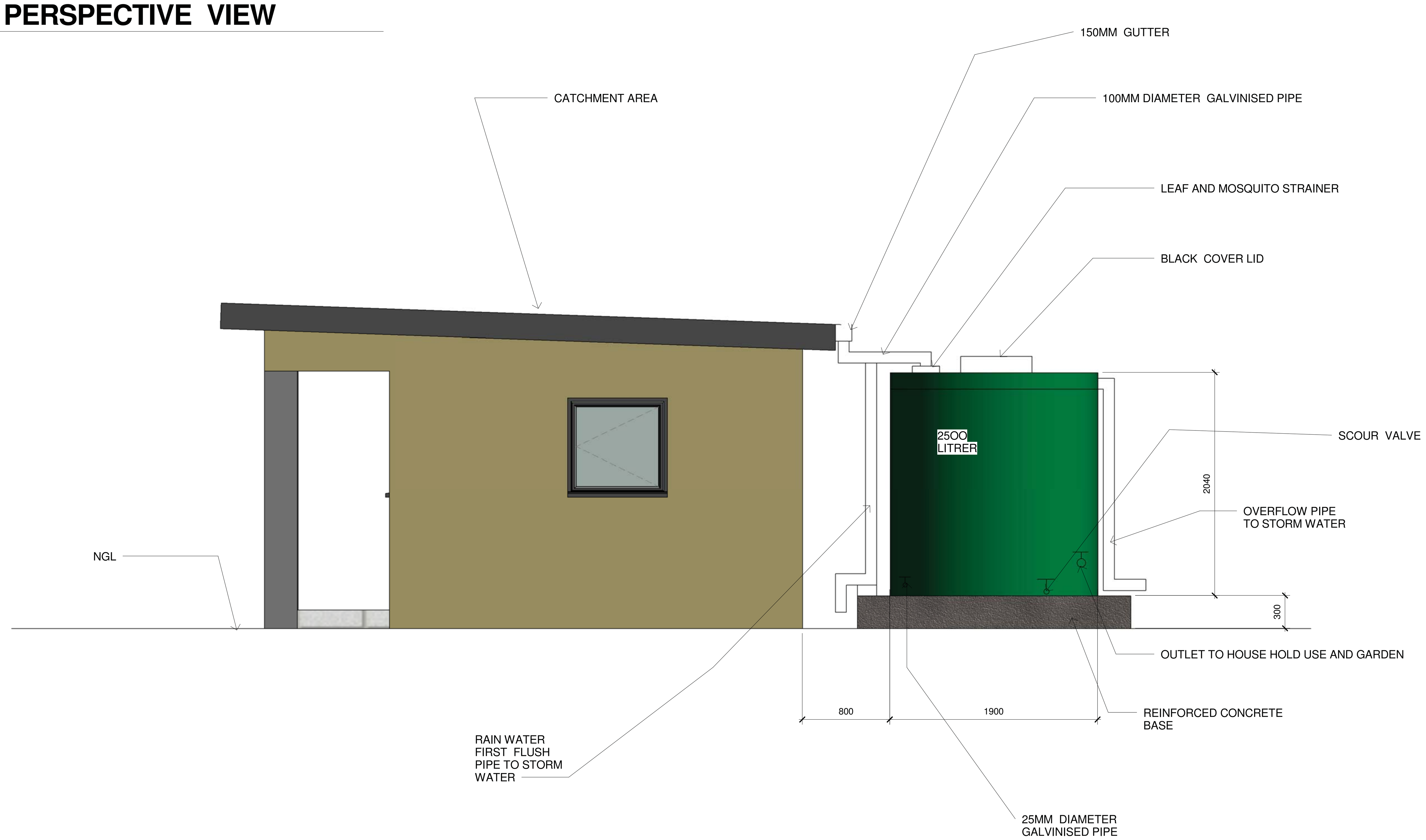
K1/2607/1-C05



2 PERSPECTIVE VIEW



1 FLOOR PLAN
1 : 40



3 SIDE ELEVATION
1 : 30

No	DATE	REVISION	ISSUED BY

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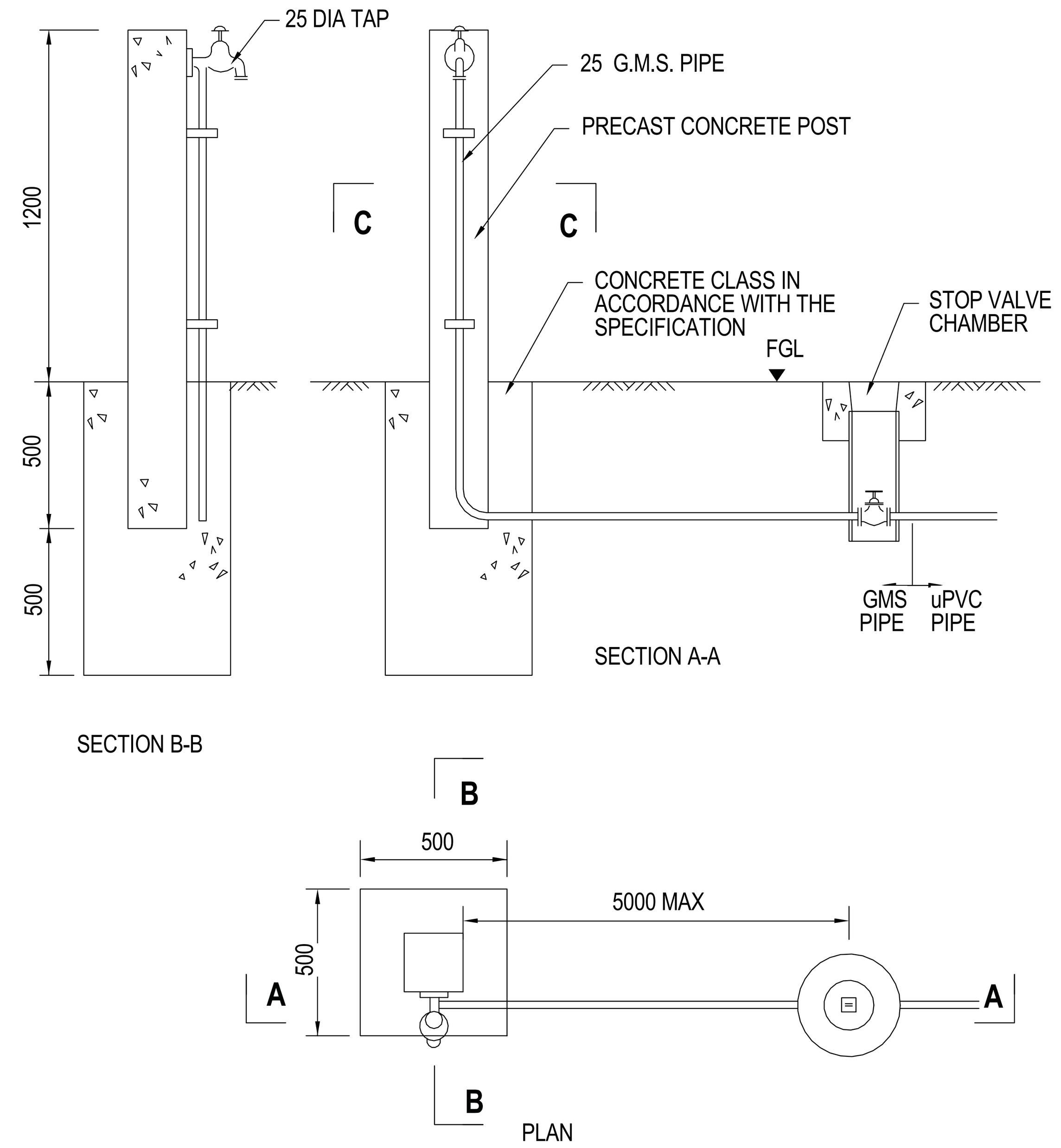
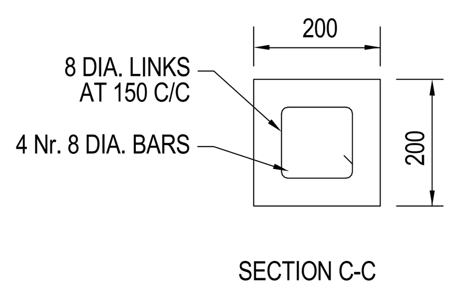
PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - GA-MOELA

DRAWING DESCRIPTION
RAIN WATER HARVESTING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C06
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C06

K1/2607/1-C06





NOTES
1. ALL DIMENSIONS IN MILLIMETRES
2. FOR DETAILS OF STOP VALVE CHAMBER SEE STANDARD DETAIL DRAWING Nr. WS/SVC/01
3. DRAINAGE TO BE PROVIDED AROUND STANDPIPE TO SUIT LOCAL CONDITIONS.

1 STAND PIPE DETAIL

1 : 1

S`STAND PIPE TYPE 1

STAND PIPE TYPE 2

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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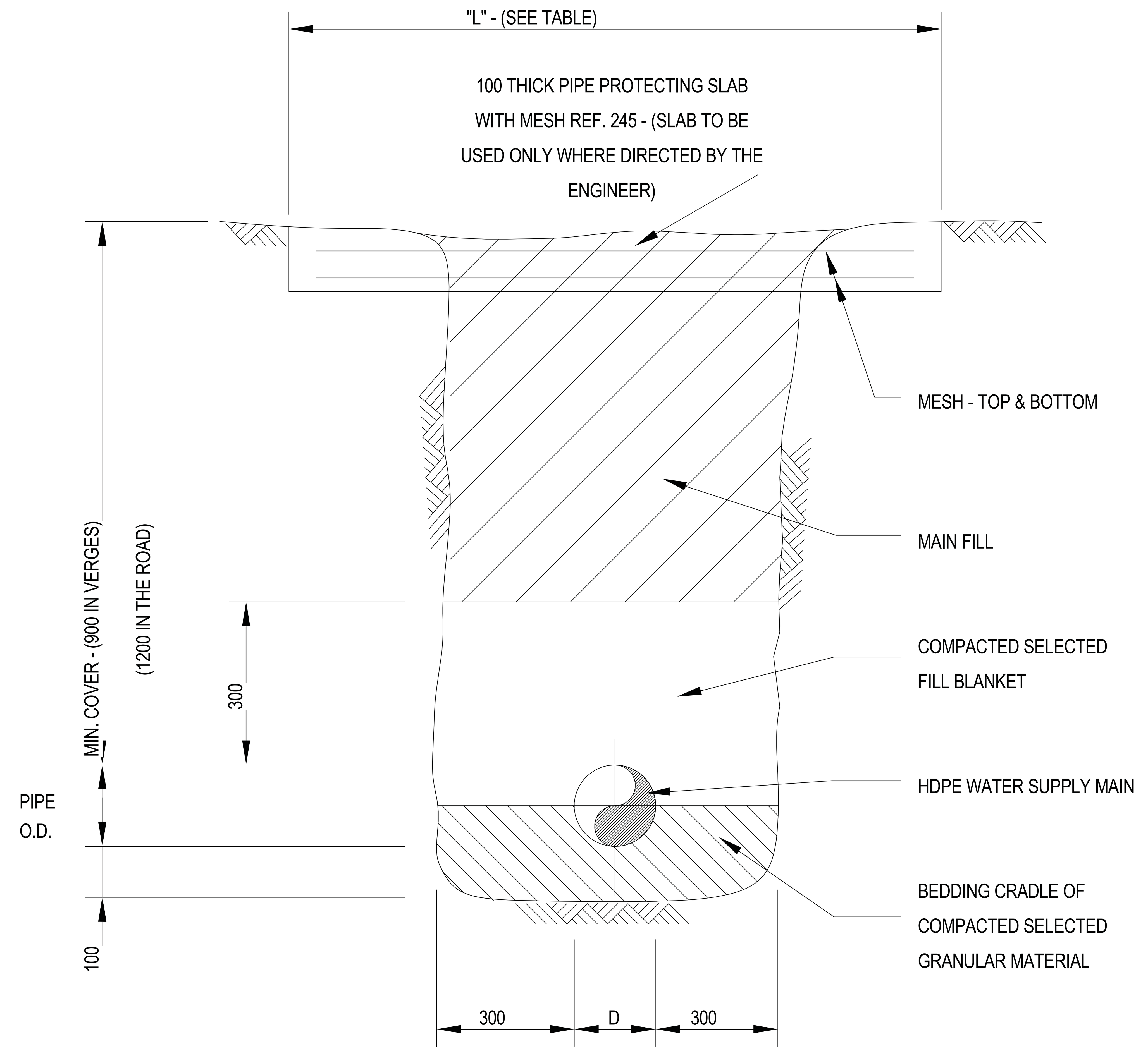
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C07
DATE	SCALE
JANUARY 2018	1 : 1
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE

PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS

1 : 65

No	DATE	REVISION	ISSUED BY

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CHECKED BY M.K.Phasha
DESIGNED BY L.M
CHECKED BY M.K.Phasha

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CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C08
DATE JANUARY 2018	SCALE 1 : 65
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C08

K1/2607/1-C08

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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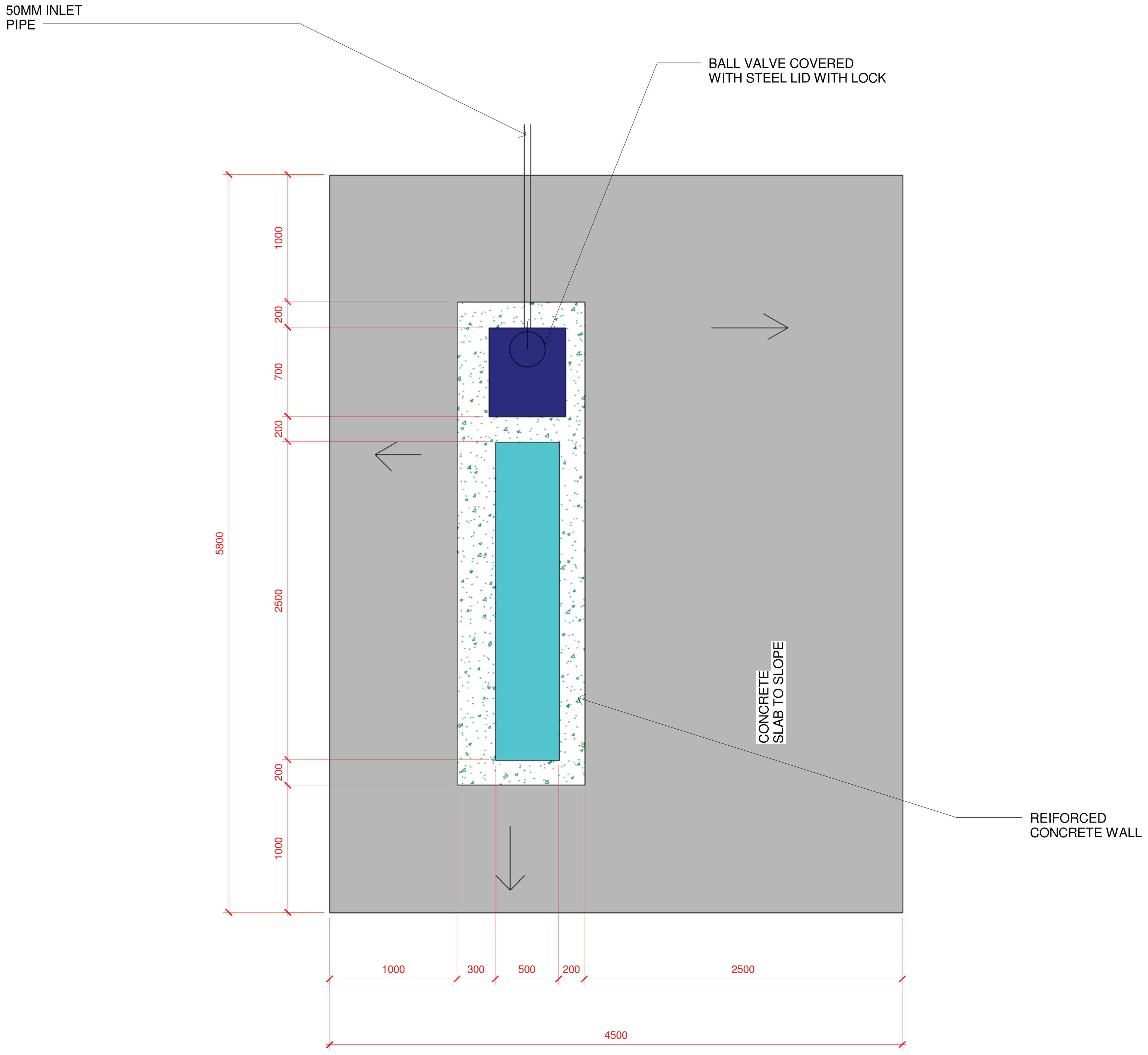
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

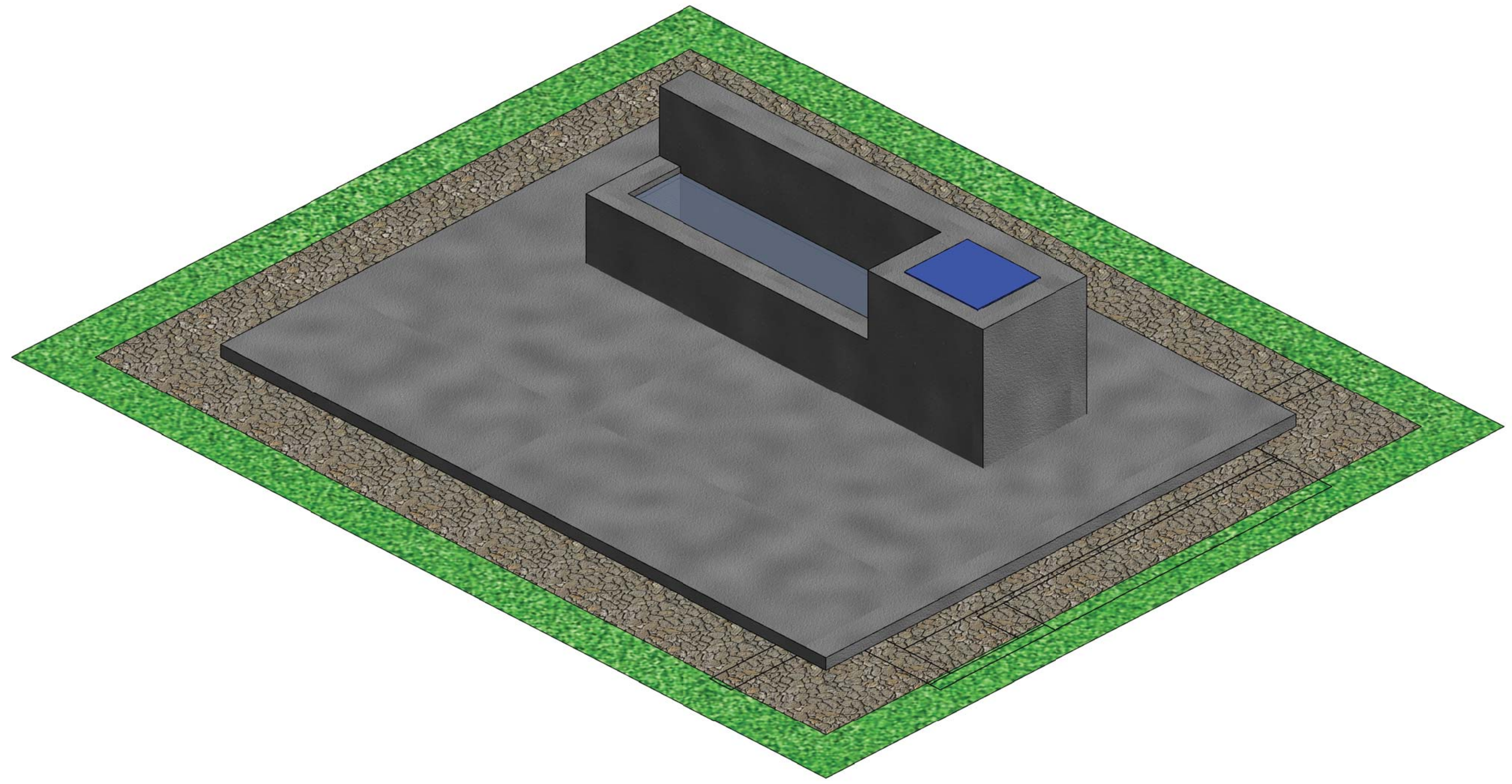
DRAWING DESCRIPTION
HOMESTEAD GARDENS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C09
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C09

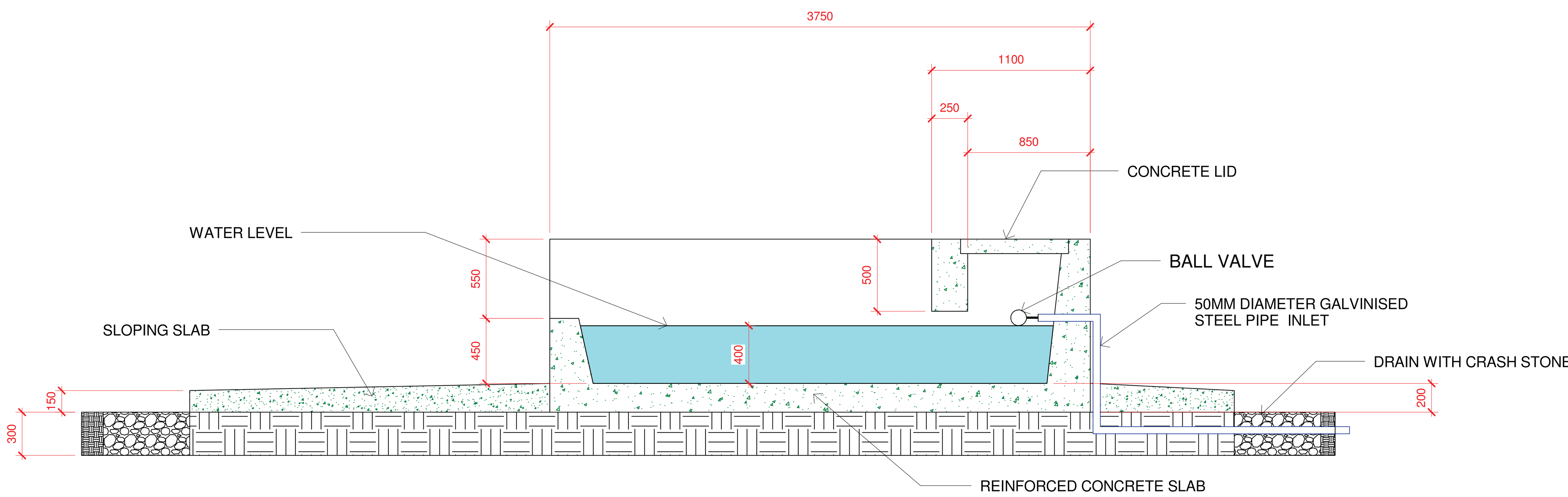
K1/2607/1-C09



3 FLOOR PLAN
1 : 30



4 3D VIEWS



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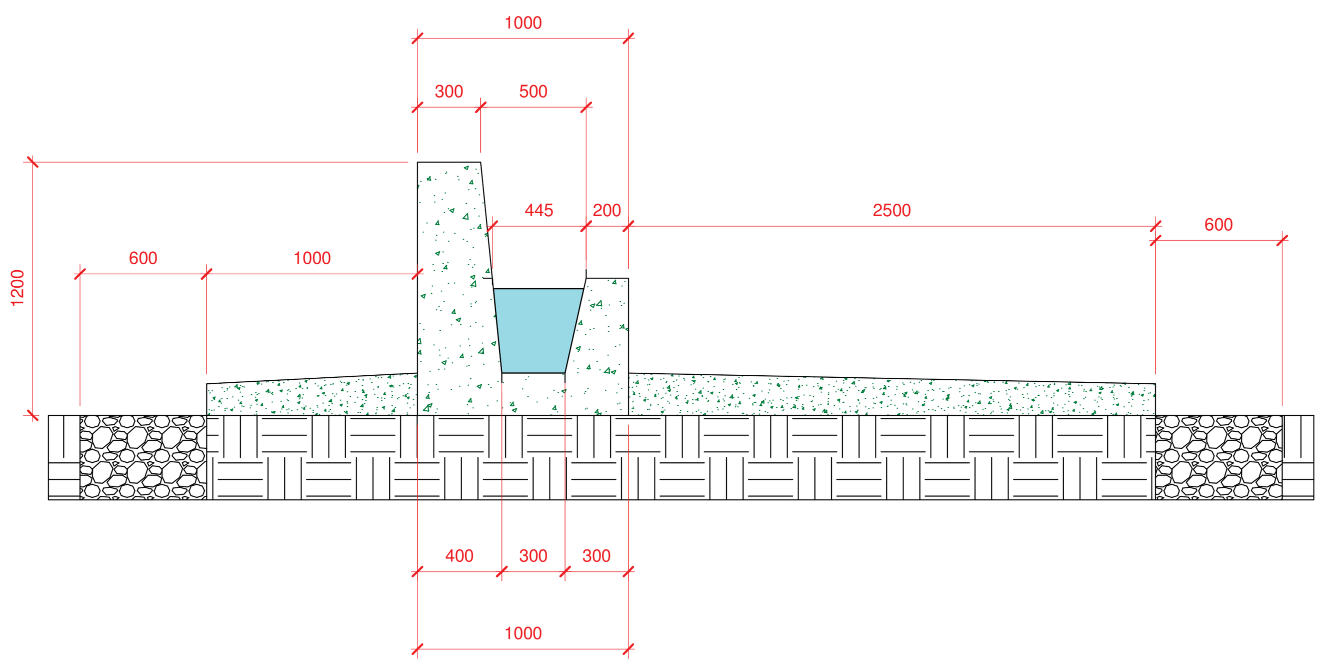

1 SECTION BB
1 : 30

No	DATE	REVISION	ISSUED BY

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WATER RESEARCH COMMISSION

IWMI International Water Management Institute

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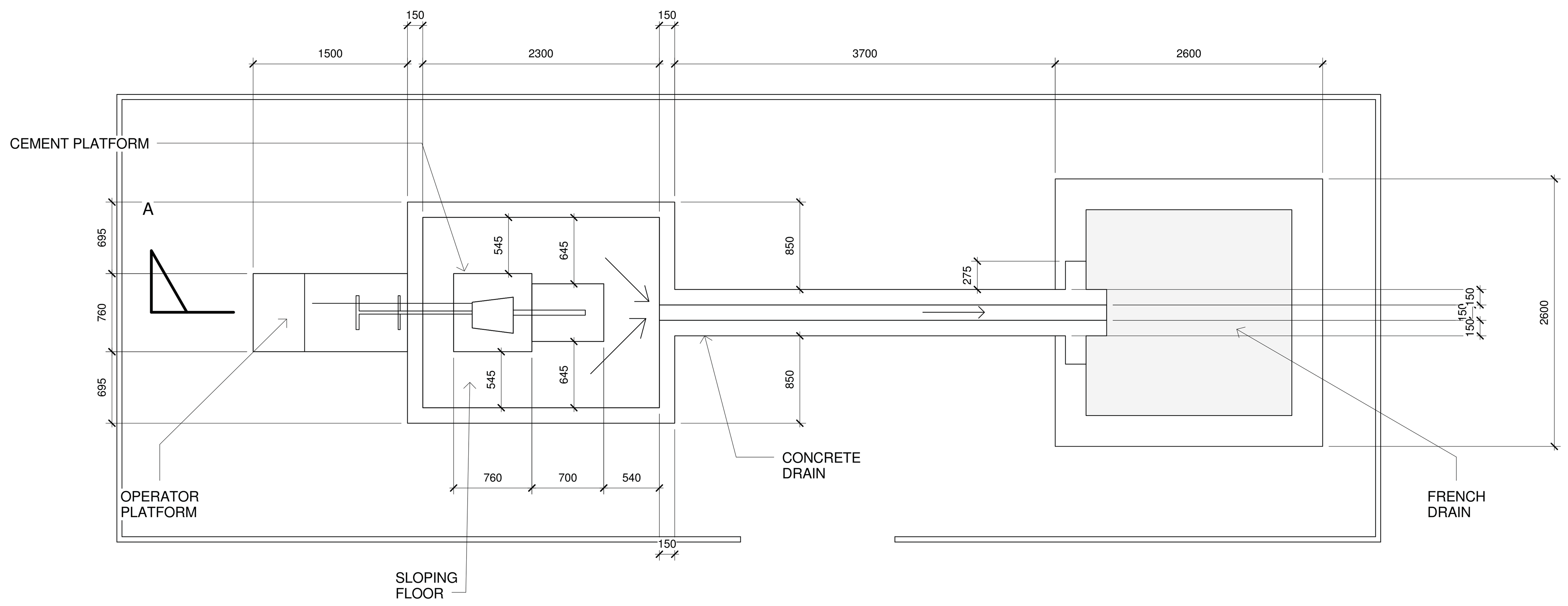
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

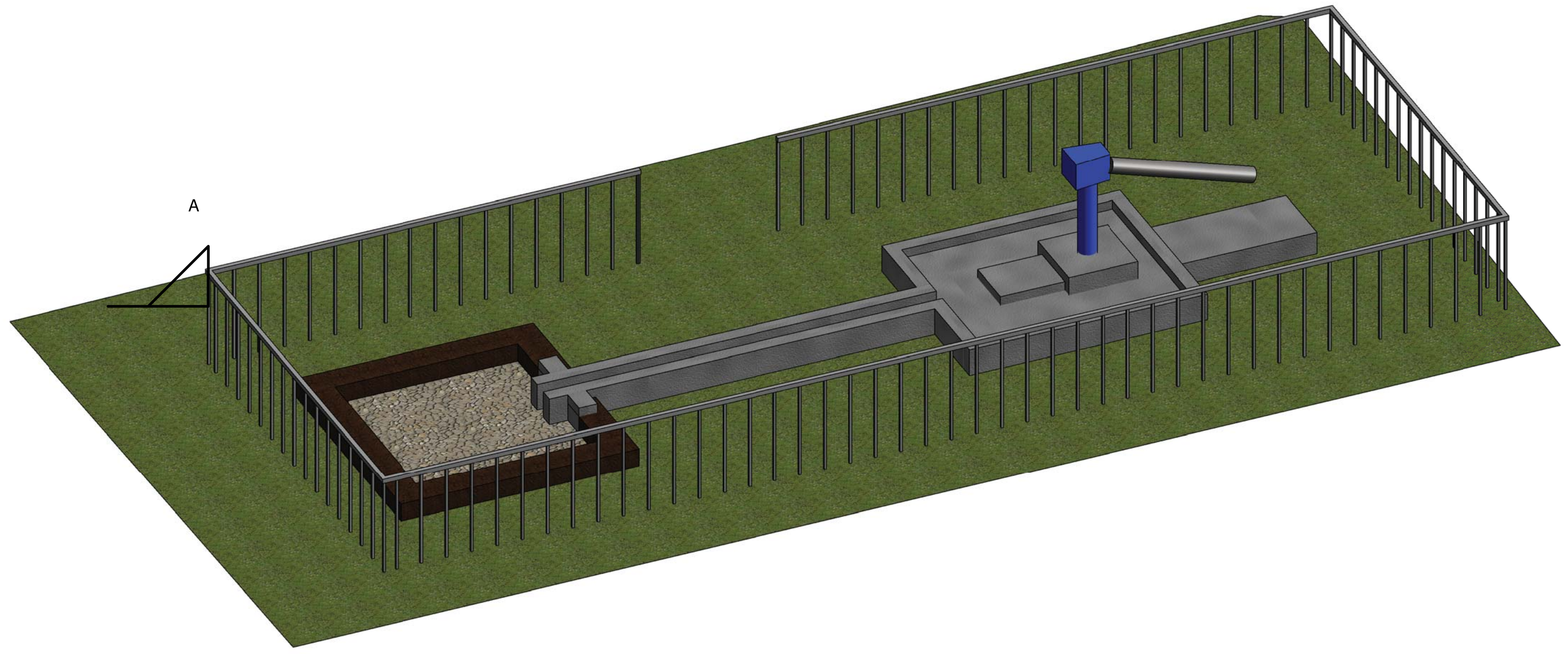
DRAWING DESCRIPTION
LIVESTOCK DRINKING TROUGH -500LITRE

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C10
DATE	SCALE
JANUARY 2018	1 : 30
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C10

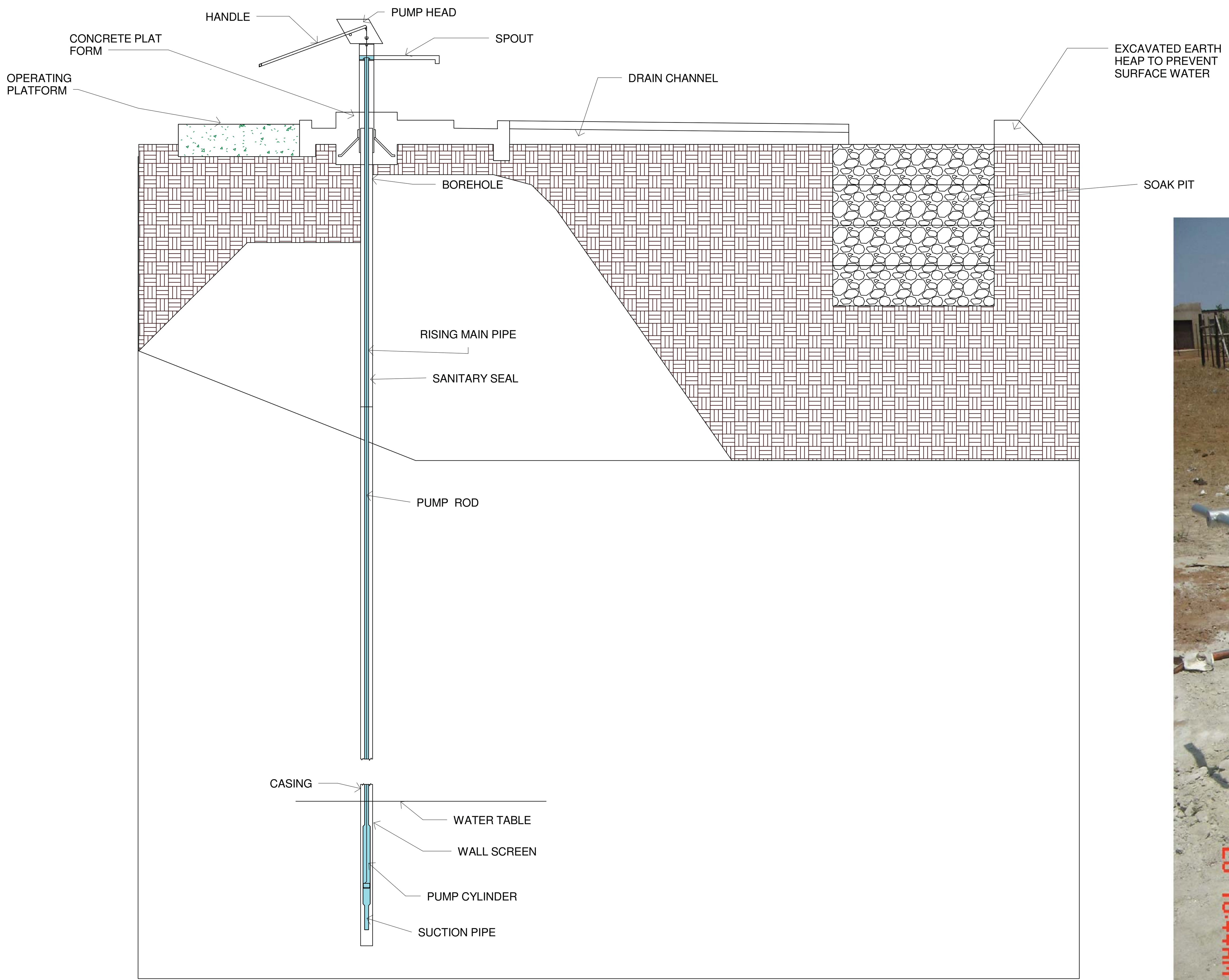
K1/2607/1-C10



1 HAND PUMP FLOOR PLAN
1 : 40



3 {3D}



2 SECTION AA
1 : 40

No	DATE	REVISION	ISSUED BY

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CLIENT DATE
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOELA

DRAWING DESCRIPTION
HAND PUMP

PROJECT STATUS CONSTRUCTION	SHEET K1/1260/1-C11
DATE	SCALE
JANUARY 2018	1 : 40
PROJECT NUMBER K1/1260/1	DRAWING NUMBER K1/1260/1-C11

K1/1260/1-C11

Appendix 2

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft Design Information for Ga Mokgotho

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

- FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

  A. PHIRING

  B. GA-MOKGOTHO

  C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

- MAKHADO LOCAL MUNICIPALITY

  A. TSHAKHUMA

  B. KHALAVHA

  C. HA-GUMBU

Prepared by:
Tsogang Water and Sanitation
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Work Design and Summary of the Diagnosis report.

I. Description of the village.

Mokgotho is a village based in Tubatse Local Municipality of Sekhukhune District Municipality. The village is situated ±38 kilometres away from Burgersfort town. Mokgotho village falls under Ward 16 led by Cllr Khosa Rankie and chieftaincy of Kgoshi Mokgotho. The village consists of ±621 households and population is estimated at ±4345.Mokgotho village is divided into Four (4) sections: Segabeng, Nkoting, Sethokgeng and Lekgwareng.

II. Current Water resources.

The village receives water from natural springs which are yielding water at high capacity. The source are protected with an intake pipeline connecting water to a brick build reservoirs that is again linked to two iron reservoirs for reticulation purpose. Water is distributed into the community through a network of pipeline with people accessing water from communal taps. The Sekhukhune district Municipality is partially involved as most activities like operation and maintenance are carried out by the community with help of local structures. Well of communities members own private poly pipes connecting water from the springs into their orchards and households but not the whole community. There are water sources like rivers, lake and spring in the village used for multiple use activities like livestock etc.

III. Water Quality test.

Water quality test for Ga-Mokgotho were conducted by Sekhukhune District Municipality in August 2017 and the results as good for both human consumption and other multiple uses. This is a continual routine contact by the district to ensure that communities use good and portable water to avoid sickness and they provided information for Ga-Mokgotho. The working relationship between the community, Tsogang and Sekhukhune District Municipality water test unit is very good.

NB: See attached spring test results with water quality tests.

IV. Design horizon for domestic and productive use supplies.

Village name	Current population	Current households	Design population (20 years)	Number of households at design life (assume 5 per household)	Minimum water need (Litres/day)	Currently available source quantity (Q) (Litres/day)	Excess Q Available for MUS activities over minimum requirement
Ga-Mokgoto	3105	621	4614	923	23 075	345 600	322 275

V. Design calculations for main supply pipes from both water sources to storage.

Measurements at site									Selected		Calculated		
System	From	Elevation m	To	Elevation m	Elev Diff (H_d) m	Min H m	Q l/s	Pipe length m	Pipe dia. mm	Pipe Class	H_f m/100m	Total head loss m	Residual head m
Ga mokgotho	Source 1	886	Storage	826	60	10	3	1100	63	10	4.6	50.6	9.4
Ga mokgotho	Source 2	937	Storage	826	111	10	1	1400	32	9	5.3	74.2	36.8

VI. Proposed scope of works at the source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge.

- **Upper and Lower Springs/streams require refurbishment. Activities to be carried out are as follows:** transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes, erect diamond mesh fencing around intake site, dig surface runoff diversion ditch around site. The two sources combined provide 345600 litres per 24 hours to 923 households at design life. The storage capacity is 200 000litres which is enough to store water for the community. Each household will have access to 217 litres of water per day (assuming 5 person household) for both domestic and multiple use water services. This equates to a per person supply of 43.4 litres per day

- **Install the main pipeline from the upper source to main reservoir**. Activities to be carried out are as follows: site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. The length of the pipeline is 1400m from the source to the storage, translating into 233 tasks of 6m each.

- **Install the main pipeline from the lowerr source to main reservoir**. Activities to be carried out are as follows: site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. The length of the pipeline is 1100m from the source to the storage, translating into 183 tasks of 6m each.

- **Extend reticulation pipeline from the main supply line to Sethogeng section,** activities to be carried out are as follows: site clearing, mark tasks, dig trenches, lay bedding, connect pipes and backfill after approval to cover a reticulation system for about 50 households to cover a distance of 600m equals to 100 tasks of 6m each with standpipes installed in each household

- **Household yard Connection**, connect water supply system to individual household yards for about 621 households, this water is used for domestic and productive use. Households promised to buy materials and provide labour to have this activity completed. The main reason being communal stand pipes are not sustainable as they were destroyed during the two communities namely Ga-Mokgotho and Maretlwaneng village conflicts. This will also make access to all community members and allow people to engage in multiple use activities.

- **Repair diamond mesh fencing** around two water sources - upper and lower sites. Activities will include: bush clearing, marking post holes, digging and installing fencing. Materials to be used are diamond mesh, concrete, wire, poles, staples and gates.

Replace damaged control valves and leaking pipes on the lower water source main pipeline and reticulation. Activities will include digging trenches, connect & re-align the pipeline, replace control valves and back fill. Materials to be used are HDPE pipes, control valves, concrete and fittings.

- **Homestead interventions,** community members will identify members to be trained in brick tank stand construction, guttering fitment, tank installation and assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives in the area.

- **Tsogang will train** community members on basic technical skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional & Social Development.

VII. Implementation Phase, time frame and the methodology.

- The scope of works, installing the main pipeline, extend the reticulation, homestead interventions, capacity building, water storage development will be implemented in six months using community labour from Ga-Mokgotho and officials from Tsogang for activities that require special skills and knowledge. Workers will be recruited from the community using a legal entity called close co-operatives in the village, who will manage the implementation at local level and pay stipends based on tasks completed, with the help of supervision by Tsogang Water and Sanitation.

VIII. Procurement of Goods and Services.

- Materials for the multiple use water services project will be procured in Limpopo Province using local suppliers in the area and nearby towns like Polokwane, Tzaneen, Burgersfort, Thohoyandou and Jane Furse. Purchasing will only take place outside the Province for things that cannot be found or procured in the Province. Ga-Mokgotho orders will be placed separately from other villages and three quotations will be gathered using a shopping exercise. All the procurement documents like quotations and close co-operatives documents will be submitted to the Water Research Commission for the procurement process to be finalised.

IX. Project Costs.

- A summary of the costs to increase the availability of water in the village, refurbish the existing water infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small businesses

Ga- Mokgotho

Lot number	Item	Material costs	Lots material	Stipend	Total	Remarks on Stipend.
1	**Water Source Developement**	10 092.53	35 X 42.5 PPC Cement, 1 X19mm Concrete 3 cube Load,12 X Y12 reinforcement,800 X Maxi Bricks,1 X River sand 1 X Building sand cubes load,10 X Brick force	9 250.00	19 342.53	Builder= 5250.00, Plumber= 1600.00, Assistance = 2400.00
2	**Water Source fencing.**	19 690.21	2X Weld Mesh 1.8m x 30m, 8 XSecurity Post Pole 2.4m,12 X Standard Security Pole 2.4m 12 XStay 2.4 HdStay, 12 X Bolt M10 x 100, 1 X Plain Wire 4mm x 50kg, 2 XPlain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single, 5 X42.5 ppc cement, 1 XRiver sand 3 cubes load, 0.50 X 19mm Concrete 3 cubes Load,	3 200.00	22 890.21	Team leader =2000.00, Assistance =1200.00
3	**Water Main & Reticulation Pipeline.**	101 454.19	8 X 40mm to 20mm saddle, 18 X 20mm elbow f/f galv, 10 X20mm x 1m stand pipe galv, 95 X 20mm tap cobra, 2 X 40mm male adaptor, 4 X 20mm Valve Ball,8 X40mm Valve Ball,2 x 40mm, 4 X HDPE Pipe cls6 x 100m.,4 X Pipe Galvanised x 32mm, 4 XPlumbers Hemp x 200g, 4X Pipe Galvanised Socket , 4 x32mm2 X 50mm HDPE Pipe cls10 x 100m.2 X63mm HDPE Pipe cls10 x 100m., 3 X75mm HDPE Pipe cls6 x 100m, 3 X90mm HDPE Pipe cls6 x 100m1 X110mm HDPE Pipe clas6 x 100m, 2 X 63mm to 50mm HDPE reducer, 2 X75mm to 63mm HDPE reducer, 2 X90mm to 75mm HDPE reducer, 2 X 110mm to 90mm HDPE reducer, 2 X 50mm HDPE coupling cls 6,2 X 63mm HDPE coupling cls 6, 3 X 75mm HDPE coupling cls 6,3 X90mm HDPE coupling cls 6 , 2 X 110mm HDPE coupling cls 6, 3 X20mm HDPE Pipe cls6 x 100m, 5 X Air Valve, 1 X Plastic Concrete Sheet, 1 X Red Oxide Paint X 10 litres, 2 X Filter Amiad 40mmx 200m 8 bar,6 X Socket Reducer Galv 50mmx40mm	33 300.00	134 754.19	2000m /6m =333 X R100.00 = 33300.00
4	**Animal Drinking trough.**	12 660.89	20 X 42.5 PPC Cement, 2 X19mm Concrete 3 cube Load,20 X Y12 reinforcement,1200X Maxi Bricks,2 X River sand 1 X Building sand cubes load,10 X Brick force	6 500.00	19 160.89	Builder =4100.00, Assistance= 2400.00.
5	**Homestead interventions**	59 696.92	15 X 2500 litres Jojo Tank	10 500.00	70 196.92	Builder= 7500.00, Assistance 3000.00 household
6	**Repair damage valves**	5 758.57	2 X 65mm Valve Ball, 4 X 65mm Male Adaptor,2 X 80mm Valve Ball, 4 X 80mm Male Adaptor,	2 500.00	8 258.57	Plumber 1600.OO & Assistance =900.00
7	**Store Room**	9 000.00	6 Months X Store room	-	9 000.00	N/A
8	**Plant Hire**	16 200.00	6 X Months Plant hire		16 200.00	N/A
	Total	234 553	-	65 110.00	299 803	

NB: Project Cost Including Vat R 299 803.

X. Please find below Ga-Mokgotho drawing booklet.

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - GA MOKGOTHO

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02
LAYOUT DRAWING	00	1 OF 1	K1/12607/1-C03
SPRING PROTECTION AND SPRING BOX	00	1 OF 1	K1/12607/1-C04
LIVESTOCK DRINKING TROUGH	00	1 OF 1	K1/12607/1-C05
RAIIN WATER HARVESTING	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILS	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08
HOMESTEAD GARDENS	00	1 OF 1	K1/12607/1-C09

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
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DESIGNED BY	Designer
CHECKED BY	Checker

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CLIENT DATE

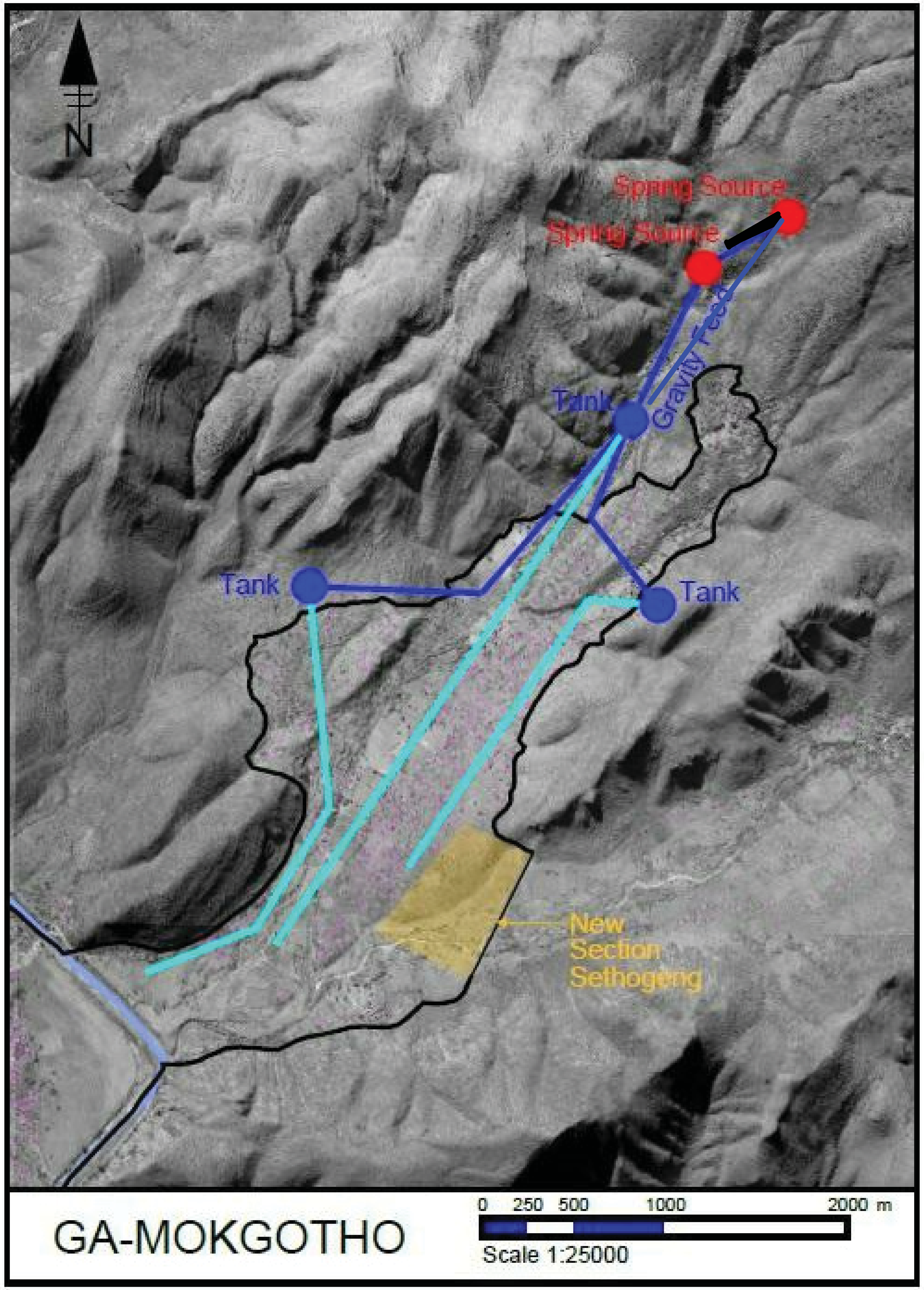
CONSULTING ENGINEER DATE

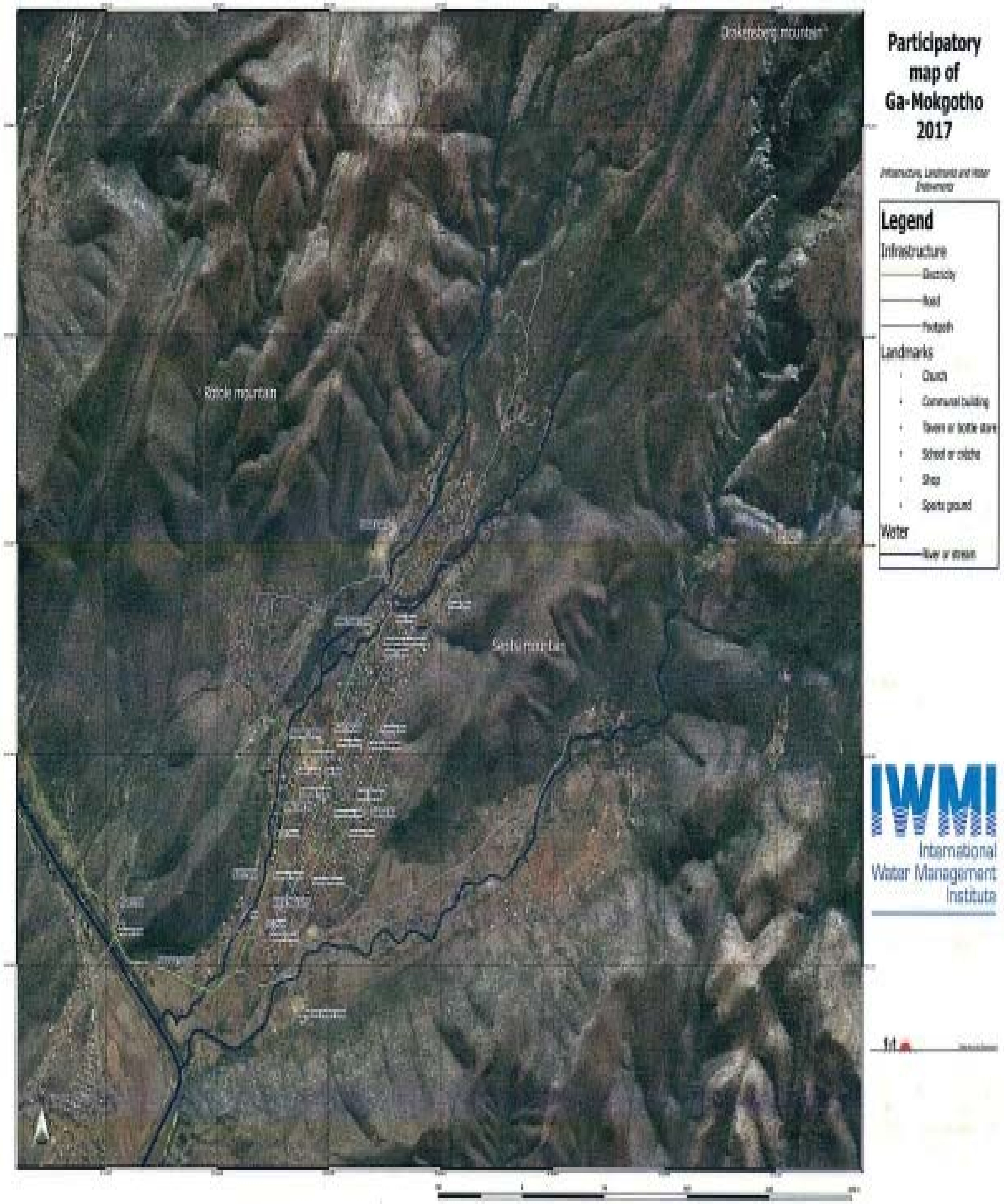
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01





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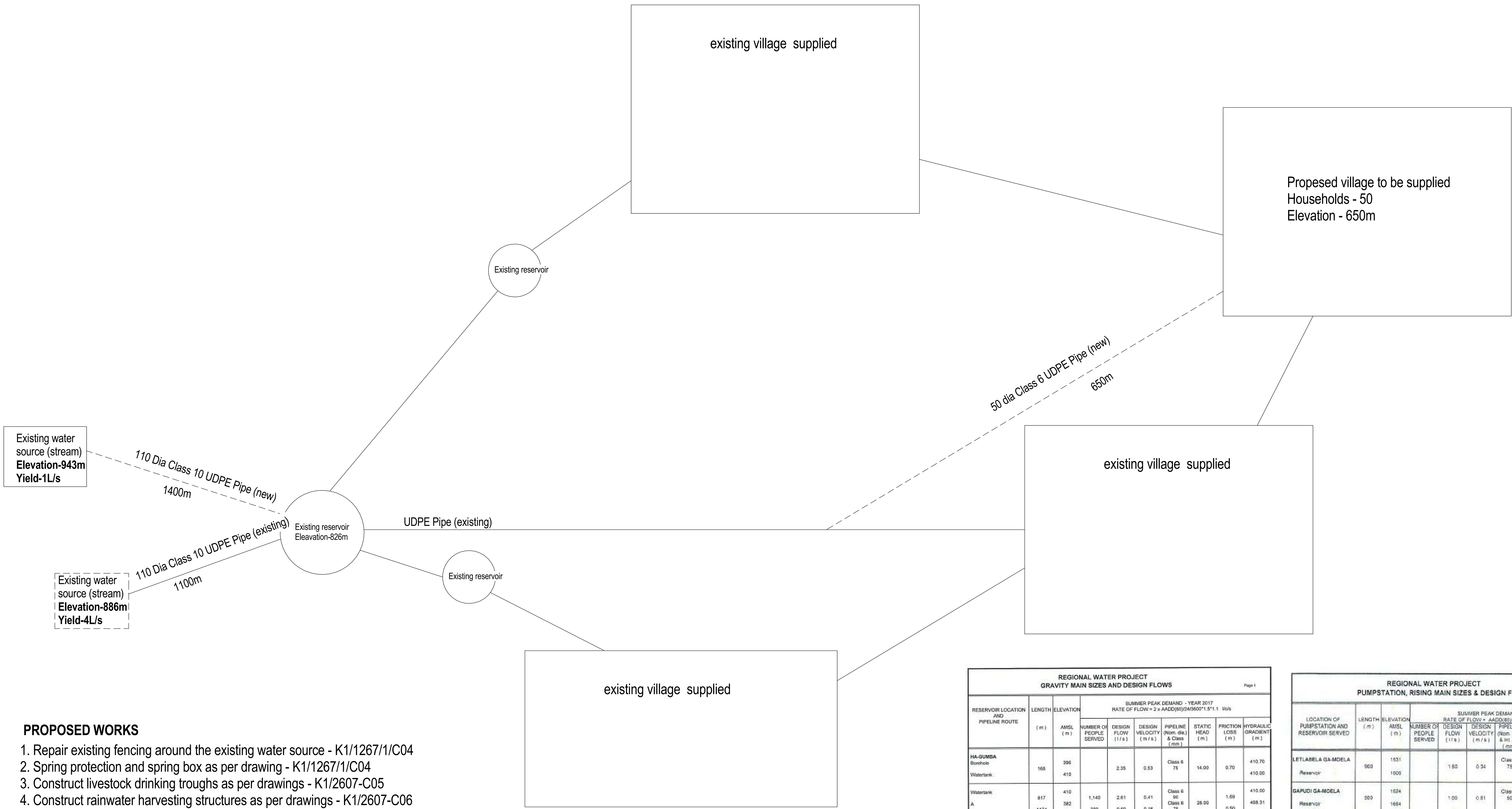
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
LOCALITY PLAN

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C02
DATE	SCALE
JANUARY 2018	
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C02

K1/2607/1-C02



PROPOSED WORKS

1. Repair existing fencing around the existing water source - K1/1267/1/C04
2. Spring protection and spring box as per drawing - K1/1267/1/C04
3. Construct livestock drinking troughs as per drawings - K1/2607-C05
4. Construct rainwater harvesting structures as per drawings - K1/2607-C06
5. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
6. Replace sections of damaged existing water lines - K1/2607-C08
7. Lay new pipes as per drawngs - K1/2607-C08
8.Connect water supply to identified homestead gardens (10 square meters) as per drawing - K1/2607-C09

LEGEND

existing water lines

new water lines

REGIONAL WATER PROJECT
GRAVITY MAIN SIZES AND DESIGN FLOWS Page 1

RESERVOIR LOCATION AND PIPELINE ROUTE	LENGTH (m)	ELEVATION AMSL (m)	SUMMER PEAK DEMAND - YEAR 2017 RATE OF FLOW = 2 x AADD(60)/24/3600*1.5*1.1 l/c/s						
			NUMBER OF PEOPLE SERVED	DESIGN FLOW (l/s)	DESIGN VELOCITY (m/s)	PIPELINE (Nom. dia.) & Class (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
HA-GUMBA Borehole Watertank	168	396 410		2.35	0.53	Class 6 75	14.00	0.70	410.70 410.00
Watertank A B	817 1174	410 382 398	1,140 300	2.61 0.69	0.41 0.16	Class 6 90 Class 6 75	28.00 12.00	1.69 0.50	410.00 408.31 407.81
A C	1643	382 401	300	0.69	0.16	Class 6 75		0.70	408.31 407.61
LUKAU Stream Watertank	400	926 838		3.50	0.79	Class 9 75	88.00	3.46	926.00 922.54
Watertank Village	661	838 462	1,260	2.89	0.65	Class 9 75	376.00	4.01	838.00 833.99
TSHAKUMA VILLAGE Borehole Watertank	1000	670 743		2.45	0.55	Class 9 75	73.00	4.47	747.47 743.00
Watertank Village	694	743 636	1,290	2.96	0.67	Class 12 75	0.00 107.00	4.40	743.00 738.60
KHALAVHA Stream Watertank	1600	1123 1091		1.10	0.56	Class 6 50	0.00 32.00	11.72	1,123.00 1,111.28
Watertank Village	2690	1091 889	546	1.25	0.64	Class 18 50	0.00 202.00	25.02	1,091.00 1,065.98

REGIONAL WATER PROJECT
PUMPSTATION, RISING MAIN SIZES & DESIGN FLOWS

LOCATION OF PUMPSTATION AND RESERVOIR SERVED	LENGTH (m)	ELEVATION AMSL (m)	SUMMER PEAK DEMAND - YEAR 2008 RATE OF FLOW = AADD(80)/24/3600*1.5*1.1 l/c/s						
			NUMBER OF PEOPLE SERVED	DESIGN FLOW (l/s)	DESIGN VELOCITY (m/s)	PIPELINE (Nom. dia.) & Int. Dia (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
LETLABELA GA-MOELA Reservoir	900	1531 1600		1.50	0.34	Class 9 75	75.00	1.62	1,531.00 1,529.38
GAPUDI GA-MOELA Reservoir	500	1524 1654		1.00	0.51	Class 6 50	30.00	3.07	1,624.00 1,620.93
MABUSA GA-MOELA Reservoir	1000	1673 1711		1.00	0.51	Class 6 50	38.00	6.14	1,673.00 1,666.86

No	DATE	REVISION	ISSUED BY

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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
LAYOUT DRAWING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03
DATE	SCALE
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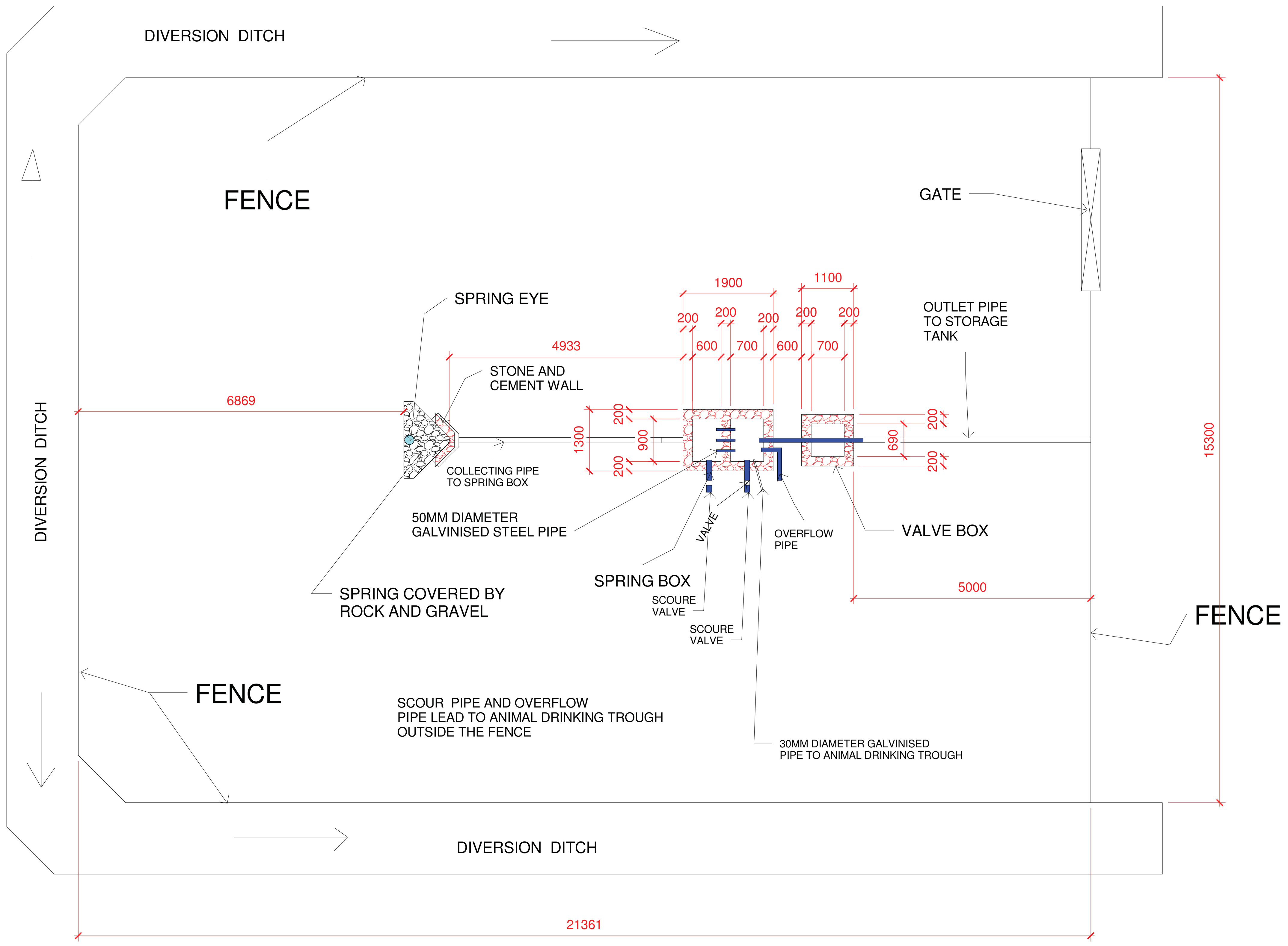
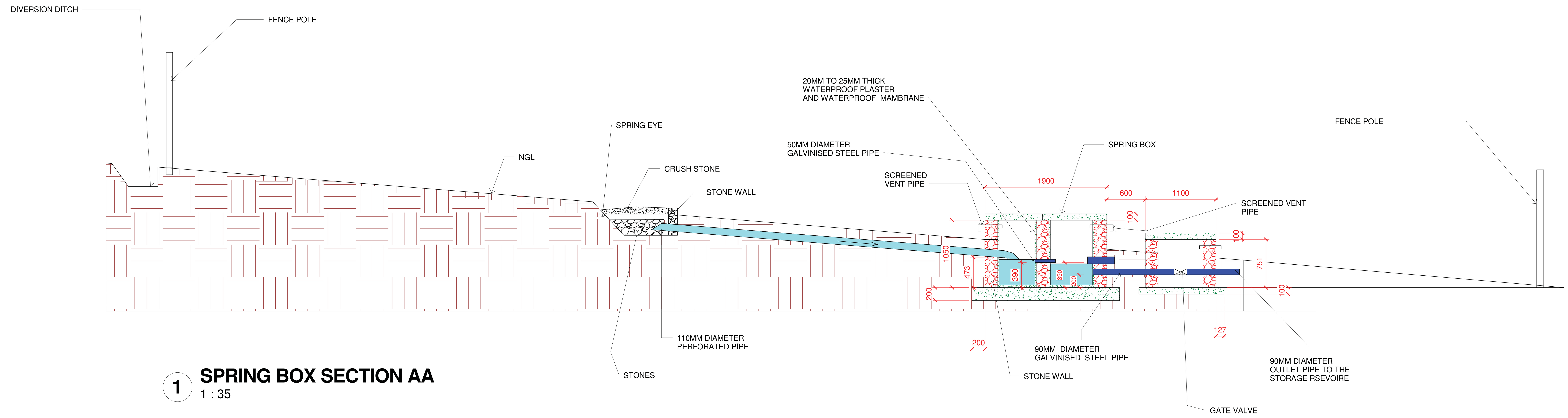
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03

K1/2607/1-C03



2 **SPRING BOX AND SPRING PROTECTION PLAN**
1 : 80

3 **3D VIEW**



1 **SPRING BOX SECTION AA**
1 : 35

No	DATE	REVISION	ISSUED BY

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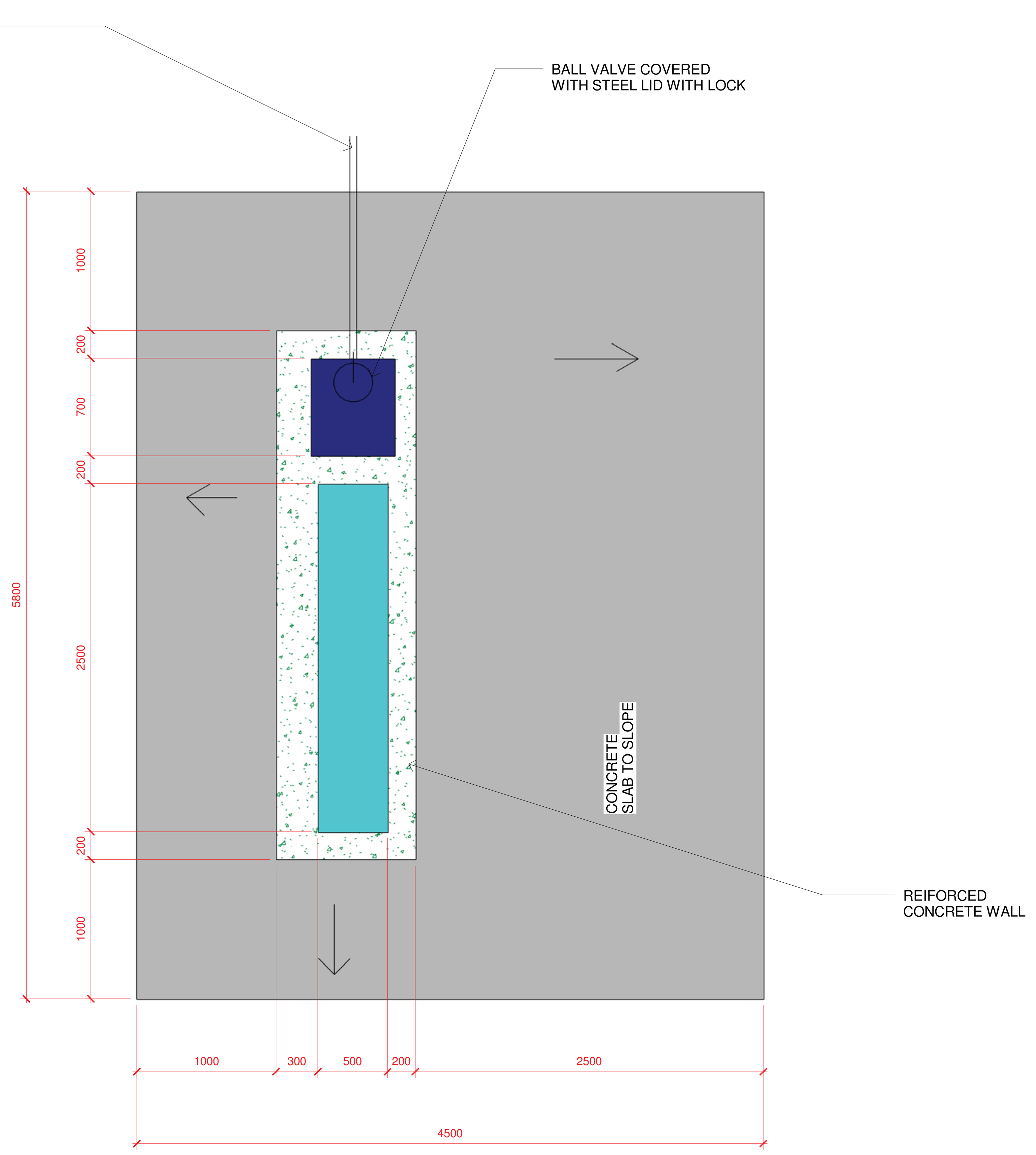
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

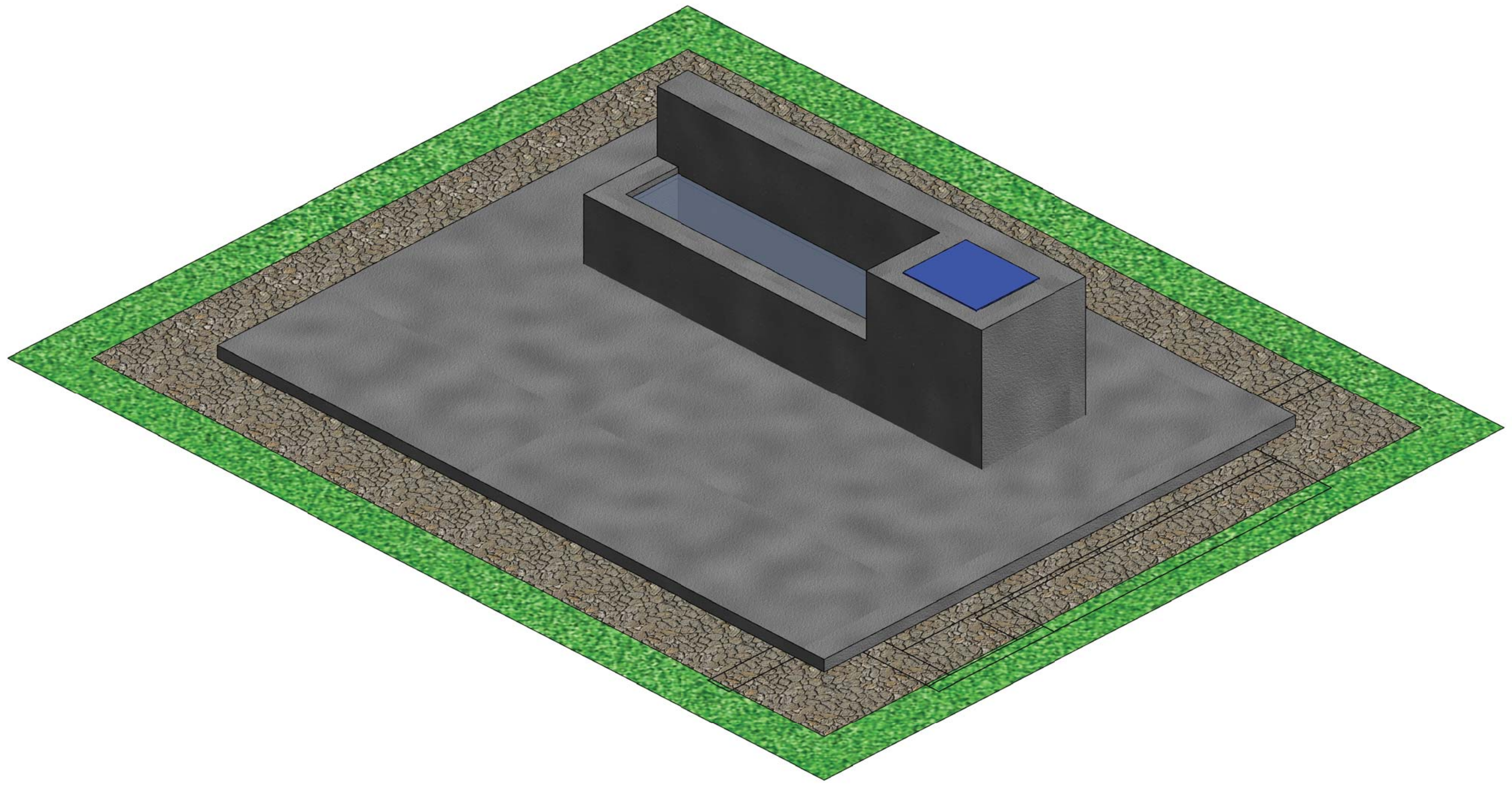
DRAWING DESCRIPTION
SPRING PROTECTION AND SPRING BOX

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C04
DATE JANUARY 208	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C04

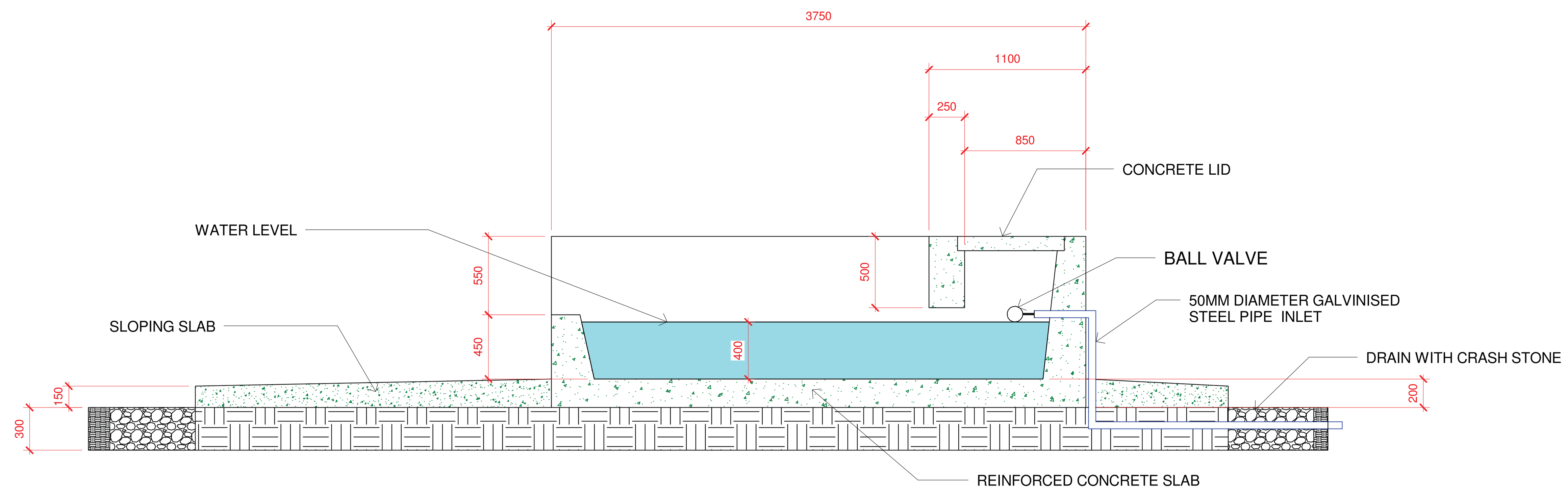
K1/2607/1-C04



3 FLOOR PLAN
1 : 30



4 3D VIEWS



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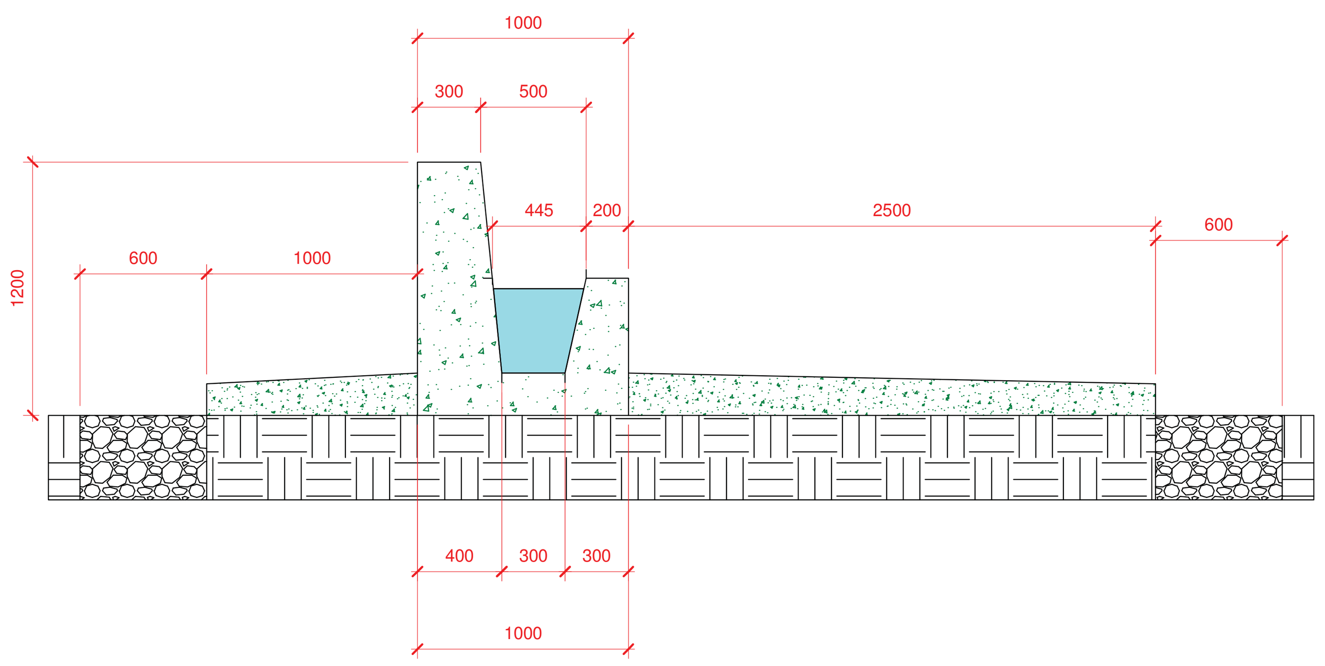

1 SECTION BB
1 : 30

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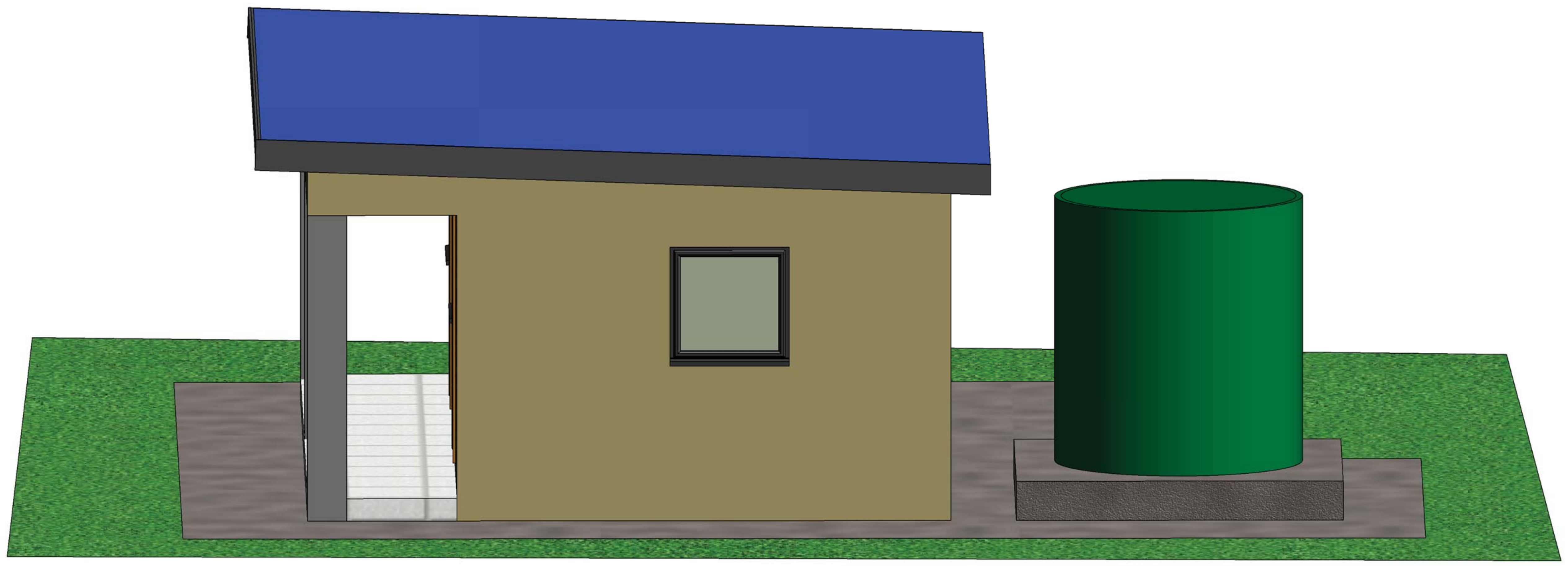
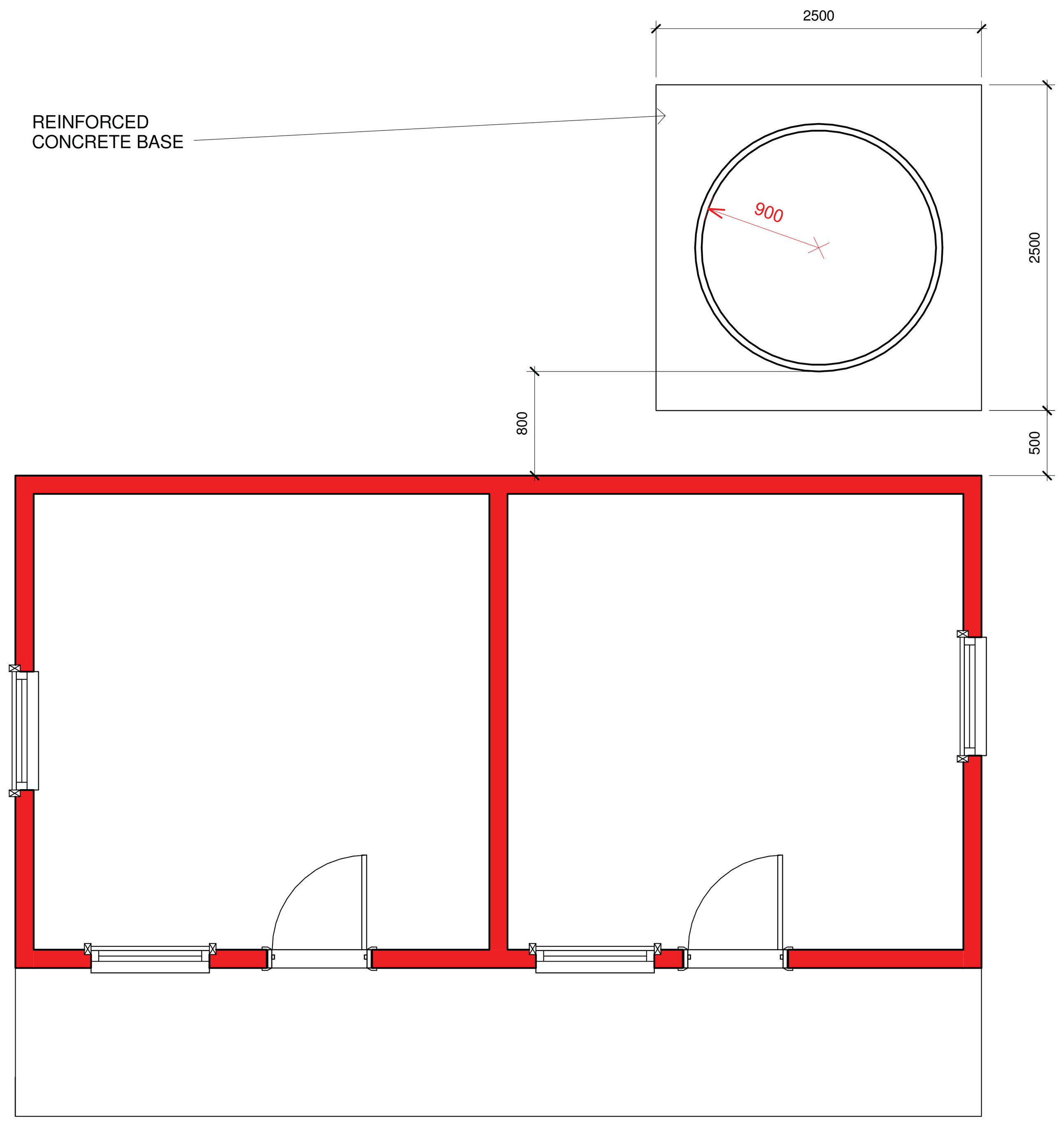
DRAWING DESCRIPTION
LIVESTOCK DRINKING TROUGH -500LITRE

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C05
DATE	SCALE
JANUARY 2018	1 : 30
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C05

K1/2607/1-C05



2 PERSPECTIVE VIEW



1 FLOOR PLAN

1 : 40

3 SIDE ELEVATION

1 : 30

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

WATER RESEARCH COMMISSION

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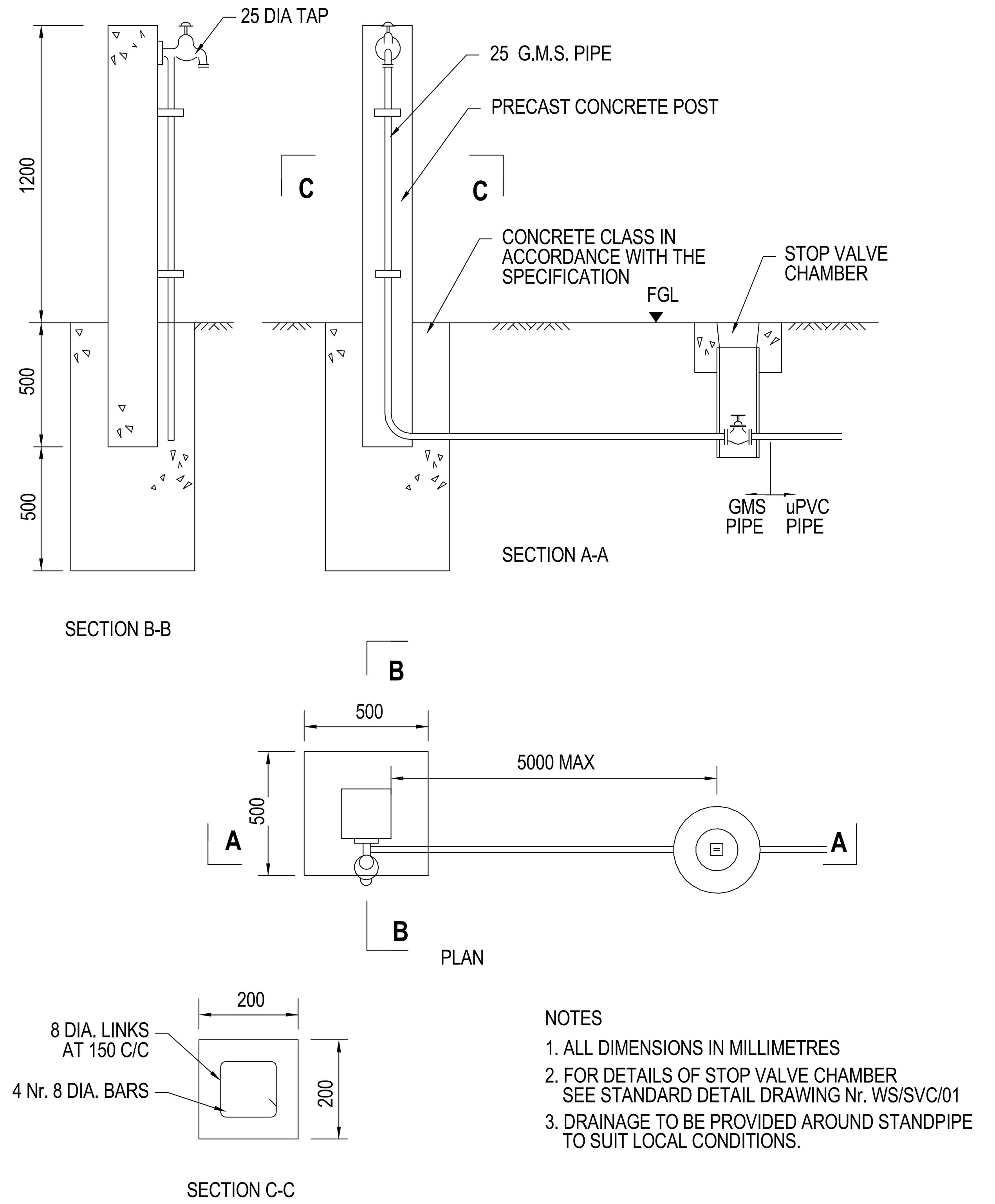
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
RAIN WATER HARVESTING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C06
DATE	SCALE
JANUARY 2018	As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C06

K1/2607/1-C06



NOTES
1. ALL DIMENSIONS IN MILLIMETRES
2. FOR DETAILS OF STOP VALVE CHAMBER SEE STANDARD DETAIL DRAWING Nr. WS/SVC/01
3. DRAINAGE TO BE PROVIDED AROUND STANDPIPE TO SUIT LOCAL CONDITIONS.

1 STAND PIPE DETAIL
1 : 1

STAND PIPE - TPYE 1

STAND PIPE - TPYE 2

No	DATE	REVISION	ISSUED BY

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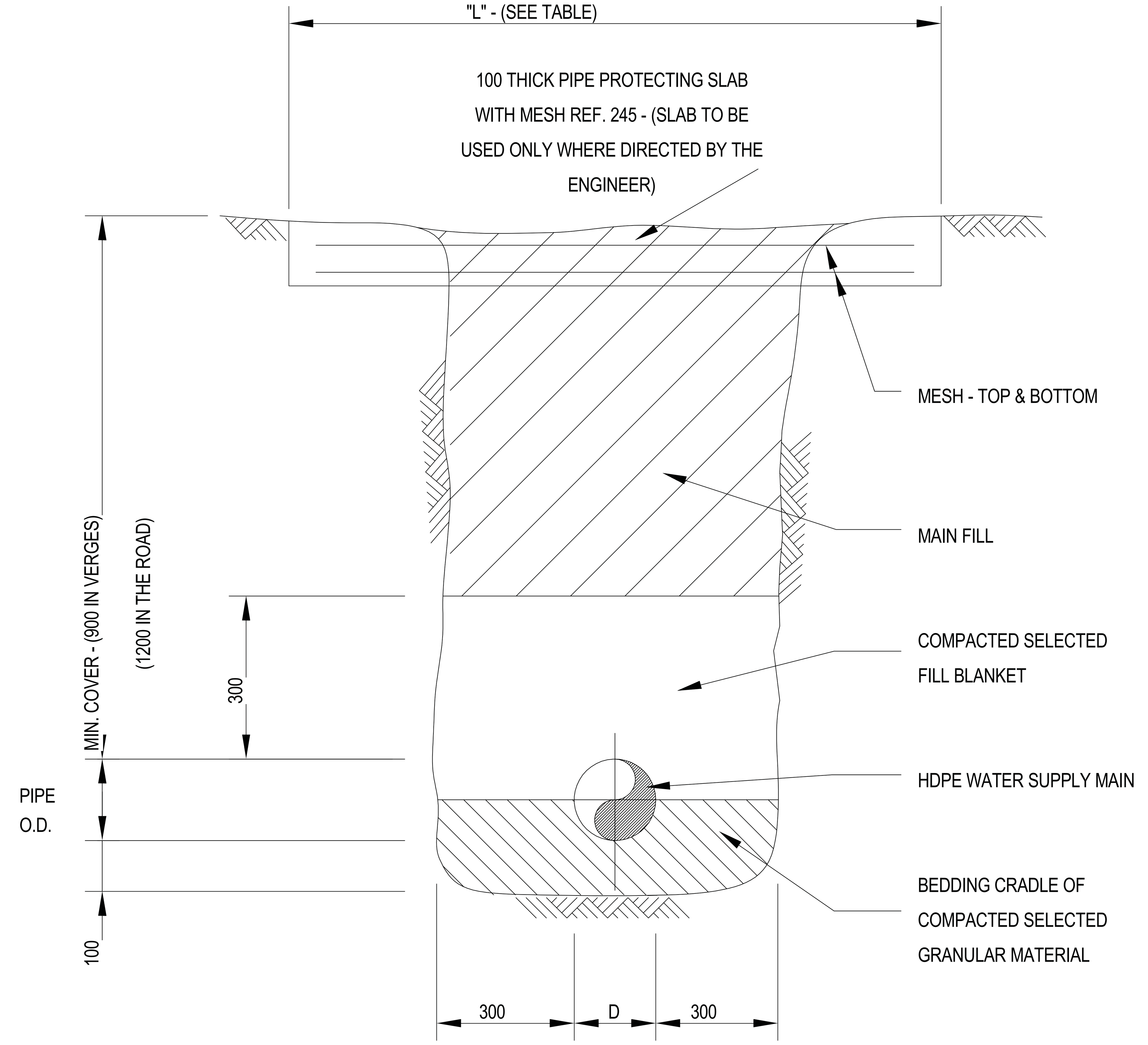
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C07
DATE JANUARY 2018	SCALE 1 : 1
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE				
PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS
1 : 65

No	DATE	REVISION	ISSUED BY

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CLIENT DATE

CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C08
DATE	SCALE
JANUARY 2018	1 : 65
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C08

K1/2607/1-C08

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - GA-MOKGOTHO

DRAWING DESCRIPTION
HOMESTEAD GARDENS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C09
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C09

K1/2607/1-C09

Appendix 3

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft Design information for Ha Gumbu

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

- FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

  A. PHIRING

  B. GA-MOKGOTHO

  C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

- MAKHADO LOCAL MUNICIPALITY

  A. TSHAKHUMA

  B. KHALAVHA

  C. HA-GUMBU

Prepared by:
Tsogang Water and Sanitation
P.O. Box 1111
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Work Design and Summary of the Diagnosis report.

I. Description of the village.

Ha-Gumbu falls under ward 9 of Musina Local Municipality; it is situated just in-between South Africa's most northern road, the R525, and the Limpopo River which is the border between South Africa and Zimbabwe. With ample groundwater base flows and fertile alluvial soils and market contracts up to Gauteng, groundwater irrigation rapidly developed, both in fields of a few hectares and at homesteads. Recent electrification further supported smallholder farming as effective pathway out of poverty and reduced out-migration.

II. Current water resources.

The main sources of water in Ha-Gumbu are ground water accessed through boreholes drilled in the village. There is a Municipality borehole equipped with a diesel pump and provides water to the community water supply. There are two hand pumps in the village, an afridev and old model hand pumps used as alternative resources of water for the community. Community use ground water for domestic, irrigation and feed their livestock water needs. The other source of water is the Limpopo River which is far from the village and some community member's livestock get water from it. The area is flat and sandy, because it is in Messina Limpopo Province, the hottest area in the province, so most people never thought that there is enough ground water in this area. The ground water table is not far to reach, about 30 to 40 mitres. There also private boreholes owned by the local commercial farmers and used to irrigate their crops.

III. Water Quality test.

As per the information received from a ground water expert in Limpopo Province (Water System Management) institute, boreholes in Ha-Gumbu are very good, water quantity and quality tests were conducted, and the result is very good.   The process of conducting new water quality test by Vhembe District Municipality is ongoing and promised to collect water samples soon.

NB: See attached borehole test results with water quality tests received from WSM.

IV. Design horizon for domestic and productive use supplies.

Village name	Current population	Design population (20 years)	Design life households	Minimum water need (Litres/day)	Currently available source quantity (Q) (Litres/day)	Excess Q Available for MUS over minimum requirement
Ha Gumbu	1 430	2 125	425	53 125	155 520	102 395

V. Available water for Multiple Use Water Services, head losses and suggested pipe sizes and classes

VI. Measurements at site									Selected		Calculated		
System	From	Elevation m	To	Elevation m	Elev Diff (H_d) m	Min H m	Q l/s	Pipe length M	Pipe dia. mm	Pipe Class	H_f m/100m	Total head loss m	Residual head m
Ha Gumbu	Borehole	396	Storage	408	12	10	1.8	100	50	6	1.8	1.8	13.8

VII. Proposed scope of works at the source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge.

- **Water storage**, Ha-Gumbu borehole provides 77760 litres of water in 12 hours, the storage current storage consists of 2 x 10,000 litres jojo tanks which store 20,000 litres of water and is not enough to supply everybody including extension to new 100 households. Adding new 30 000 litres storage system will make a difference and people will have water for both domestic and productive use. A storage capacity of 50 000 litres will allow each households to collect 175 litres of water a day but bearing in mind that there are 96 privately owned boreholes in the area which belong to those who afford. Activities to be carried out include the following site clearing, dig foundation, transport materials, cast concrete slabs, erect steel tank stands, install jojo tanks with anchor ties, connect source pipe and delivery connections.

- **Raise tank stands to 12m height to provide enough head** to reach far end of the system. The area is flat and the current tank stands are only four metres so some taps don't get water at all because pressure is very low. Installing 12 m high steel tank stands will increase pressure inside the pipes and ensure that all section of Ha-Gumbu access water for domestic and productive use.

- **Refurbish the existing pump house and fence the area.** The corrugated iron sheet pump house is poorly constructed, weak and need to be refurbished and fenced to protect the infrastructure against damaged by animals and theft by strangers. Activities to be carried out are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh, install a gate. The close co-operatives will help Tsogang to identify and advise on a local welder to be utilised. The welder will prepare, clean, weld and paint the required items. Materials to be used for fencing are diamond mesh, concrete, wire, poles, staples and gates.

- **Re-build animal drinking trough and connect it to the hand pump for cattle'**s, goats and other domestic animals. Activities to be carried out are transport materials, identify members to build, identify the site, clear vegetation, mark layout, dig foundations, lay concrete, and build, connect trough to water supply and install isolation valve and water level control valve.

- **Extend the reticulation system** to cover new households (100) living far away from the existing water system. Activities to be carried out are as follows, site clearing, mark tasks, dig trenches, lay bedding, and connect pipes and backfill after approval to cover 100 new households in the area. The total distance to be covered is 600m equals to 100 tasks of pipe-laying with standpipes installed at communal sites. Materials to be used are HDPE pipes, concrete, taps, fittings and control valves.

  Refurbish an existing hand pump in the village to give the community an option to use in-case the domestic water supply is broken. Workers will assist Tsogang to remove the pump from the borehole, inspect the pumping and valve mechanisms, replace defective components and reinstall pump to borehole. Materials to be used are foot pumps & valves, upvc pipes, hand pump spare parts and tools like a tri-port.

- **Homestead interventions,** community members will identify members to be trained in brick tank stand construction, gutters fitment, tank installation and assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives as agreed the area. Materials to be used are HDPE pipes, concrete, stand pipes, jojo tanks, taps, fittings and control valves.

- **Tsogang to train community members on basic technical** skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional Social Development. Capacity building will takes in the village using available community resources like community halls and churches. Learners will be given food and provide with the necessary training materials like handouts, pens and note books.

VIII. Implementation phase, time frame and the methodology.

- The scope of works include the following, install 3 x 10 000litres jojo tanks, extent the reticulation to 100 new households, refurbish the pump house, repair hand pumps, refurbish animal drinking trough, train the community and support other Multiple use water services initiatives like homestead gardens and local farmers. The activities will be implemented in six months using community labour from Ha-Gumbu and officials from Tsogang for activities that require special skills and knowledge. Workers will be recruited from the community using a legal entity called close co-operatives to manage the implementation at local level and pay stipend based on tasks complete with the help of Tsogang Water and Sanitation’s supervision

IX. Procurement of Goods and Services.

- **Materials for the multiple use water services project** will be procured in Limpopo Province using local suppliers in the area and nearby towns like Polokwane, Tzaneen, Burgersfort, Thohoyandou and Jane Furse. Purchasing can only take place outside the Province for items that cannot be found or procured in the Province. Ha-Gumbu project material orders will be placed to suppliers separately from other villages and more than three quotations will be gathered using a shopping exercise. All the procurement documents like quotations and close co-operatives documents will be submitted to the Water Research Commission for the procurement process to be finalised. Tsogang will create a filing system to keep all project documentation in good order for future references and accountability. Tsogang will also ensure that the project materials is well received, store and dispatched according using deliverable notes etc. See the Proposal note for information.

X. Project Costs and lots of materials including rates.

Below is a summary of costs to increase the availability of water in the village for domestic and irrigation, refurbish the existing infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small businesses.

Ha Gumbu

Lot number	Item	Material costs	Lots material	Stipend	Total	Remarks on Stipend.
1	**Water storage Development**	140 745.38	1 X River Sand 3 cubes load, 0.5 X 19mm Concrete 3 cube Load, 3 X 10 000 litre Jojo Tank, 10 X 42.5 PPC Cement, 3 X 12m Height Tank Stand Galvinised including installation.	11 400.00	152 145.38	Builder =5000, Plumber =4800, Assistance =1600
2	**Water Source Fencing.**	10 800.61	1 x Weld Mesh 1.8m x 30m, 5 x Security Post Pole 2.4m, 10X Standard Security Pole 2.4m, 8 X Stay 2.4 Hd, 8 x Stay Bolt M10 x 100, 1 x Plain Wire 4mm x 50kg, 1 x Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single, 2 X 42.5 PPC Cement, 1 X Labour	3 200.00	14 000.61	Team leader=2000.00, Assistance = 1200.00
3	**Water Pipeline, Extention**	41 523.49	5 x 50mm HDPE Pipe cls 6 x 100m, 5 X 40mm HDPE Pipe cls6 x100m, 5 x 50mm HDPE coupling, 4 X 40mm HDPE coupling, 2 x 63mm to 50mm saddles, 3 X 50mm to 40mm saddle, 8 X 40mm to 20mm saddle, 20 x 20mm elbow f/f galv, 10 x 20mm x 1m stand pipe galv, 10 x 20mm tap cobra, 1 X 40mm Valve ball,2 x 40mm male adaptor, 4 X 20mm Valve Ball, 2 X 20mm Male adaptor, 2 X 50mm Valve Ball, 4 X 50mm Male adaptor, 2 X 65mm Valve Ball, 4 X 65mm Male Adaptor, 2 x 80mm Valve Ball, 4 X 80mm Male Adaptor, 2 X 100mm Valve Ball, 4 X100mm Male Adaptor, 15 X 42.5 PPC Cement, 12 x Y12 reinforcement, 0.5 X River Sand 3 cubes load, 0.5 X 19mm Concrete 3 cube Load, 500 X Bricks, 0.5 X Building sand, 4 X20mm HDPE Pipe cls 6, 1 x Labour	23 300.00	64 823.49	Pipe laying 1400m /6m X 100 = 23300.00
4	**Animal Drinking trough**	6 028.34	10 X 42.5 PPC Cement, 10 X Y12 reinforcement, 1 X River Sand 3 cubes load, 1 X 19mm Concrete 3 cube Load, 500 X Bricks.	3 250.00	9 278.34	Builder=1250,00 assistance= 1200.00 & Plumber =800.00
5	**Homestead Intervention**	39 797.95	10 X 2500 litres Jojo Tank plus fittings.	7 000.00	46 797.95	Builder =5000.00, Assistance =2000.00
6	**Valve box**	6 170.22	10 X 42.5 ppc cement, 1 X River sand 3 cubes load, 1000 X Maxi Bricks, 1 X Building sand, 12 X Brick force, 2 X Labour	5 180.00	11 350.22	Builder =3500.00, Assistance= 1680.00
7	**Pump House Repair**	5 700.00	1 X Pump House Welding & Painting material	2 500.00	8 200.00	Welder=2500.00
8	**Hand Pump**	5 840.00	Afridev spares material	2 000.00	7 840.00	Plumber=1300.00 assistance= 700.00
9	**Store Room**	9 000.00	6 Months X Store room	-	9 000.00	N/A
10	**Plant Hire**	16 200.00	6 X Months Plant hire		16 200.00	N/A
	Total	281 805	-	57 830.00	339 636	

NB: Project Cost Including Vat R339 636.

XI. **Please find below a drawing booklet for Ha-Gumbu Project.**

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02
LAYOUT DRAWING	00	1 OF 1	K1/12607/1-C03
STEEL TANK STAND	00	1 OF 1	K1/12607/1-C04
PUMP HOUSE FENCING	00	1 OF 1	K1/12607/1-C05
RAIIN WATER HARVESTING	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILS	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08
HOMESTEAD GARDENS	00	1 OF 1	K1/12607/1-C09
LIVESTOCK DRINKING TROUGH	00	1 OF 1	K1/12607/1-C10
HAND PUMP	00	1 OF 1	K1/12607/1-C11
VALVE BOX	00	1 OF 1	K1/12607/1-C12

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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CLIENT DATE

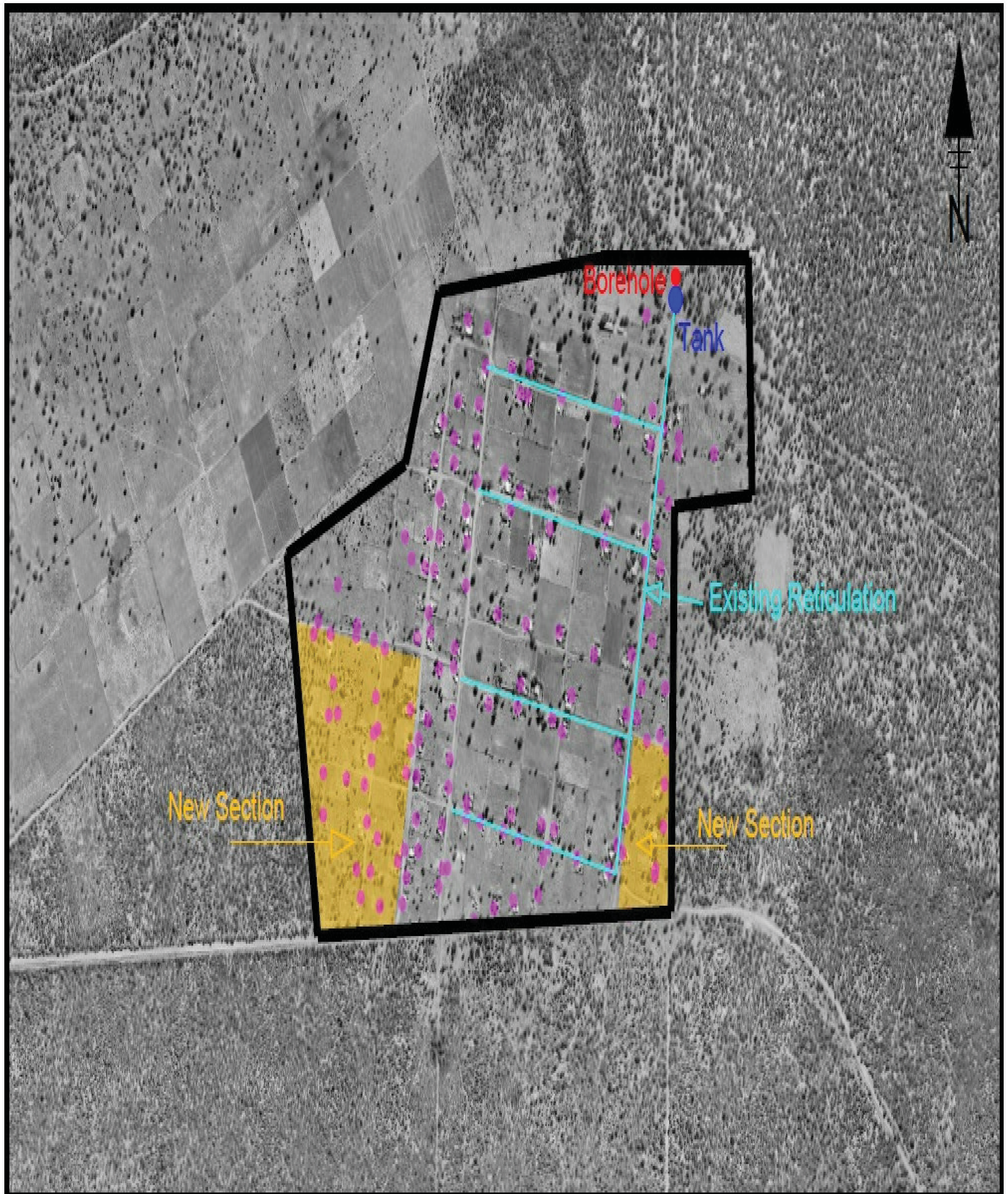
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01



HA-GUMBU

0 100 200 400 800 m

Scale 1:10000

Map 1b: lay-out of homesteads and distant fields Ha-Gumbu section 1

No	DATE	REVISION	ISSUED BY

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CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

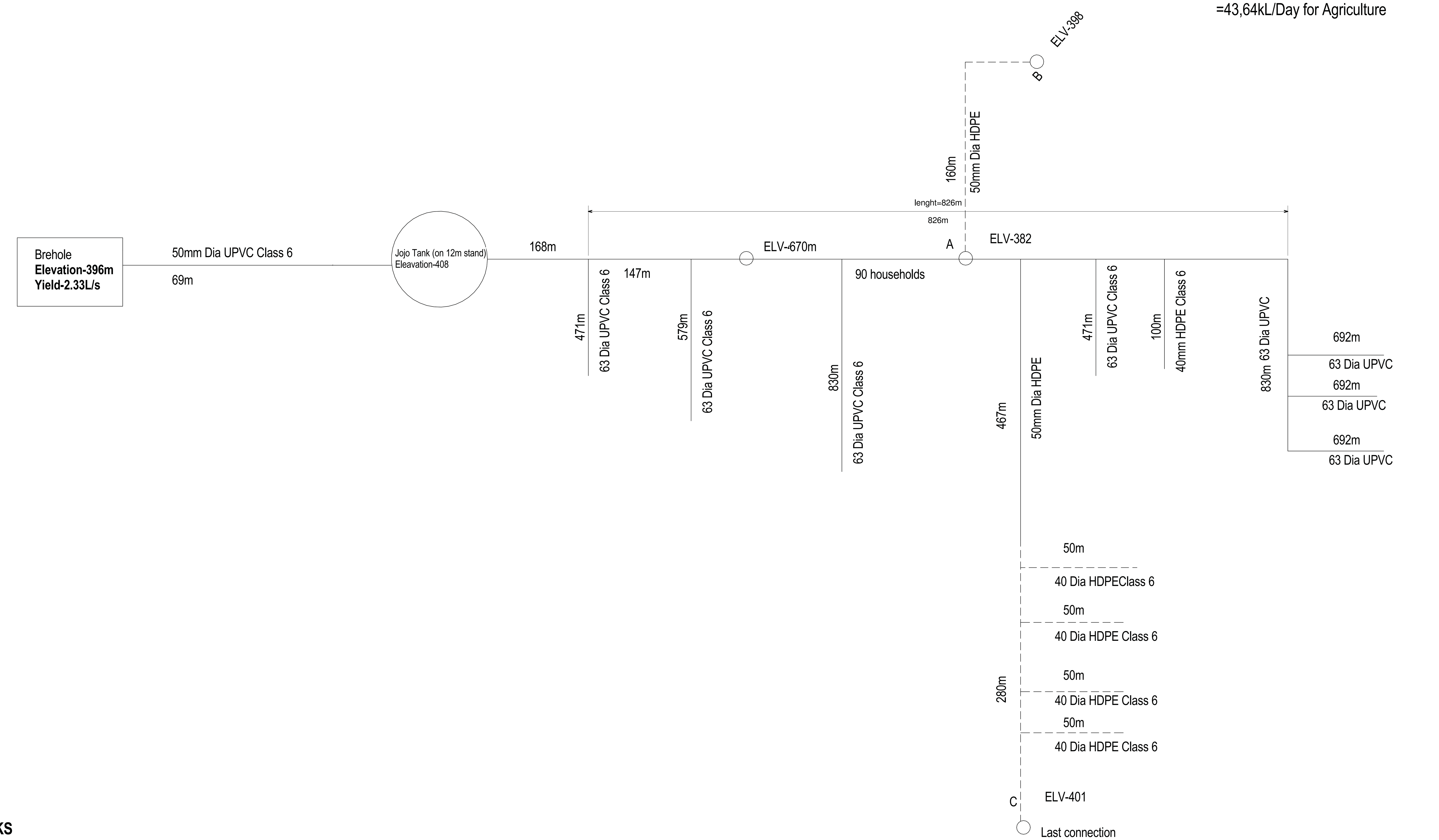
DRAWING DESCRIPTION
LOCALITY PLAN

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C02
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C02

K1/2607/1-C02

WATER AVAILABLE

Total No of HH is 286,
But 96 have private BH,
therefore 90 HH left
2,33 x 60x60x12=100,656 kl/Day
100 656/190=529,7 L/HH/Day
=68L/Person/Day
Assuming 50L/Person/Day required,
That leaves 38,2x6x190
=43,64kL/Day for Agriculture



PROPOSED WORKS

1. Construct steel tank stand 12 m high to carry 10 000 L Jojo tank as per as per drawing - K1/2607-C04
2. Install fencing (diamond mesh) to the pumphouse as per drawing K1/2607-C05
3. Construct rainwater harvesting structures as per drawing- K1/2607-C06
4. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
5. Lay new pipeline as per drawing K1/2607-C08
6. Provide water supply to homestead gardens (10 square meters) as per drawing - K1/2607-C09
7.Construct livestock drinking troughs as per drawing- K1/2607-C10
8.Construct hand pump as per drawing- K1/2607-C11
9.Construct valve box as per drawing- K1/2607-C12

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.PHASHA
DESIGNED BY	L.M
CHECKED BY	M.K.PHASHA

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CLIENT DATE

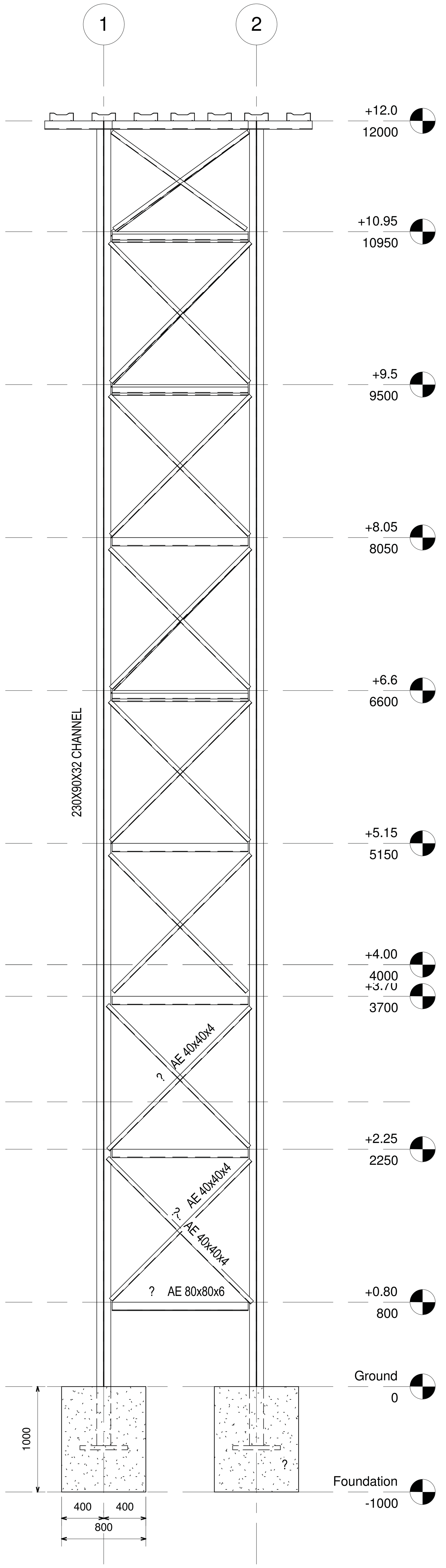
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

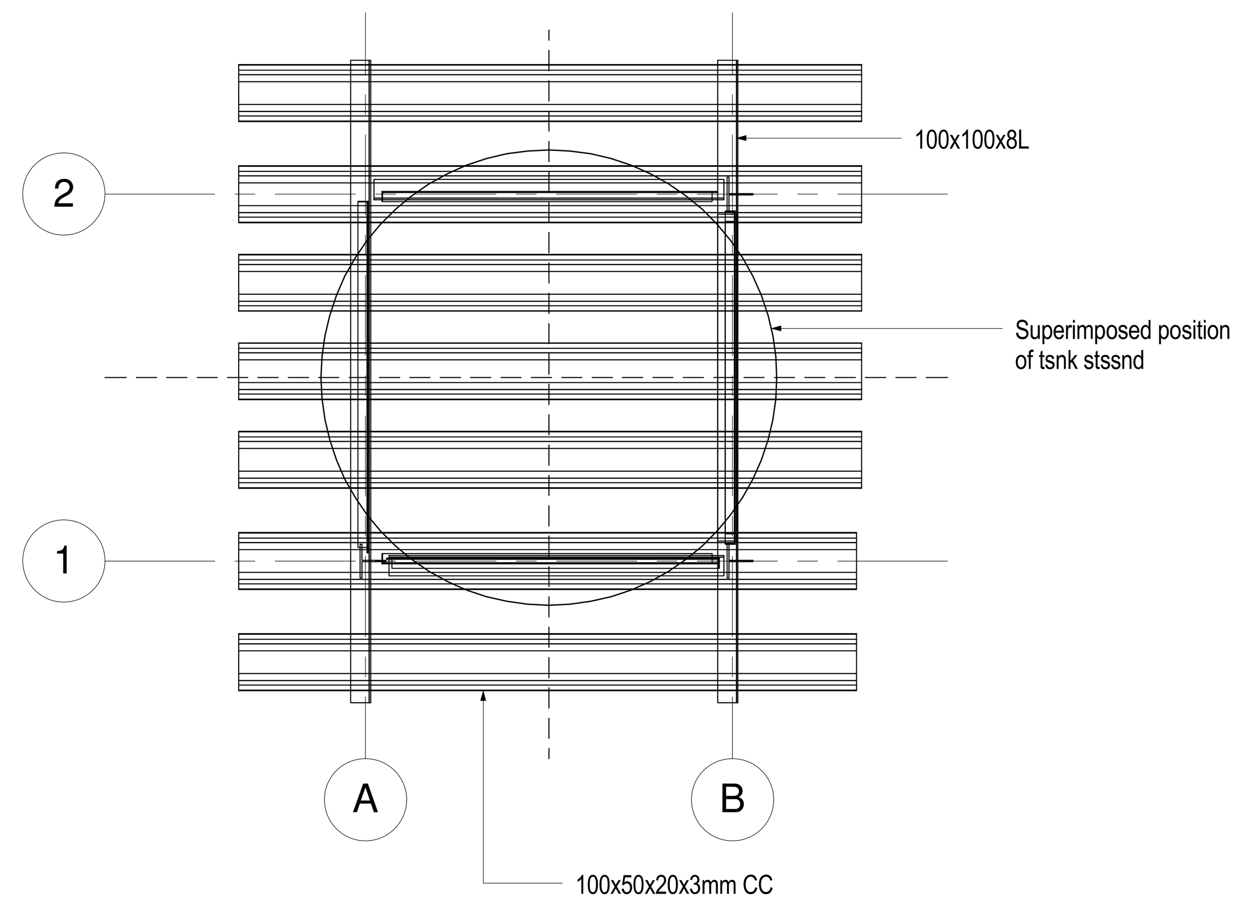
DRAWING DESCRIPTION
LAYOUT DRAWING

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C03
DATE	SCALE
JANUARY 2018	1 : 35
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C03

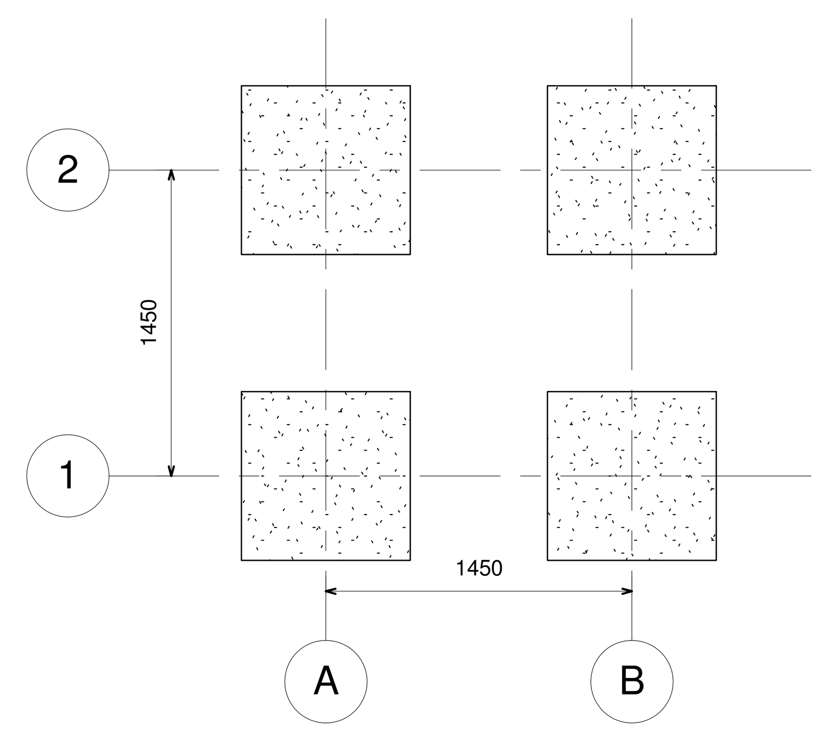
K1/2607/1-C03



8 East
1 : 30



9 00 Eaves
1 : 25

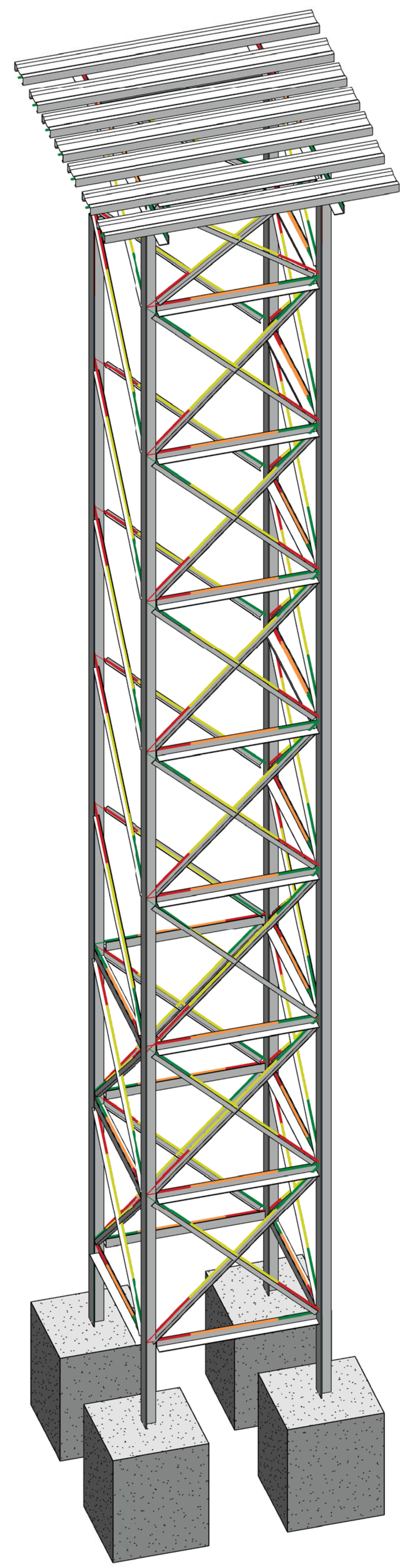


6 00 Foundation (TOF)
1 : 30

NOTES:

1.Grade of concrete to be 25Mpa

2.Water tank to be suitably held to position on platform using minimum 2 strands of 4mm galvanised steel wire fixed and looped through the bracket and the ear of the tank and the platform of the base



7 {3D}

BASE SCHEDULE		
TYPE	SIZE	QAUANTITY
	800 x800 x 100dp	4

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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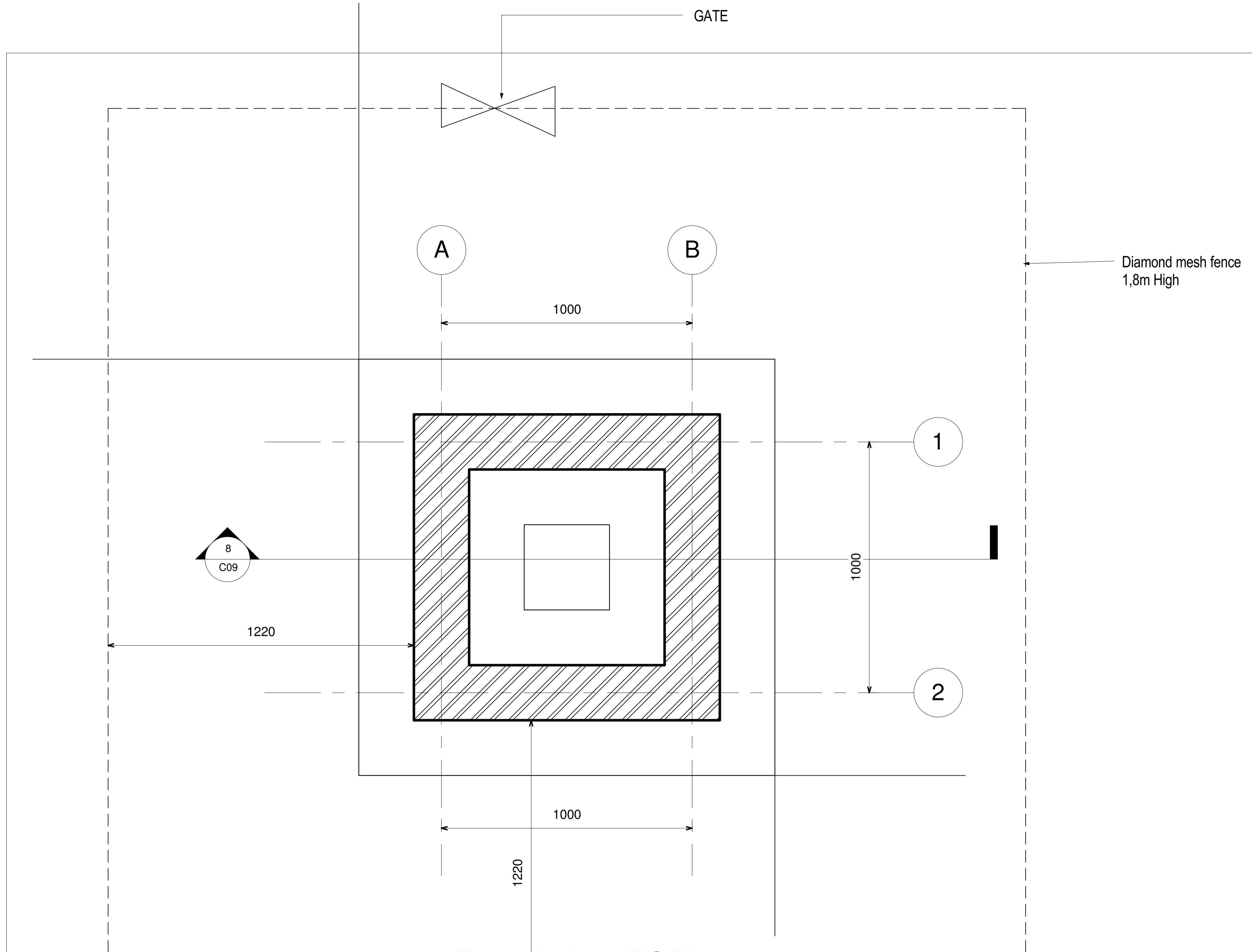
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

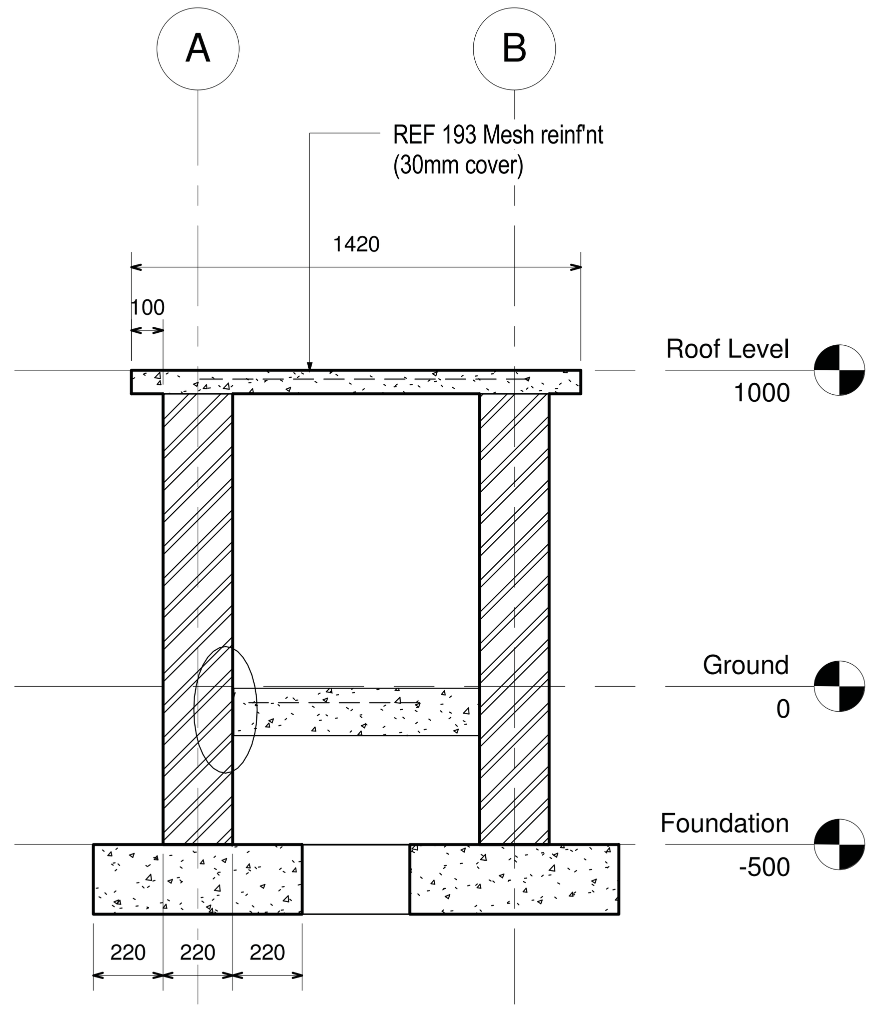
DRAWING DESCRIPTION
STEEL TANK STAND - TO CARRY 5 000 LITRE JOJO TANK

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C04
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C04

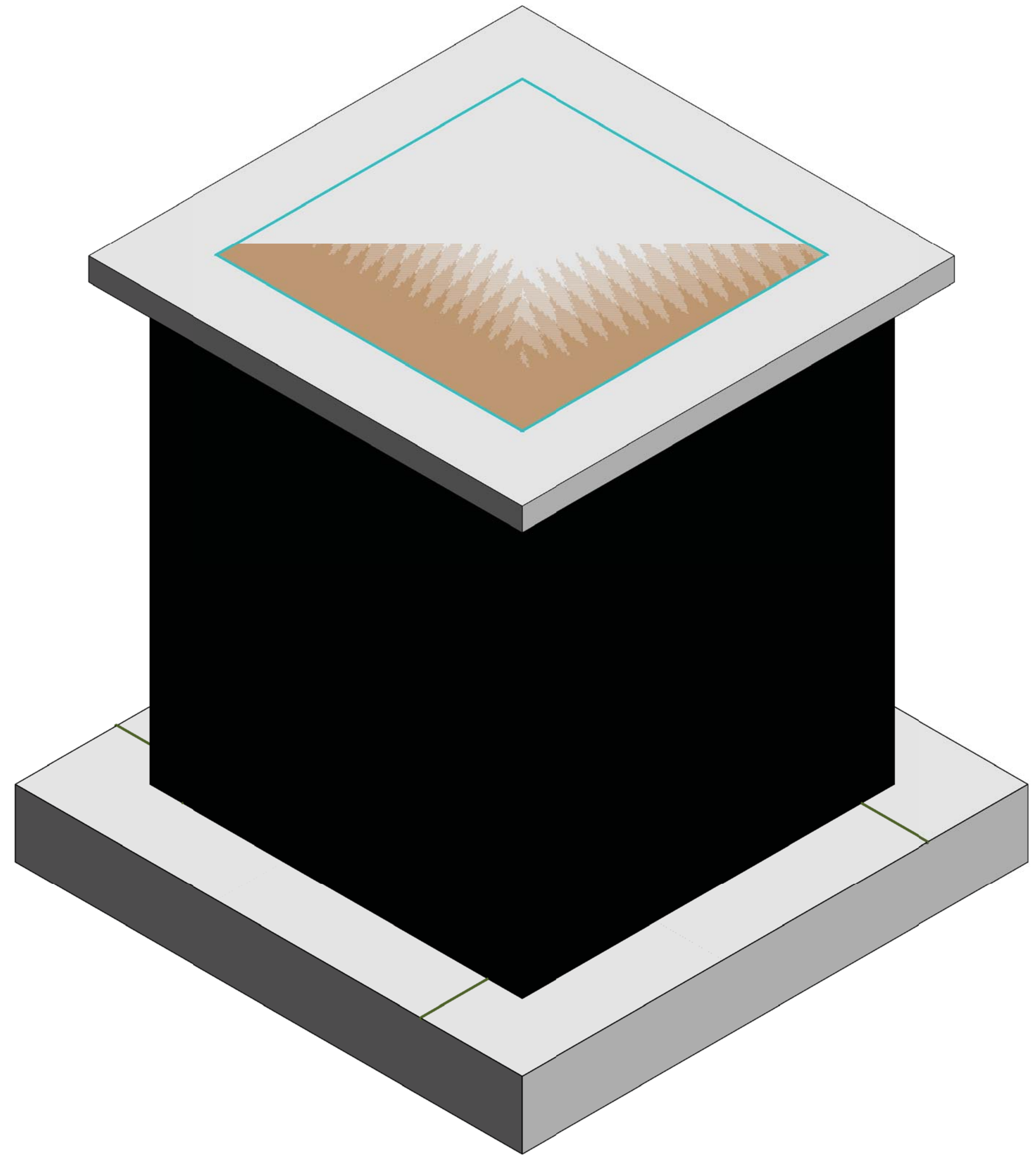
K1/2607/1-C04



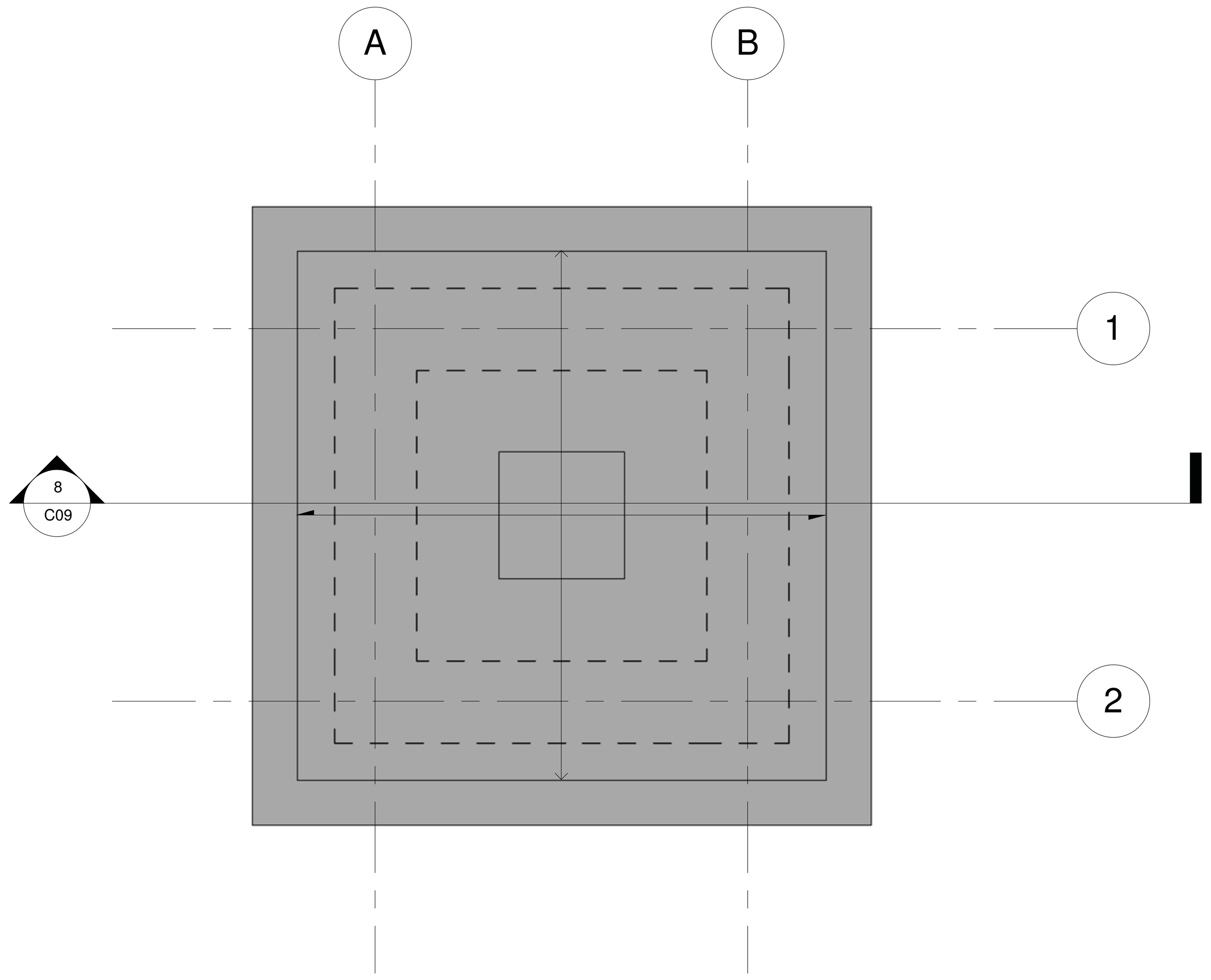
6 00 Foundation (TOF)
1 : 15



8 Section 1
1 : 20



7 {3D}

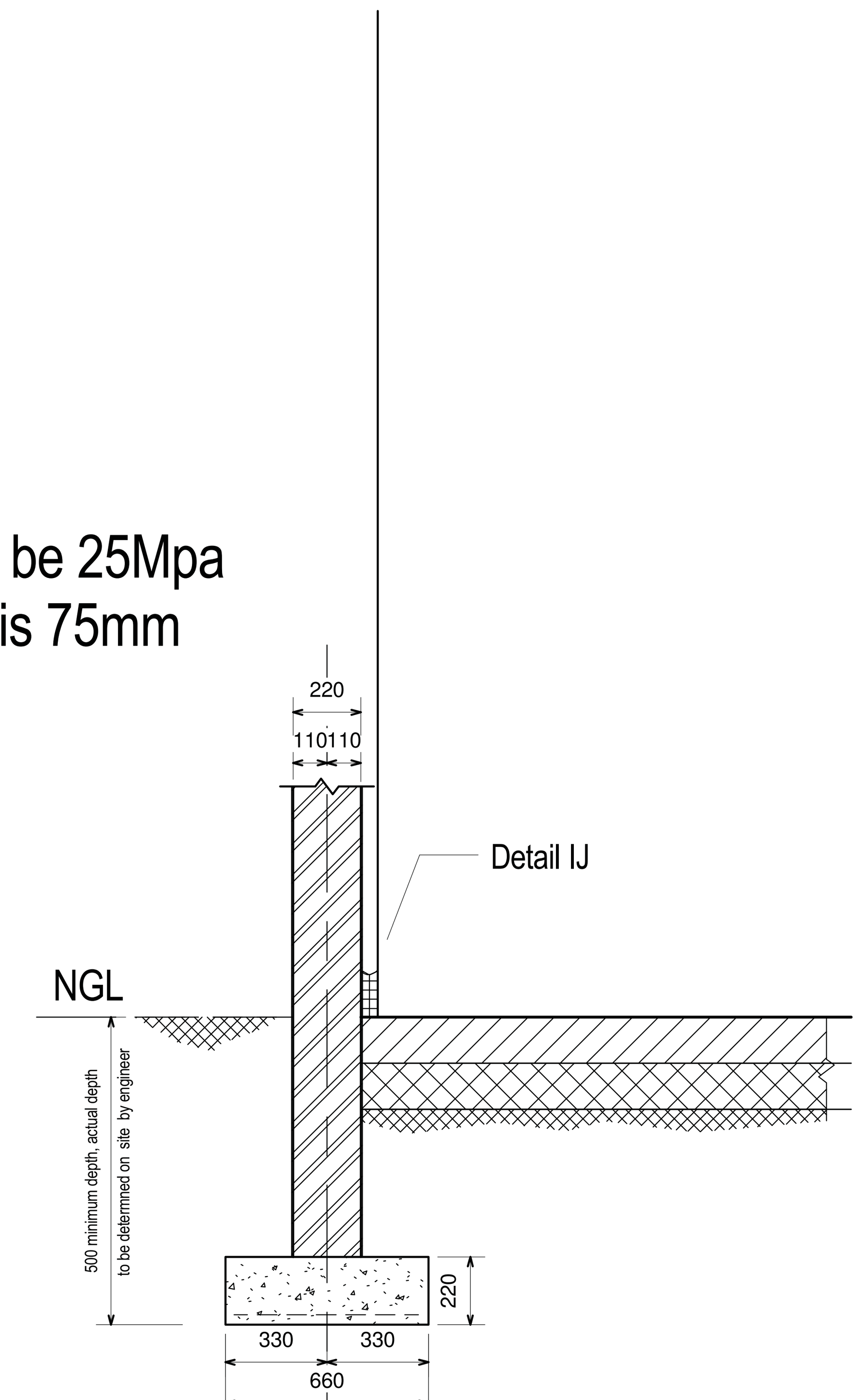


5 00 First Floor
1 : 15

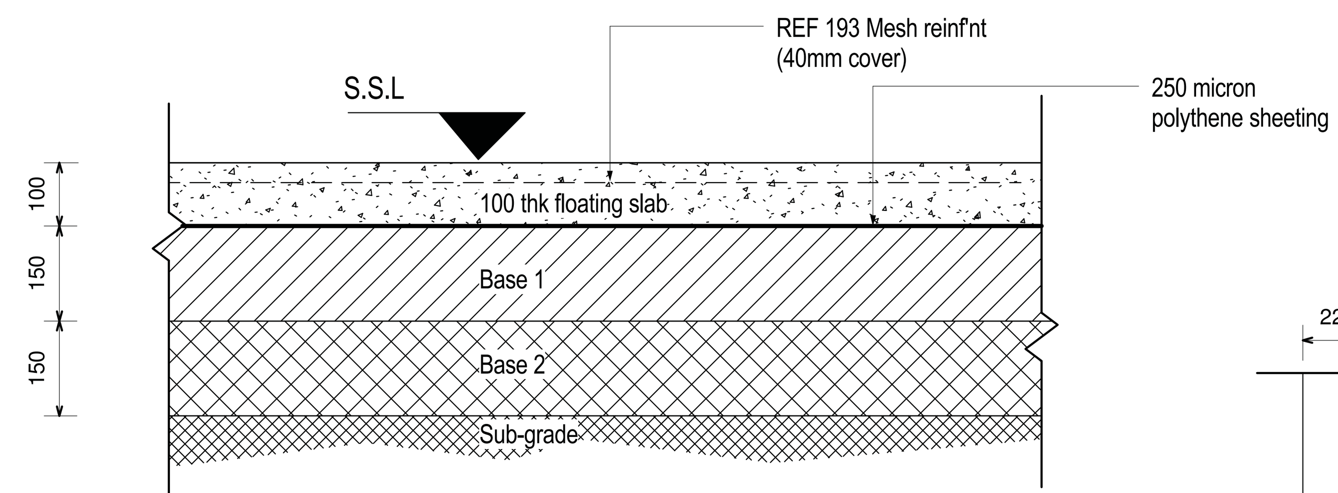
NOTES:

1.Grade of concrete to be 25Mpa

2.Floor slab thickness is 75mm

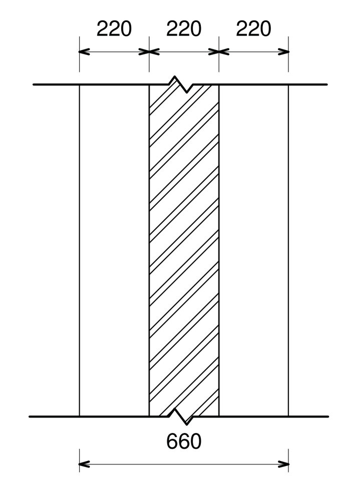


1 Typical cross section detail through external wall
1 : 20



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

2 Floating slab detail
1 : 10



3 Strip footing/wall plan detail
1 : 20

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	D.M
DESIGNED BY	L.M
CHECKED BY	D.M

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CLIENT DATE

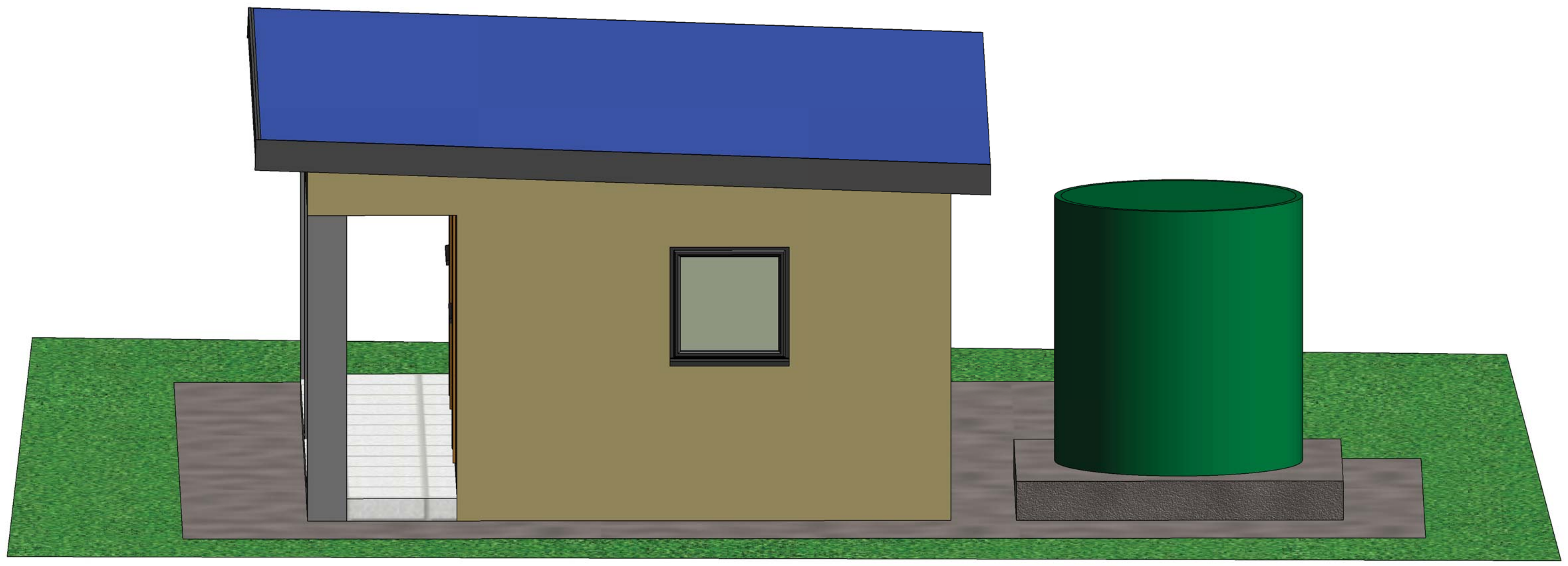
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - GA MOKGOTO

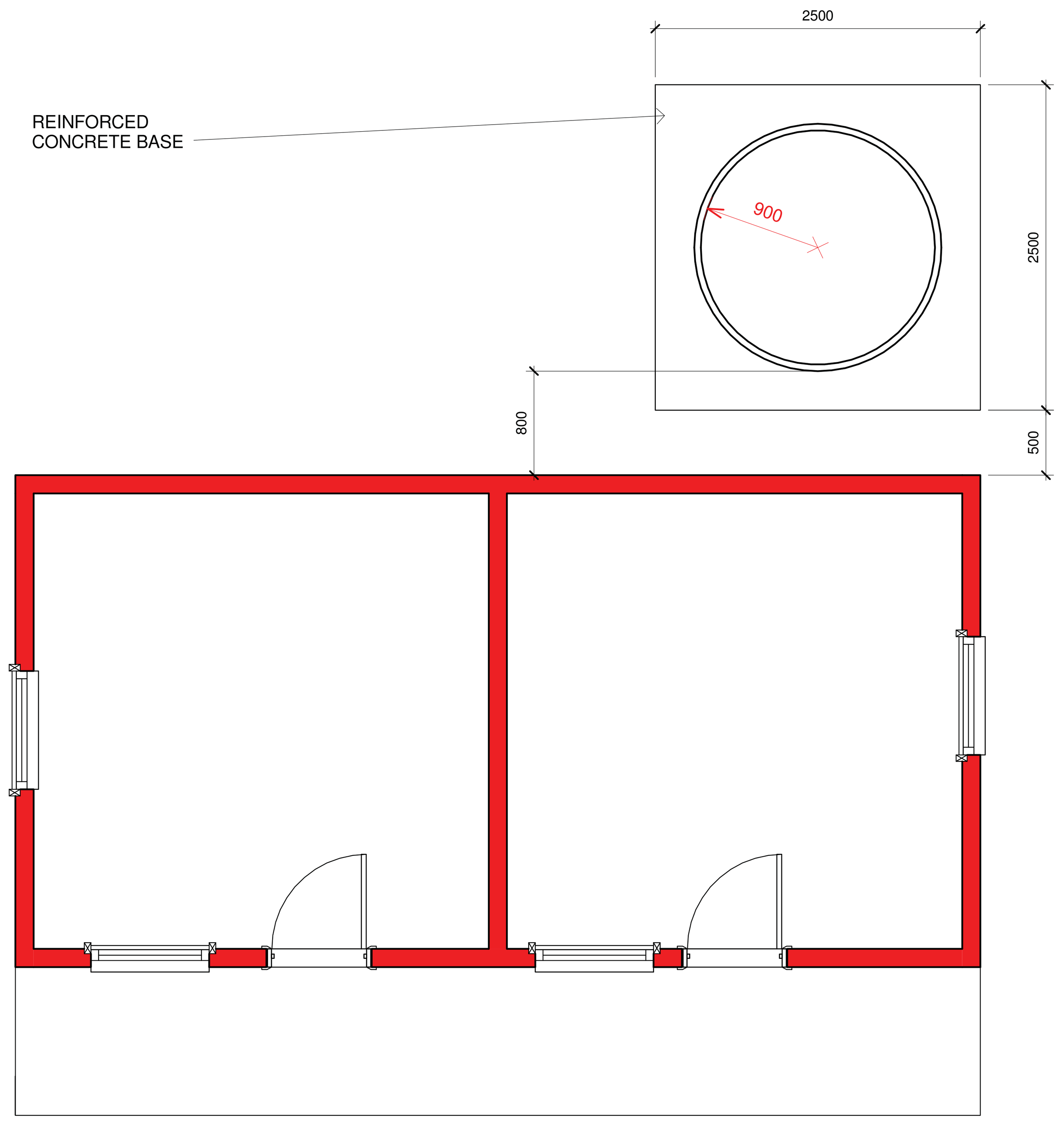
DRAWING DESCRIPTION
PUMP HOUSE FENCING

PROJECT STATUS	SHEET
CONSTRUCTION	K1/12607/1-C09
DATE	SCALE
JANUARY 2018	As indicated
PROJECT NUMBER	DRAWING NUMBER
K1/12607/1	K1/12607/1-C09

K1/12607/1-C09



2 **PERSPECTIVE VIEW**



1 **FLOOR PLAN**
1 : 40

3 **SIDE ELEVATION**
1 : 30

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
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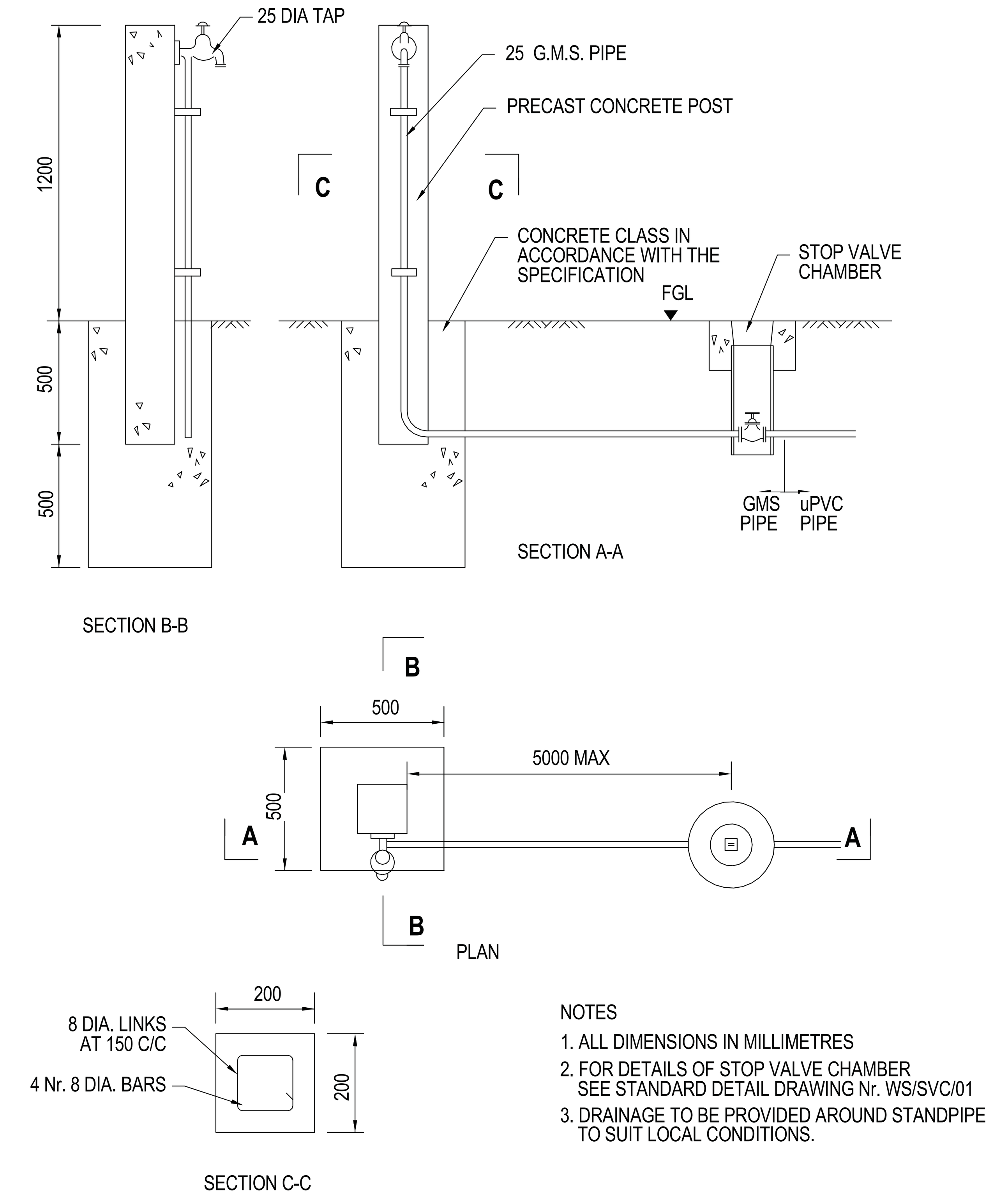
PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - HA-GUMBU

DRAWING DESCRIPTION
RAIN WATER HARVESTING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C06
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C06

K1/2607/1-C06



NOTES
1. ALL DIMENSIONS IN MILLIMETRES
2. FOR DETAILS OF STOP VALVE CHAMBER SEE STANDARD DETAIL DRAWING Nr. WS/SVC/01
3. DRAINAGE TO BE PROVIDED AROUND STANDPIPE TO SUIT LOCAL CONDITIONS.

1 STAND PIPE DETAIL
1 : 1

STAND PIPE - TPYE 1

STAND PIPE - TPYE 2

No	DATE	REVISION	ISSUED BY

DRAWN BY: L.M
CHECKED BY: M.K.Phasha
DESIGNED BY: L.M
CHECKED BY: M.K.Phasha

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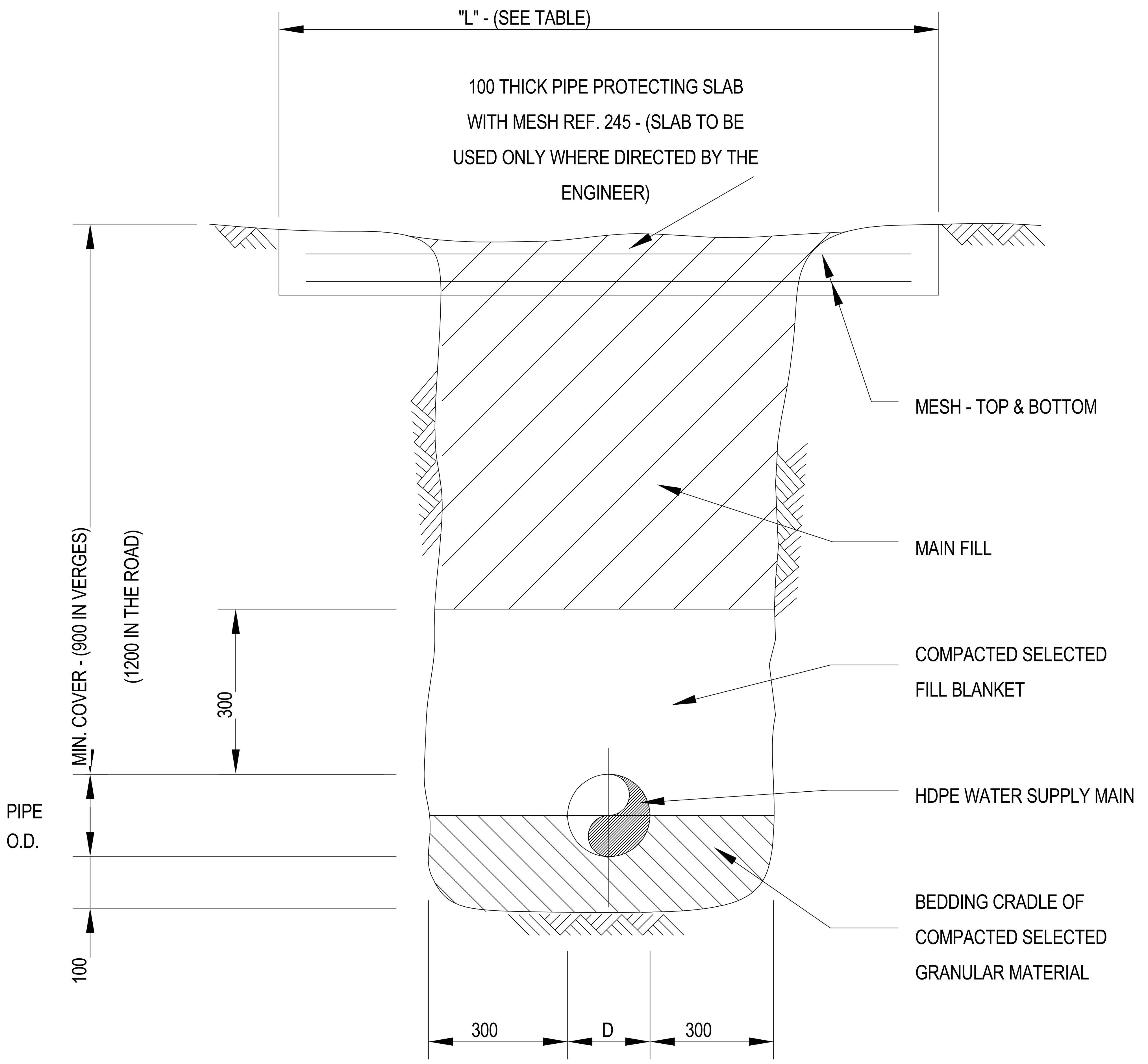
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS: CONSTRUCTION
SHEET: K1/2607/1-C07
DATE: JANUARY 2018
SCALE: 1 : 1
PROJECT NUMBER: K1/2607/1
DRAWING NUMBER: K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE

PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS

1 : 65

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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CHECKED BY	M.K.Phasha

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CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C08
DATE	SCALE
JANUARY 2018	1 : 65
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C08

K1/2607/1-C08

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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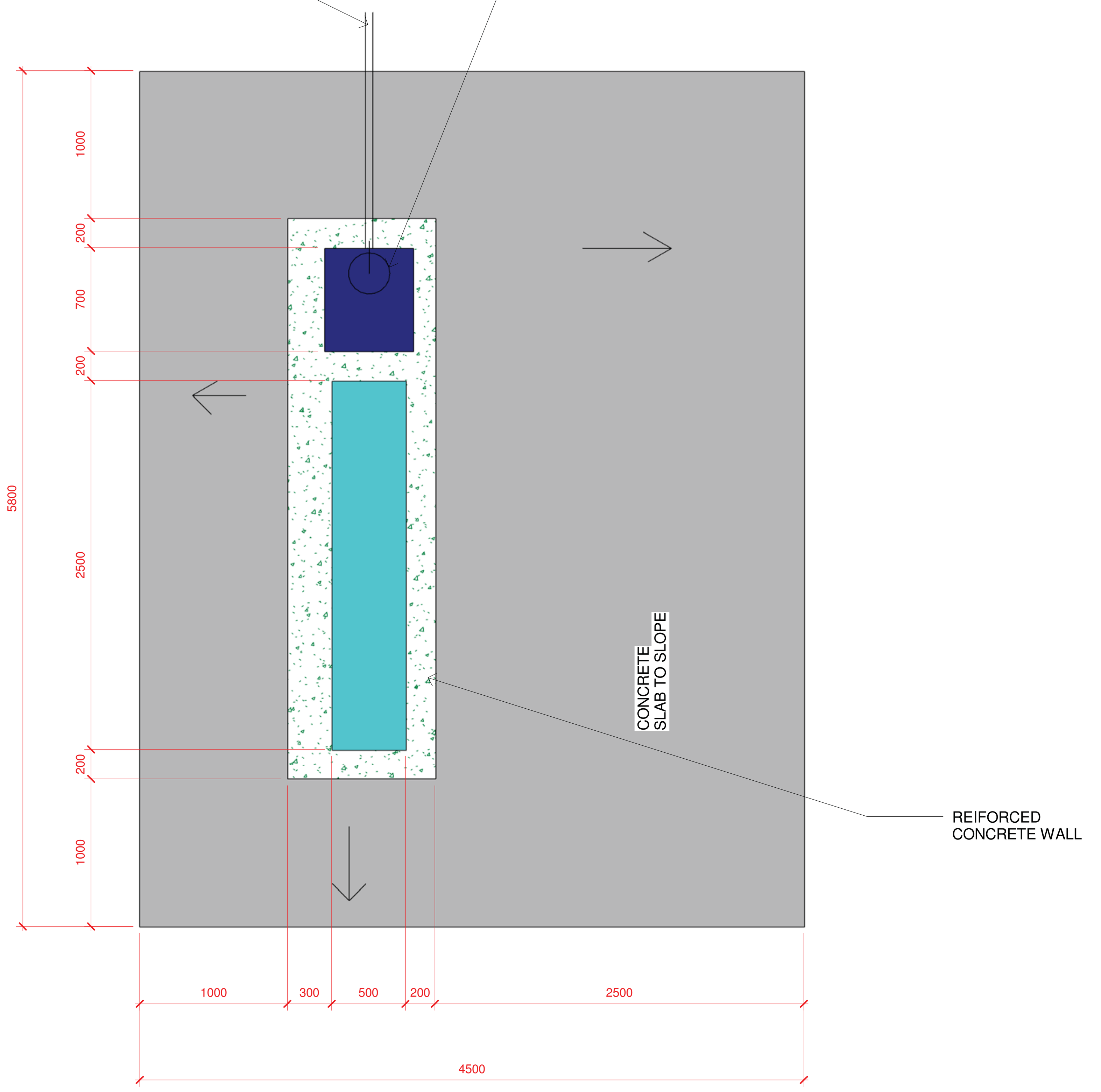
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

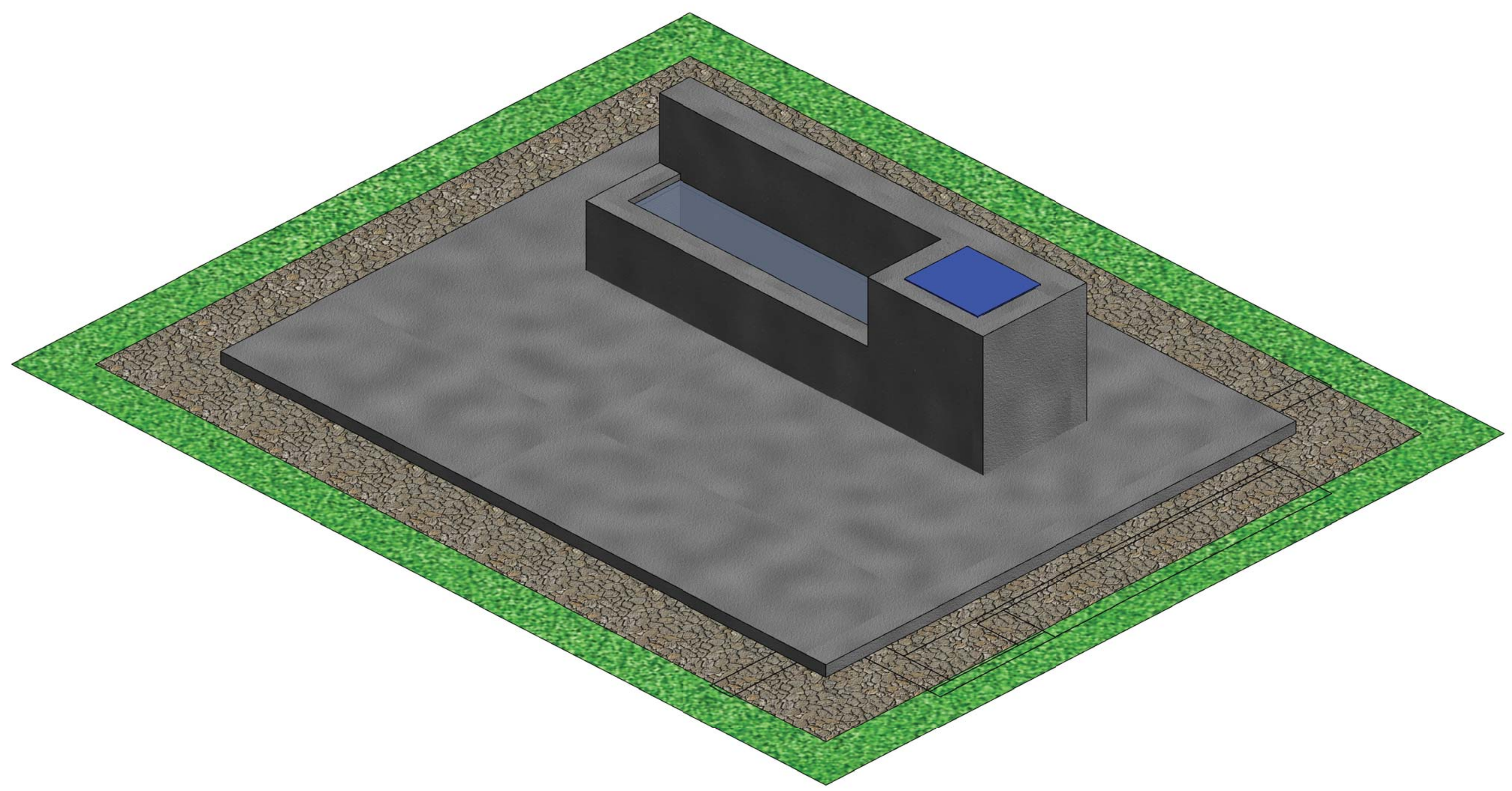
DRAWING DESCRIPTION
HOMESTEAD GARDENS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C09
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C09

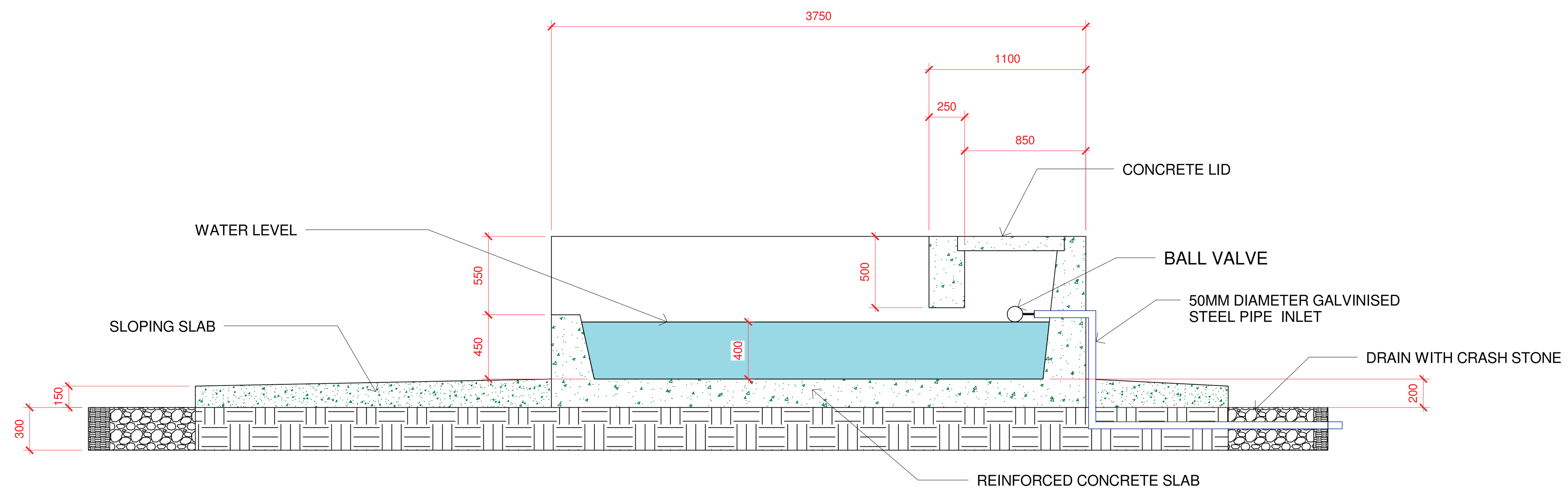
K1/2607/1-C09



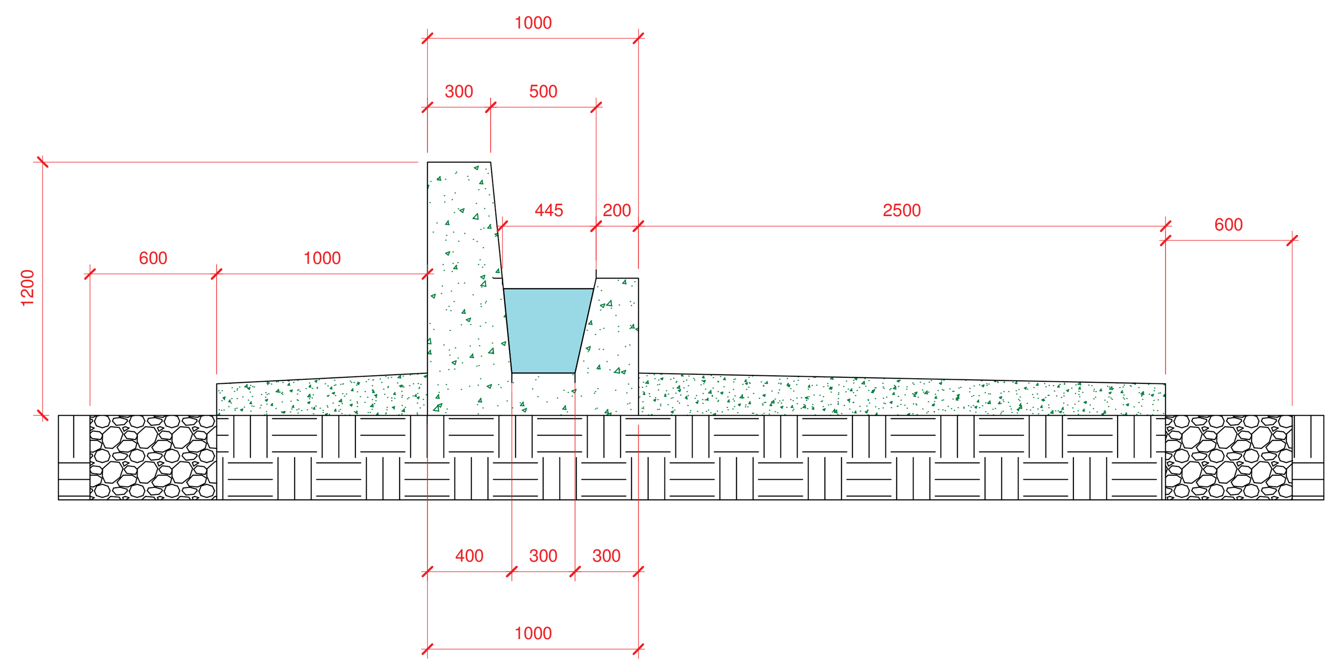
3 FLOOR PLAN
1 : 30



4 3D VIEWS



2 SECTION AA
1 : 30



1 SECTION BB
1 : 30

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
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DESIGNED BY	Designer
CHECKED BY	Checker

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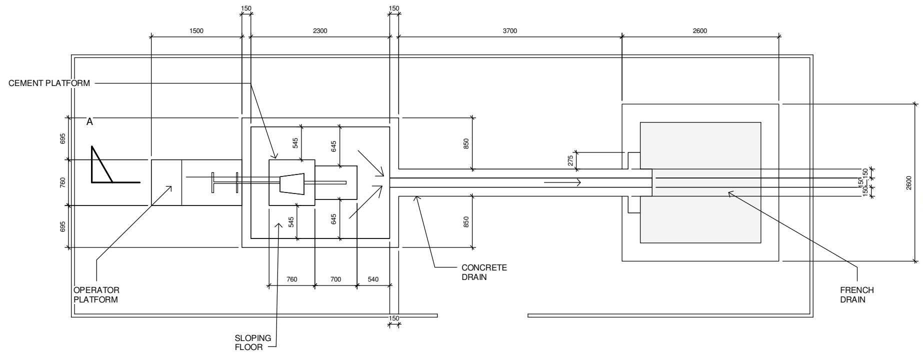
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

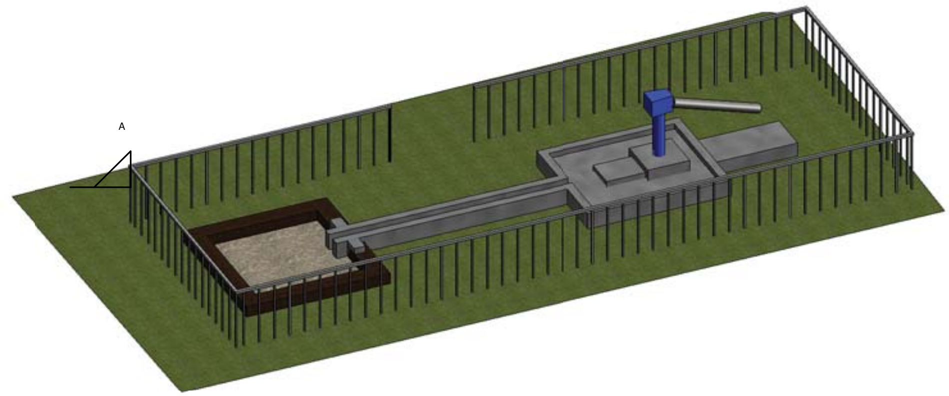
DRAWING DESCRIPTION
LIVESTOCK DRINKING TROUGH -500LITRE

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C10
DATE JANUARY 2018	SCALE 1 : 30
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C10

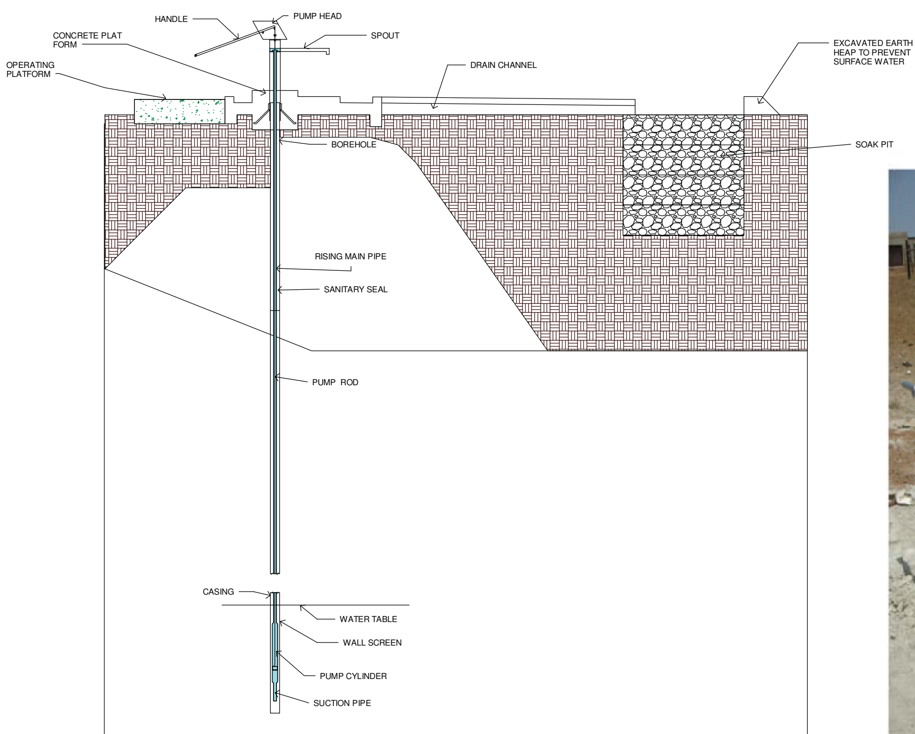
K1/2607/1-C10



1 HAND PUMP FLOOR PLAN
1 : 40



3 {3D}



2 SECTION AA
1 : 40

No	DATE	REVISION	ISSUED BY

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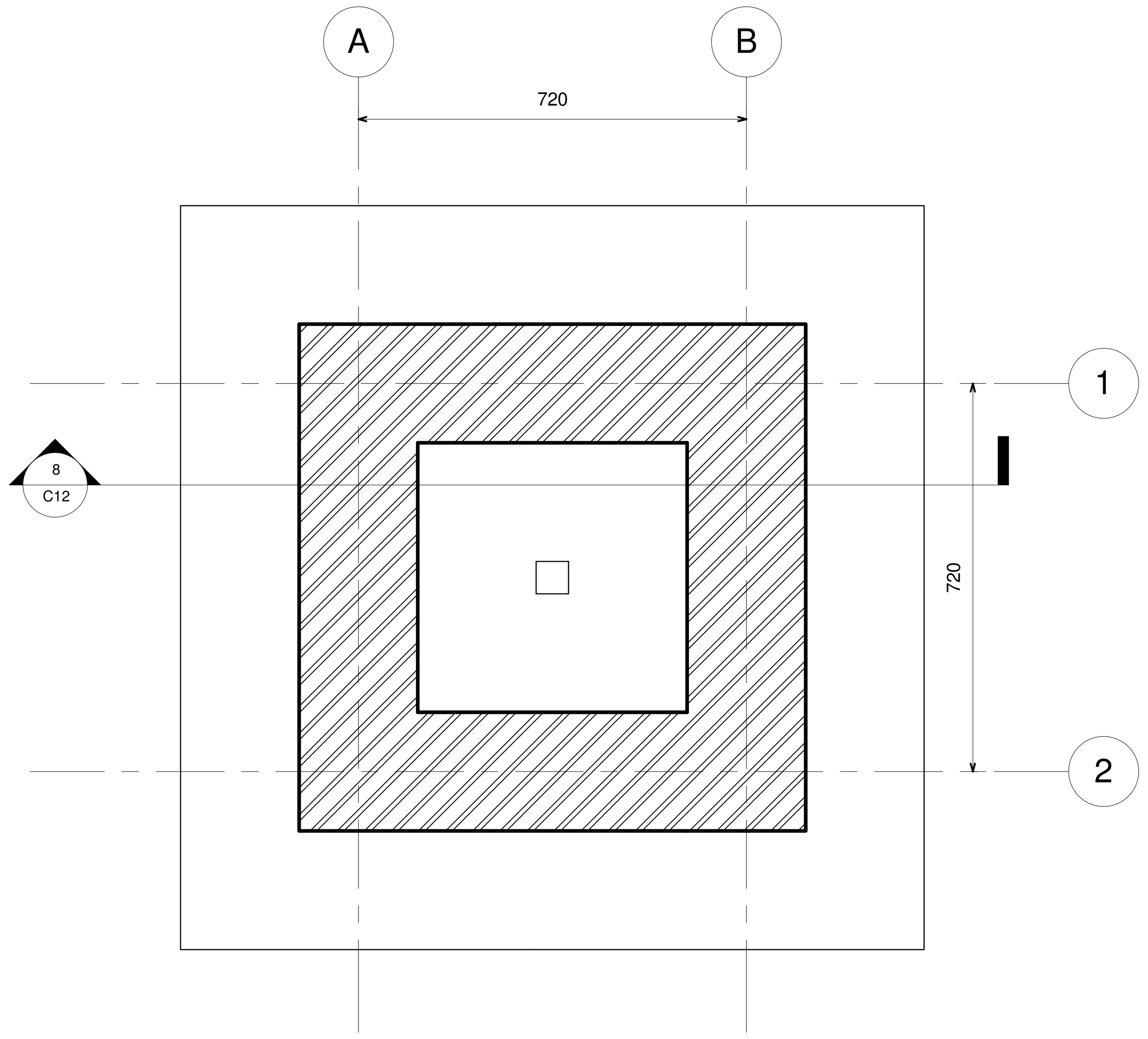
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - HA-GUMBU

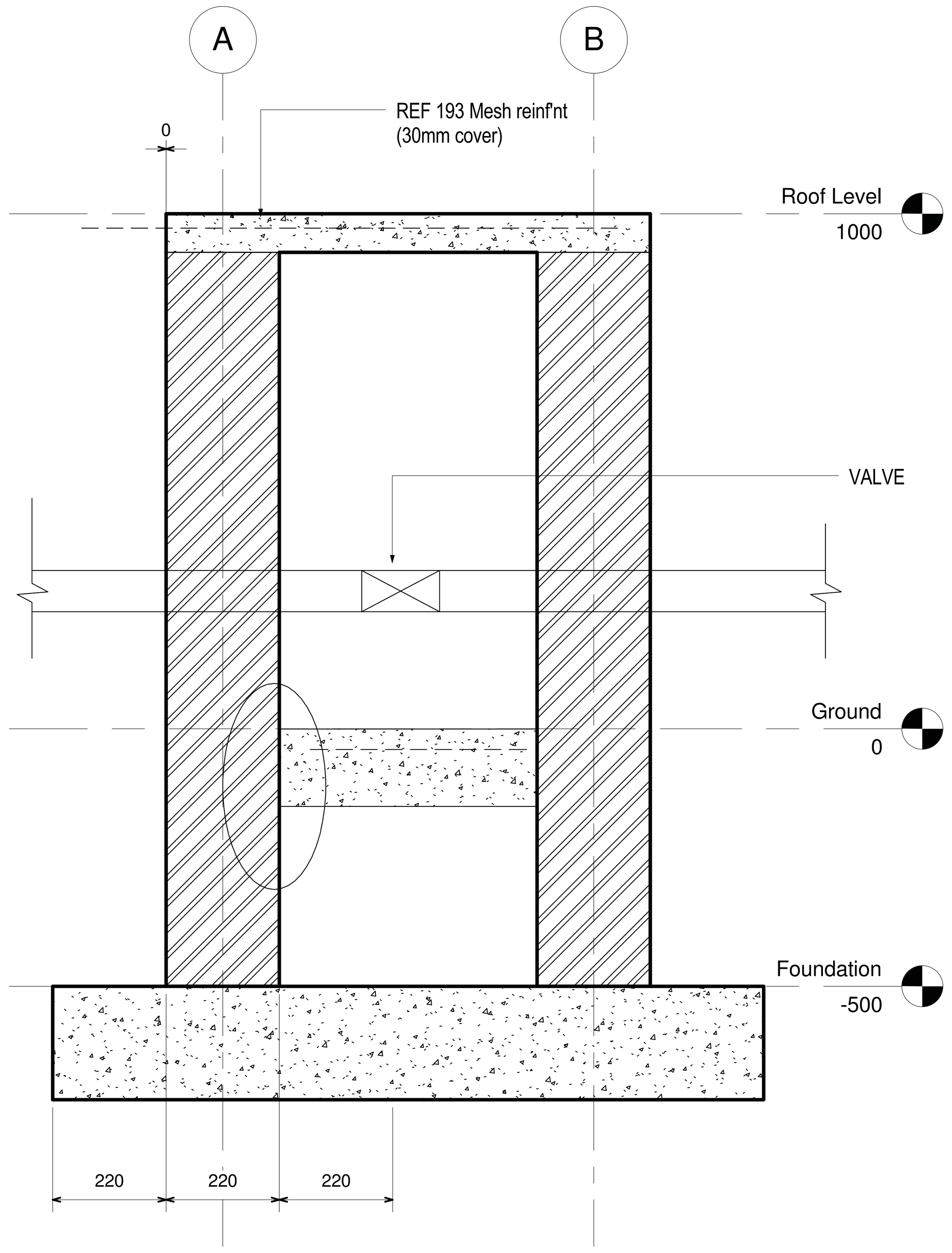
DRAWING DESCRIPTION
HAND PUMP

PROJECT STATUS CONSTRUCTION	SHEET K1/1260/1-C11
DATE JANUARY 2018	SCALE 1 : 40
PROJECT NUMBER K1/1260/1	DRAWING NUMBER K1/1260/1-C11

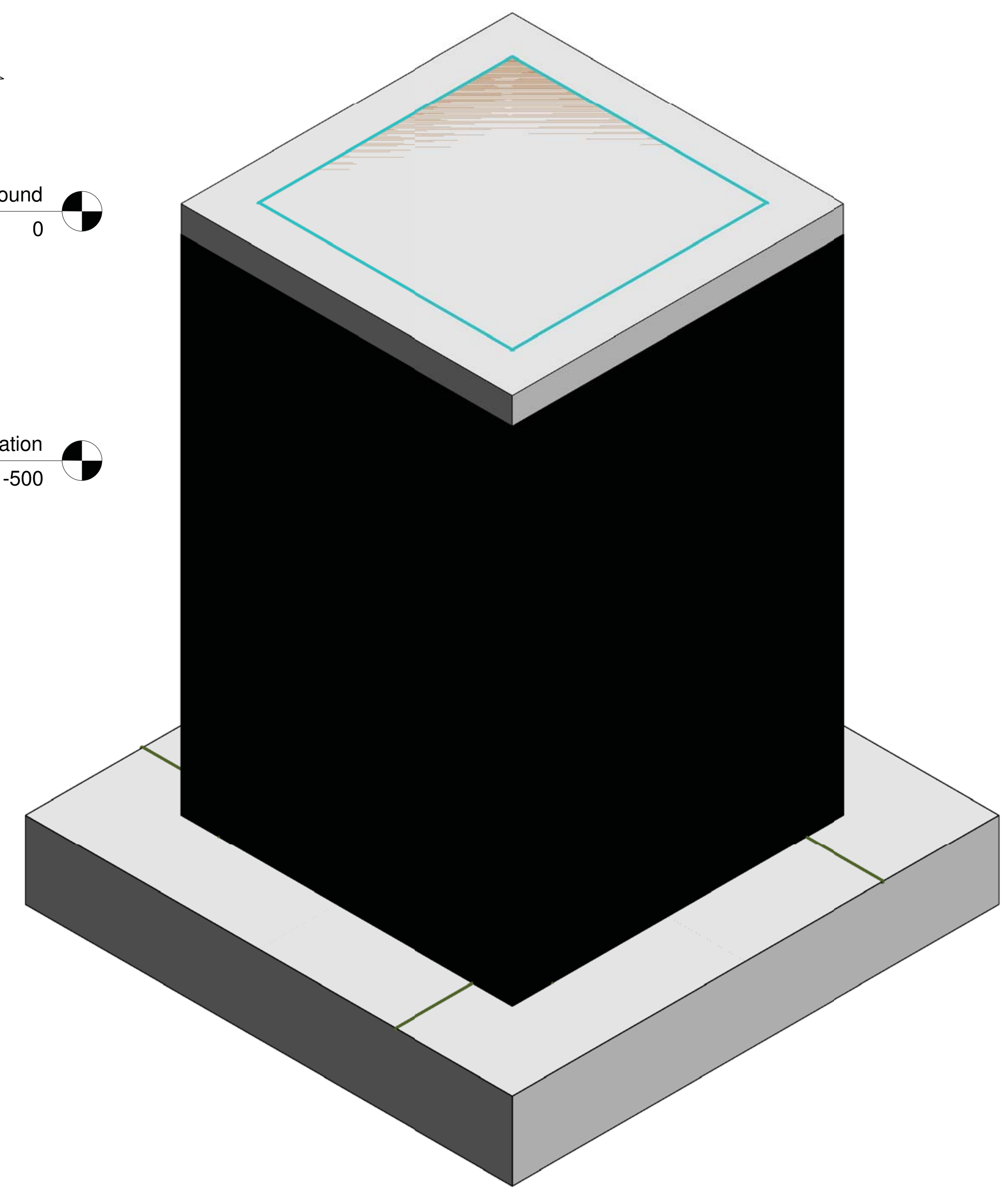
K1/1260/1-C11



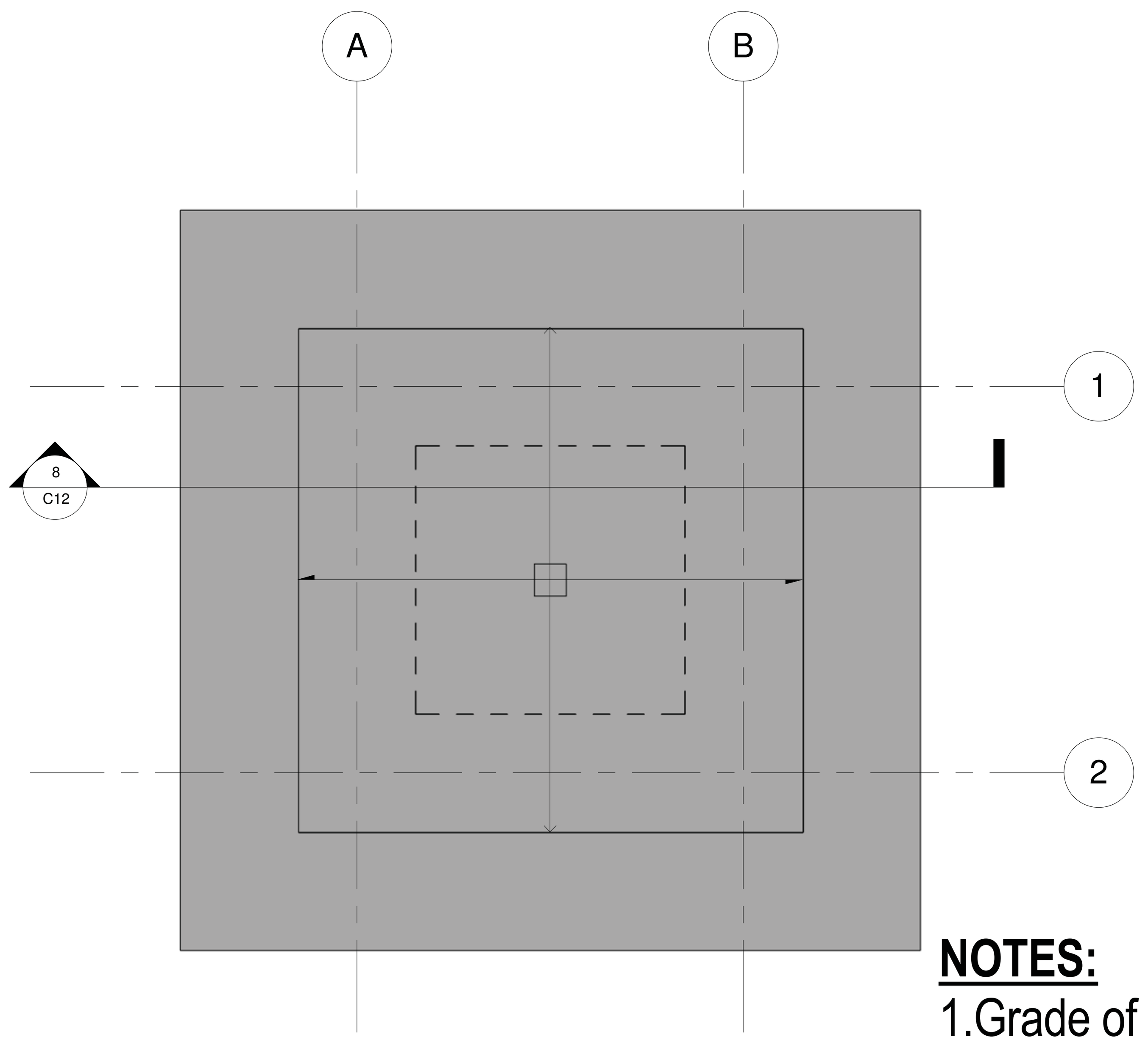
6 00 Foundation (TOF)
1 : 10



8 Section 1
1 : 10



7 {3D}

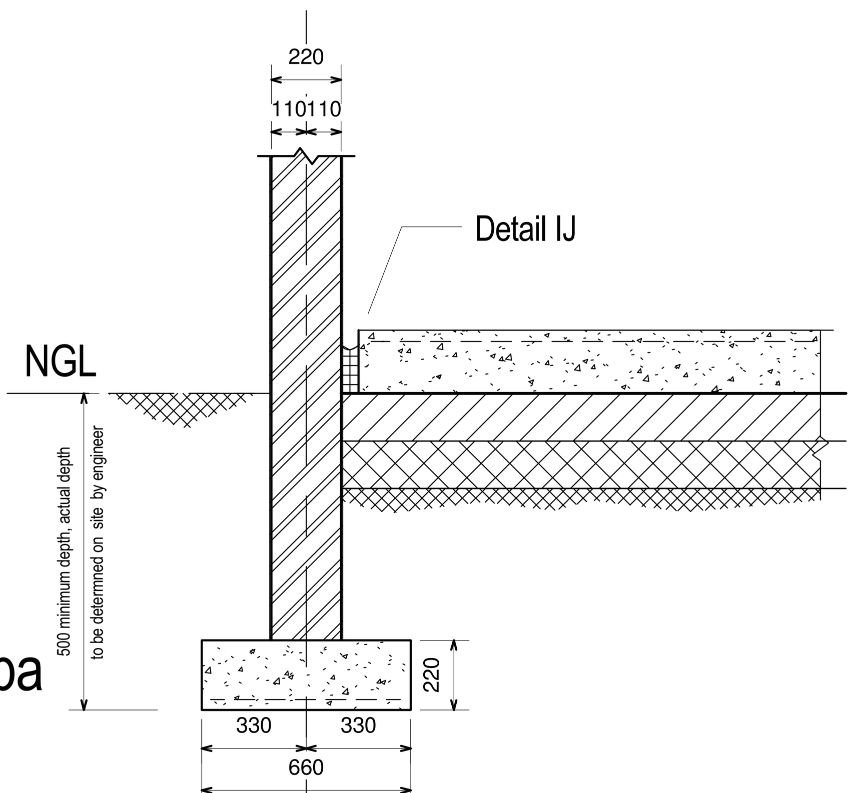


5 00 ROOF LEVEL
1 : 10

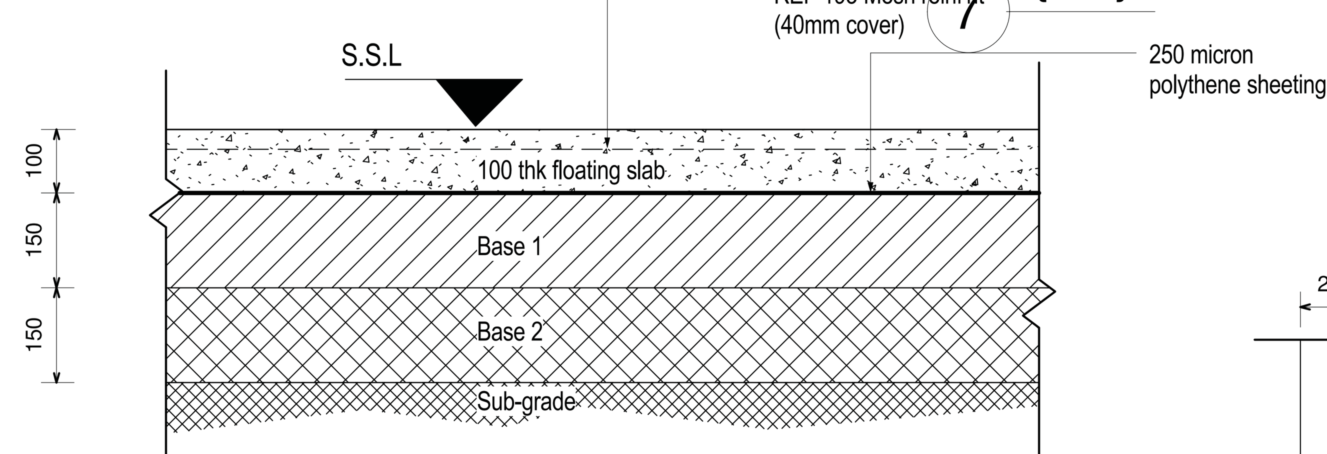
NOTES:

1.Grade of concrete to be 25Mpa

2.Floor slab thickness is 75mm

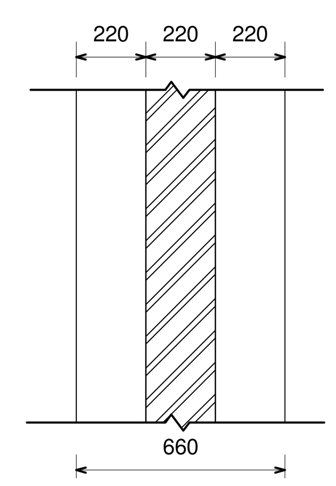


1 Typical cross section detail through external wall
1 : 20



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

2 Floating slab detail
1 : 10



3 Strip footing/wall plan detail
1 : 20

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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CLIENT | DATE

CONSULTING ENGINEER | DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - HA-GUMBU

DRAWING DESCRIPTION
VALVE BOX

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C12
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C12

K1/12607/1-C12

Appendix 4

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft Design information for Khalavha

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

- FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

  A. PHIRING

  B. GA-MOKGOTHO

  C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

- MAKHADO LOCAL MUNICIPALITY

  A. TSHAKHUMA

  B. KHALAVHA

  C. HA-GUMBU

__**Prepared by:**__
Tsogang Water and Sanitation
P.O. Box 1111
Tzaneen, 0850

Work Design and Summary of the Diagnosis report.

I. Description of the village.

Khalavha is in Ward 32 of Thulamela Municipality, the village is situated 30 km north-west of Thohoyandou, along the R523 tar road. The population is poor and just-above poor; especially many men migrate. Closeness to this main road, good rainfall and fertile soils represent potential for more cultivation and trade of, for example, rain fed avocado trees and irrigated vegetables or other water-dependent produce. However, access to water infrastructure is a limiting factor. The municipal system is unreliable and population is growing. All six sections have started developing private gravity piped infrastructure. The village has six sections: Halvah Thomson, Tshikhalani, Matserere A, Matserere B, Mutavhani, and Luvhumbo, and is governed by the ward and its councillor and committees, blocks, and the tribal authority and council (which, since 1994 also includes some women). Since some five years, civic committees were constituted for keeping order; they are now being federated into one civic. In this initial phase of MUS in Limpopo only the one section (Thondoni) of Khalavha is being addressed. The purpose of this is to provide an easily accessible site for upscaling activities with other funds (to be identified: hopefully IDP).

II. Current Water Resources.

There is an existing none functional municipality water scheme in the village operated and maintained by Vhembe District Municipality, water services from this system are poor. After experiencing serious water problems in the area the community initiated their own water scheme in the area, the source is two streams flowing from top of the mountains right inside the plantation own by Komati land. They grouped themselves and contribute funds to invest in this project to meet community's water demand. The two volunteers in the village help them to design and draft a list of materials mainly poly pipes and fittings to connect water from the intake. The diameter of the pipes differs from, one size to another and water is connected to each households.

III. Water Quality test.

After Tsogang water and sanitation's consultation with Vhembe District Municipality's water quality test unit, officials went to Khalavha and collected water samples from the sources. Samples were tested and there no signs of any chemical or bacteria that affects the quality of water for both domestic and productive use.

NB: Please find attached water quality test results for Khalavha.

IV. Design horizon for domestic and productive use supplies.

Village name	Current population	Current households	Design population (20 years)	Minimum water need (Litres/day)	Currently available source quantity (Q) (Litres/day)	Excess Q Available for MUS over minimum requirement
Khalavha	815	163	1020	25500	92 448	66948

V. Available water for Multiple Use Water Services, delivery pipe size and head loss calculations.

VI. Measurements at site									Selected		Calculated		
System	**From**	**Elevation M**	**To**	**Elevation m**	**Elev Diff (H_d) m**	**Min H m**	**Q l/s**	**Pipe length M**	**Pipe dia. mm**	**Pipe Class**	**H_f m/100m**	**Total head loss m**	**Residual head m**
Khalavha	**Source**	**1123**	**Storage**	**1089**	**34**	**10**	**1.07**	**2600**	**40**	**6**	**0.7**	**18.2**	**15.8**

VII. Proposed works at source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge.

- **Two** S**prings/streams require refurbishment for coll**ection chamber**,** activities to be carried out are: transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers, plus overflow and delivery pipes, erect diamond mesh fencing around intake site, dig surface runoff diversion ditch around site. Two sources combined provide 92 448 litres of water per 24 hours to supply 135 households projected to be in the area. Once the system has been improved each household will have access to 685 litres of water per day for domestic and multiple use water services. Leading to each person receiving 136 litres per person per day from this system alone as opposed to infrequent and unreliable supply from the government system.

- **Install 5 x 10 000 litres and 500 litres jojo tanks** to serve as the storage, the 500 litres will serve as a sieve for dirty before water get into the other tanks. Currently there is no water storage for the system. During participatory consultative meetings members proposed a need for storage as pipes run dry daily because they don't have a mechanism to store water. Currently the source provides 92 448 litres a day which can be improved and the proposed storage is 50 000 litres which is enough to serve 163 households with water for domestic and multiple use. Activities will include clearing vegetation, dig foundations, transport materials, cast concrete slabs, install jojo tanks with anchor ties, connect source pipe and delivery connections.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 1100m translating into 183 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connection**, connect water supply system to individual household yards for about 163 households, water is used for domestic and productive use. Households promised to buy materials and provide labour to have this activity completed. The main reason being communal stand pipes are not sustainable, children play with them and there are issues of vandalism. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Khalavha need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point to allow streams to continue flowing and provide animals drinking spots. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

- **Tsogang to train community members on basic technical** skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional Social Development. Capacity building will takes in the village using available community resources like community halls and churches. Learners will be given food and provide with the necessary training materials like handouts, pens and note books.

- **Homestead interventions,** community members will identify members to be trained in brick tank stand construction, guttering fitment, tank installation and assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives agreed the area. Materials to be used are HDPE pipes, concrete, stand pipes, jojo tanks, taps, fittings and control valves.

VIII. Implementation phase, time frame and the methodology.

- The scope of works include the following, installing the pipeline from the source to the storage, connect water to households, extend the reticulation, homestead interventions, capacity building, water storage development and will be implemented in six months using community labour from Khalavha and officials from Tsogang for activities that require special skills and knowledge. Workers will be recruited from the community using a legal entity called close co-operatives in the village to manage the implementation at local level and pay stipend based on tasks complete with the help of Tsogang Water and Sanitation’s supervision

IX. Procurement of Goods and Services.

- **Materials for the multiple use water services project** will be procured in Limpopo Province using local suppliers in the area and nearby towns like Polokwane, Tzaneen, Burgersfort, Thohoyandou and Jane Furse. Purchasing can only take place outside the Province for items that cannot be found or procured in the Province. Khalavha material orders will be placed with suppliers separately from other villages and three quotations will be gathered using a shopping exercise. All the procurement documents like quotations and close co-operatives documents will be submitted to the Water Research Commission for the procurement process to be finalised. Tsogang will create a filing system to keep all project documentation in good order for future references and accountability**. See the Proposal note for information.**

X. Project Costs, lots of materials and stipend rates.

Below is a summary of cost to increase the availability of water in the village for domestic and irrigation, refurbish the existing infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small businesses

Khalavha

Lot number	Item	Material costs	Lots material	Stipend	Total	Remarks on Stipend.
1	**Water Storage Development.**	85 028.44	1X500 litre jojo tank, 5X10 000 litre Jojo Tank, 3XRiver sand 3 cubes load, 4XFilter Amiad 40mmx 20mm 8 bar, 6X40mm male adaptors, 40X42.5 ppc cement, 800 X Maxi Bricks, 2X Building sand,1,5 X19mm Concrete 3 cubes Load, 0.5 Building sand.	10 950.00	95 978.44	Builder =7500.00, Assistance =3450.00
2	**Water Storage Fencing**	18 540.93	2xWelded Mesh 1.8m x 30m,8x Standard security Pole 2.4m, 12x Standard security Pole 2.4m, 12xStay 2.4 Hd,12x Stay Bolt M10 x 100, 1xPlain wire 4mm x 50kg, 1xSecurity Gate 1.8m single,1x Plain wire 1.6mm x 5kg, 2x42.5 ppc cement, 0,5x River sand 3 cubes load, 19mm Concrete 3 cubes Load.	3 200.00	21 740.93	Team leader= 2000.00, Assistance 1200.00
3	**Water Source Development.**	11 263.20	40x42.5 ppc cement, 1.5 x River sand 3 cubes load, 1x19mm Concrete 3 cubes Load,12xY12 reinforcement, 500 x Maxi Bricks, 1xBuilding sand,8mx Shade Netting 95% 1m x 3m, 10xBrick force.	9 250.00	20 513.20	Builder =5250.00, Assistance =2400.00. Plumber=1600.00
4	**Water Source Fencing**	18 540.93	2xWelded Mesh 1.8m x 30m,8x Standard security Pole 2.4m, 12x Standard security Pole 2.4m, 12xStay 2.4 Hd,12x Stay Bolt M10 x 100, 1xPlain wire 4mm x 50kg, 1xSecurity Gate 1.8m single,1x Plain wire 1.6mm x 5kg, 2x42.5 ppc cement, 0,5x River sand 3 cubes load, 19mm Concrete 3 cubes Load.	3 200.00	21 740.93	Team leader =2000.00, Assistance =1200.00
5	**Water Main & Reticulation Pipeline**	107 500.00	1x110mm HDPE cls 6, 2x90mm HDPE cls 6, 2x75mm HDPE cls 6, 1x63mm HDPE cls 6, 12x40mm HDPE cls 6, 10x25mm HDPE cls 6, 1x110mm to 90 mm reducer, 1x90mm to 75 mm reducer, 1x75mm to 63 mm reducer, 1x 63 mm to 40mm reducer, 1x63mm to 40 mm reducer, 3x75mm UPVC pipe class 6, 3x80mm x steel pipe 40 x 42.5 PPC Cement, 2x 19mm Concrete 3 cube Load, 50xY12 reinforcement, 2xRed Oxide Paint X 10 litres,500x Maxi Bricks,3x River sand 3 cubes load, 15x40mm to 20mm saddle,163x40mm to 25mm ,326x 20mm elbow f/f galv, 163x20mm x 1m stand pipe galv,20x20mm tap cobra, 10x40mm male adaptor,6x 40mm Valve Ball, Pipe Galvanised x 32mm,, 179x9x40mm x 40 mm coupling,4x40mm Air Valve, 4x Socket Red Galv 50x40mm, 20x50mm clamps, 12x50mm nylon adaptor, 1x75mm HDPE coupling, 9x 40mm HDPE coupling, 163x 25mm female elbow, 9x 25mm coupling, 1x Buiding sand.	30 000.00	137 500.00	1800m /6m=300 X R100.00= 30000.00
6	**Animal Drinking trough.**	6 330.00	10 x42.5 PPC Cement, 10xY12 reinforcement, 1x River Sand 3 cubes load, 1x 19mm Crushers 3 cube Load, 600x Cement Bricks	3 250.00	9 580.00	Builder =1250.00, Assistance=1200.00, Plumber= 800.00
7	**Homestead Int**	36 179.95	10x2500 litres Jojo Tank, 10x gutters and fittings	7 000.00	43 179.95	Builder =5000.00, Assistance= 2000.00.
8	**Store Room**	9 000.00	6 Months X Store room	-	9 000.00	N/A
9	**Plant Hire**	16 200.00	6 X Months Plant hire		16 200.00	N/A
	Total	308 583	-	66 850	375 433	

NB: Project Cost Including Vat R375 433

XI. Please find below Khalavha drawing booklet.

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02
LAYOUT DRAWING	00	1 OF 1	K1/12607/1-C03
CONCRETE SLAB FOR JOJO TANKS	00	1 OF 1	K1/12607/1-C04
SPRING PROTECTION AND SPRING BOX	00	1 OF 1	K1/12607/1-C05
RAIIN WATER HARVESTING	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILS	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08
HOMESTEAD GARDENS	00	1 OF 1	K1/12607/1-C09
LIVESTOCK DRINKING TROUGH	00	1 OF 1	K1/12607/1-C10
PIPE LINE DETAIL AT RIVER CROSSINGS	00	1 OF 1	K1/12607/1-C11
WATER STORAGE FENCING DETAILS	00	1 OF 1	K1/12607/1-C12

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
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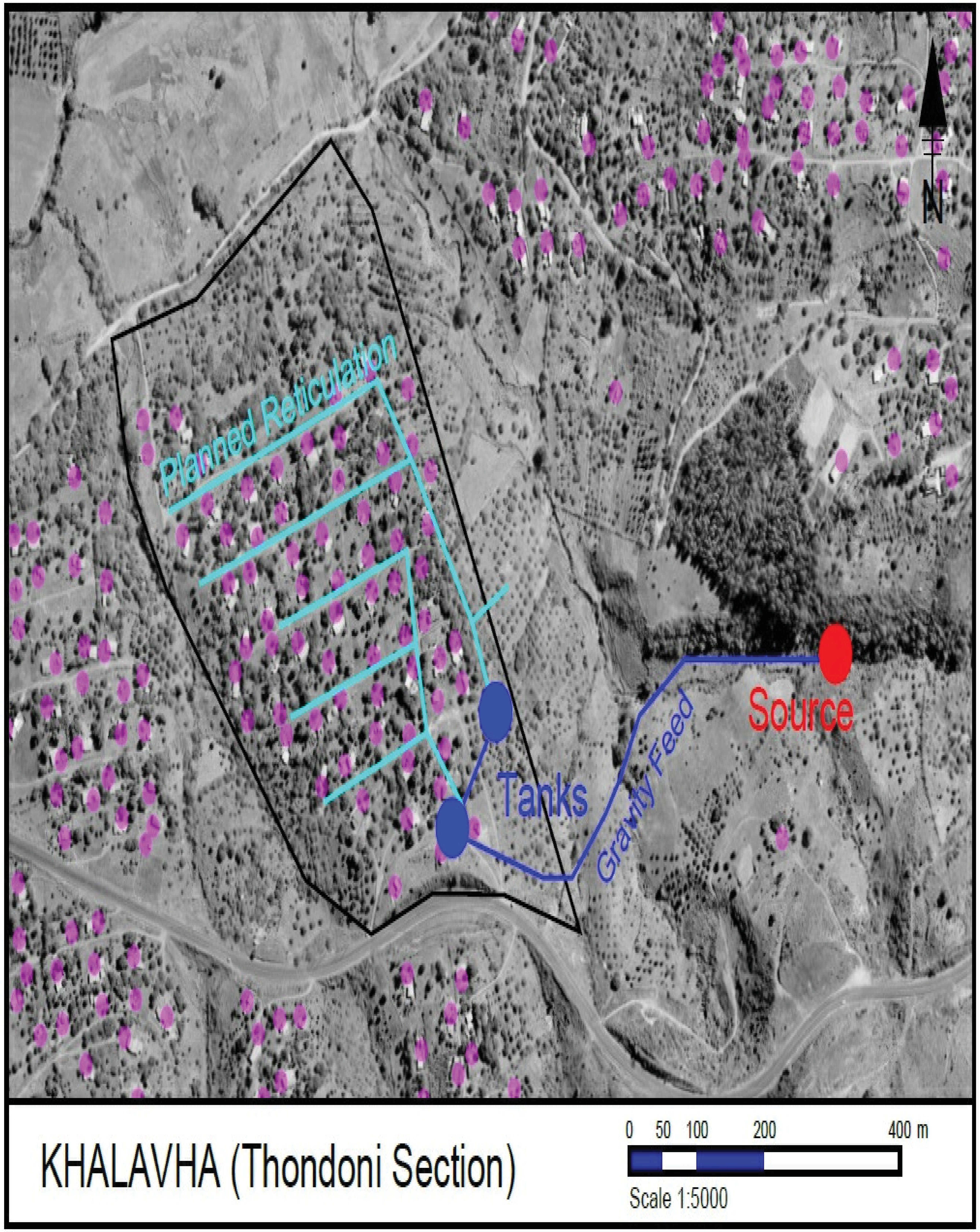
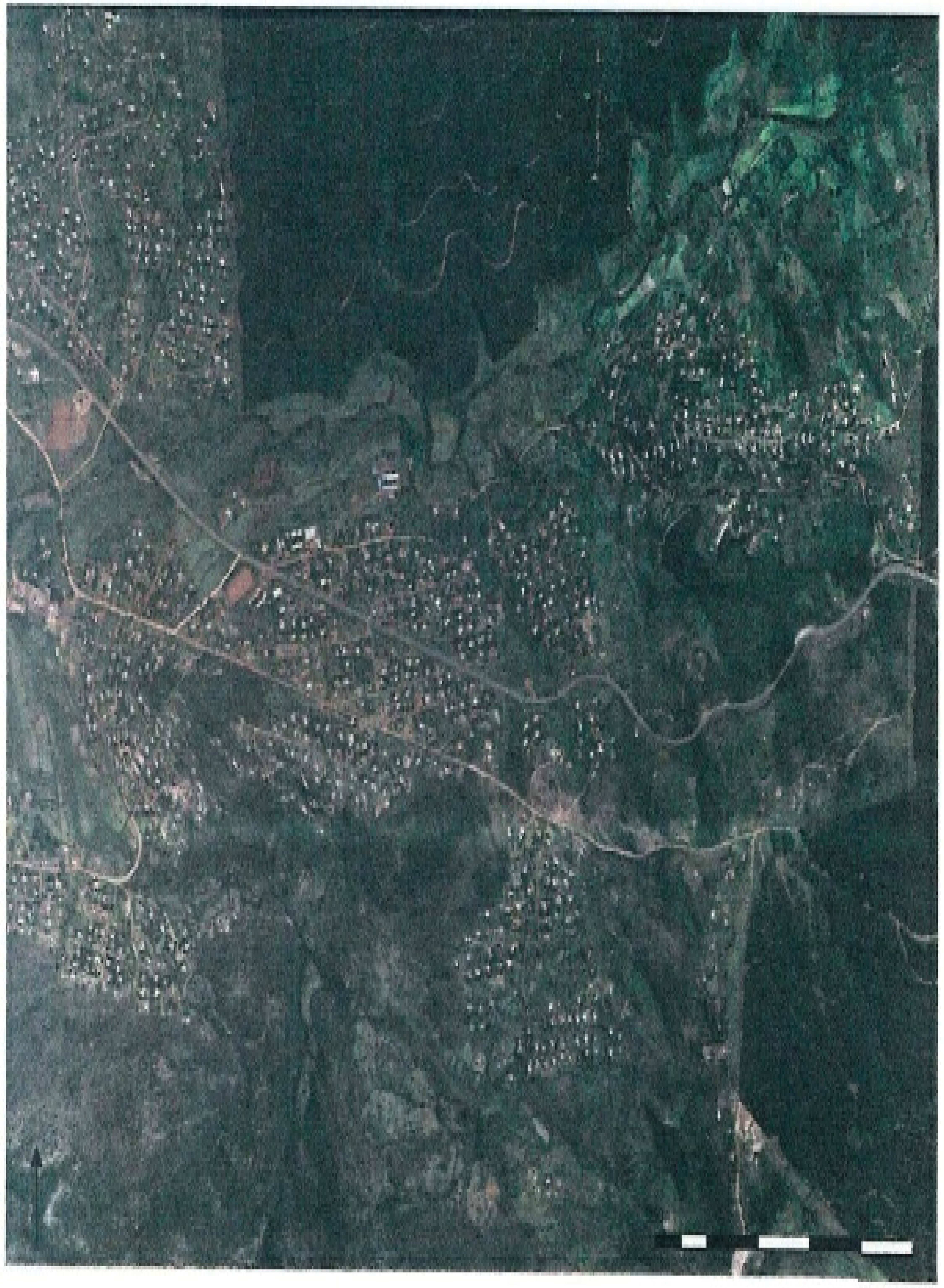
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01





Map 1 Khalavha with Thondoni section

No	DATE	REVISION	ISSUED BY

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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

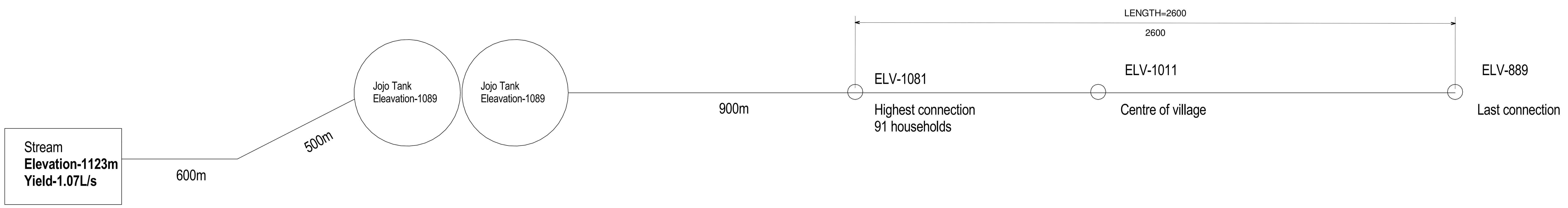
DRAWING DESCRIPTION
LOCALITY PLAN

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C02
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C02

K1/2607/1-C02

WATER AVAILABLE

1.07 L/s x60x60x24=92 448 L
92 448L/91 Households=1016L/HH/Day
If we assume 50L P/P/Day,
We still have 119/Day available
for agriculture (Total 65kL/Day)



PROPOSED WORKS

1. Construct concrete slabs on the ground for jojo tanks as per drawing - K1/2607-C04
2. Protect spring with fencing as per drawing K1/2607-C05
3. Construct rainwater harvesting structures as per drawing- K1/2607-C06
4. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
5. Lay new pipeline as per drawing K1/2607-C08
6. Provide water supply to homestead gadernd as per drawing - K1/2607-C09
7.Construct livestock drinking troughs as per drawing- K1/2607-C10
8.Construct pipeline supports at river crossings as per drawing- K1/2607-C11

No	DATE	REVISION	ISSUED BY

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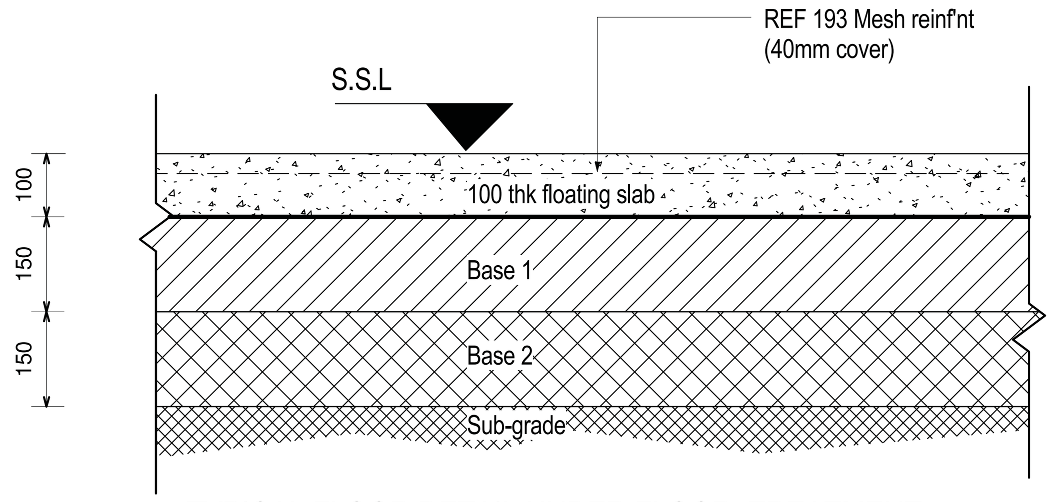
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
LAYOUT DRAWING

PROJECT STATUS **CONSTRUCTION**	**SHEET** **K1/2607/1-C03**
DATE **JANUARY 2018**	**SCALE** **1 : 35**
PROJECT NUMBER **K1/2607/1**	**DRAWING NUMBER** **K1/2607/1-C03**

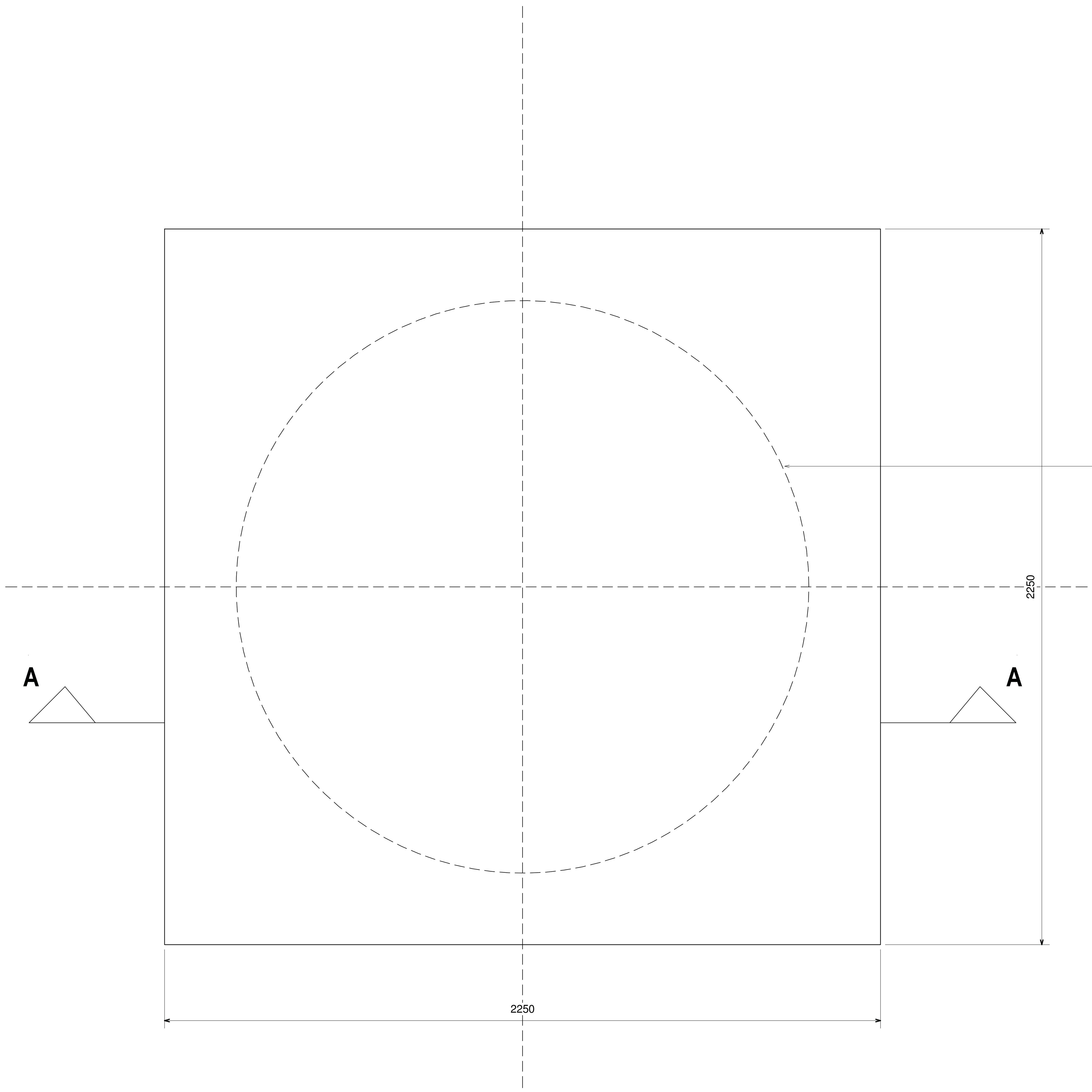
K1/2607/1-C03



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

SECTION A-A

NOTES:
1.Grade of concrete to be 25Mpa
2 Ground slab thickness is 100mm



1 GROUND TANK STAND SLAB
1 : 10

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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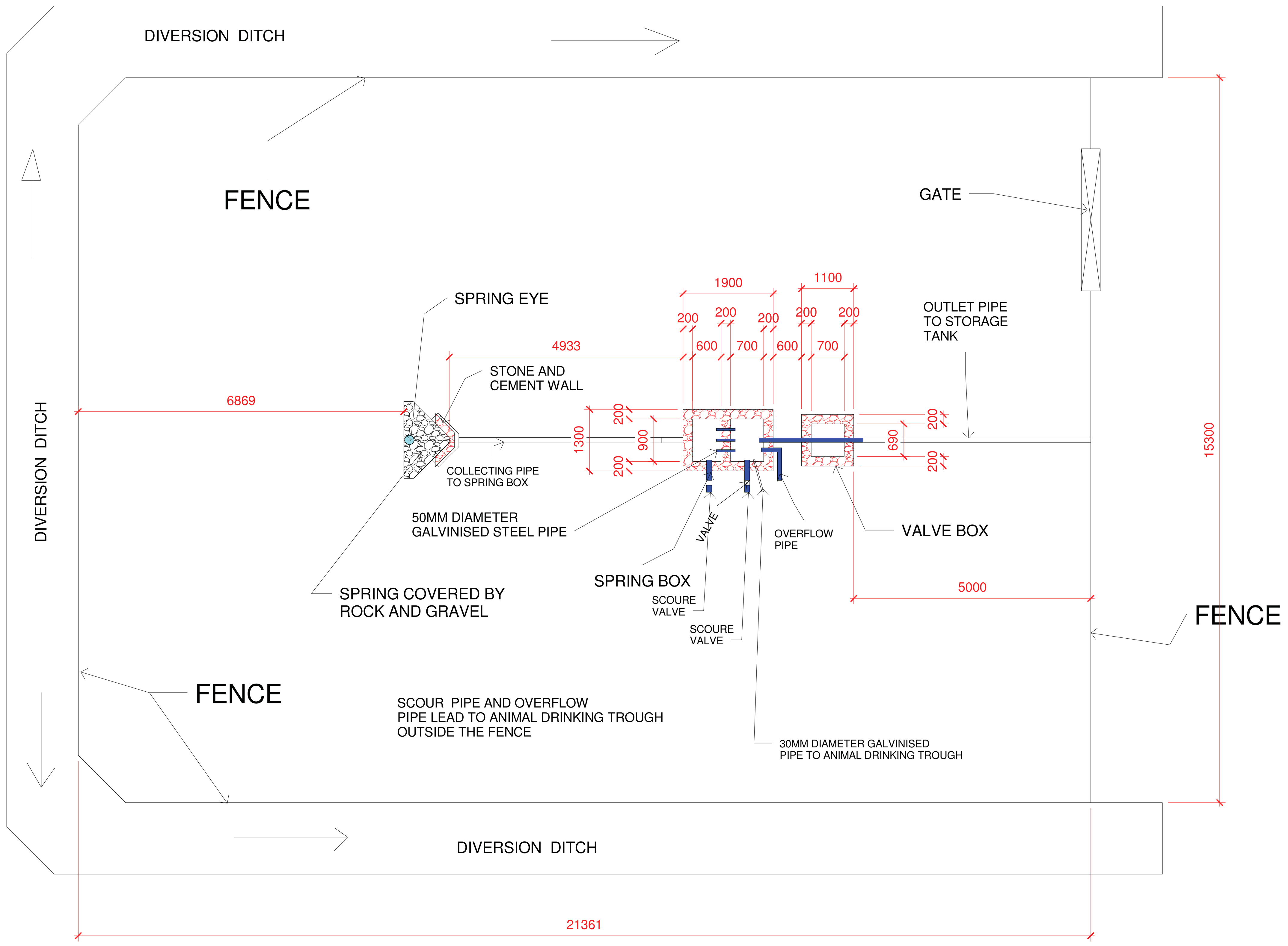
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
CONCRETE GROUND SLAB FOR JOJO TANK

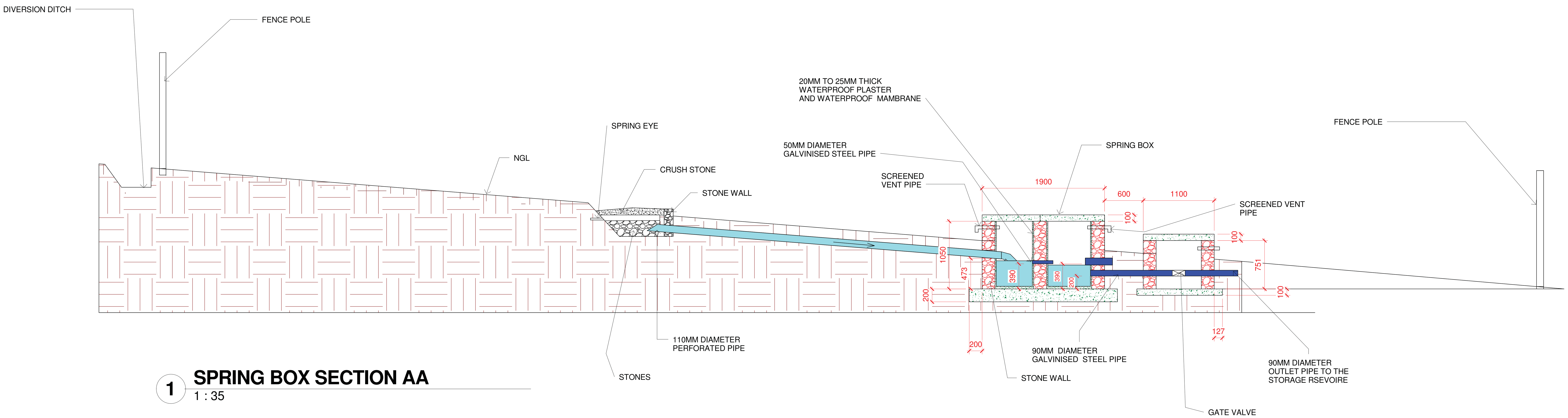
PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C04
DATE	SCALE
JANUARY 2018	1 : 10
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C04

K1/2607/1-C04



2 SPRING BOX AND SPRING PROTECTION PLAN
1 : 80

3 3D VIEW



1 SPRING BOX SECTION AA
1 : 35

No	DATE	REVISION	ISSUED BY

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WATER RESEARCH COMMISSION

Owner

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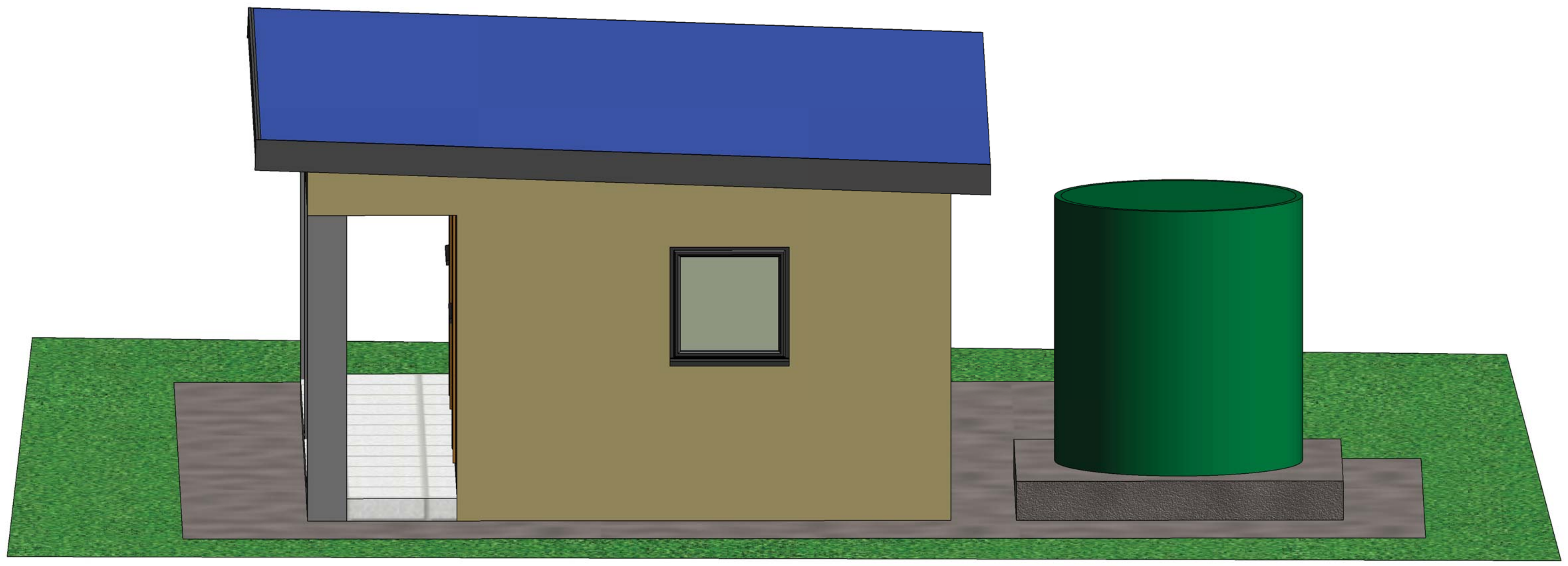
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVA

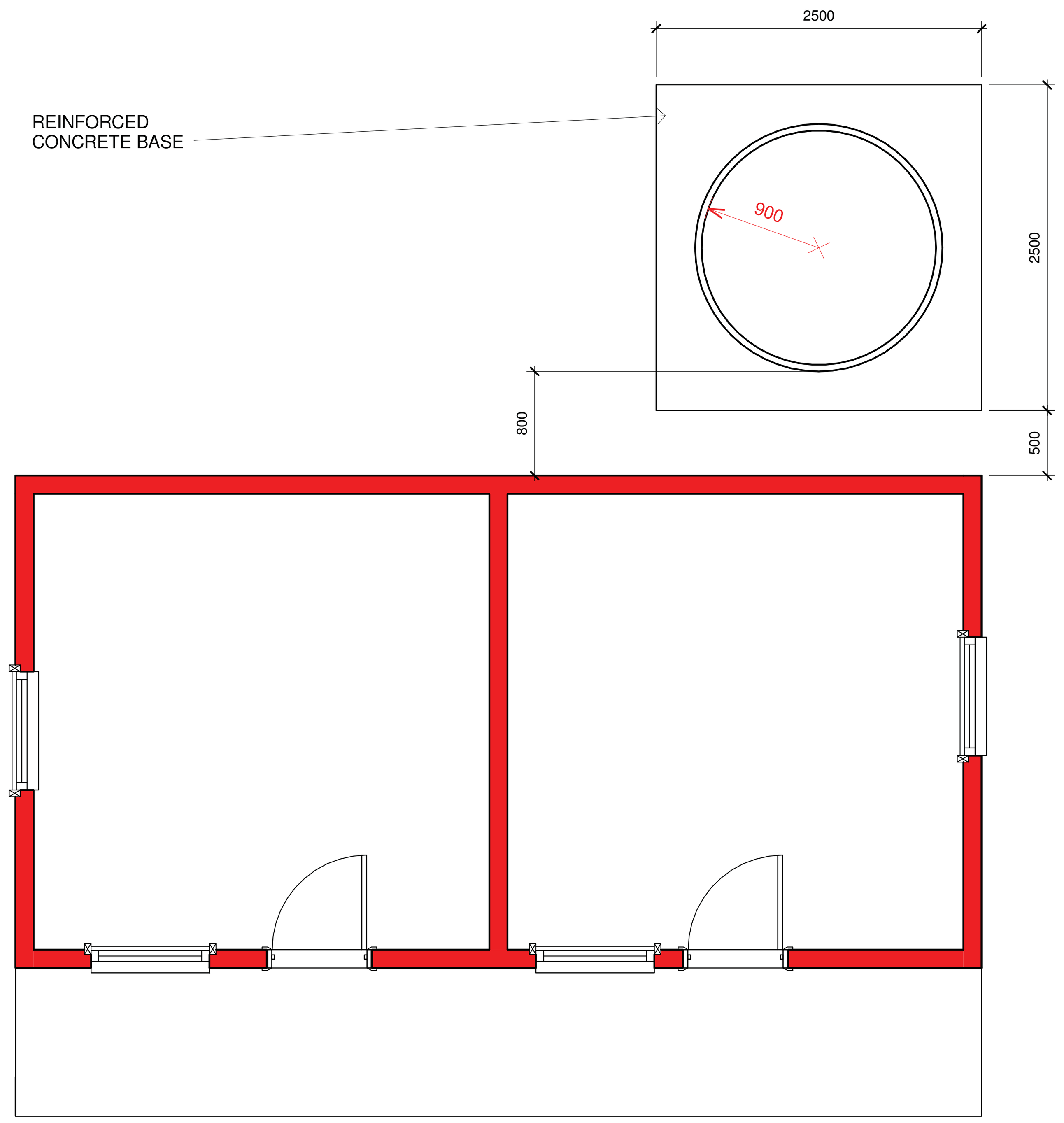
DRAWING DESCRIPTION
SPRING PROTECTION AND SPRING BOX

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C05
DATE	SCALE
JANUARY 208	As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C05

K1/2607/1-C05



2 PERSPECTIVE VIEW



1 FLOOR PLAN
1 : 40

3 SIDE ELEVATION
1 : 30

No	DATE	REVISION	ISSUED BY

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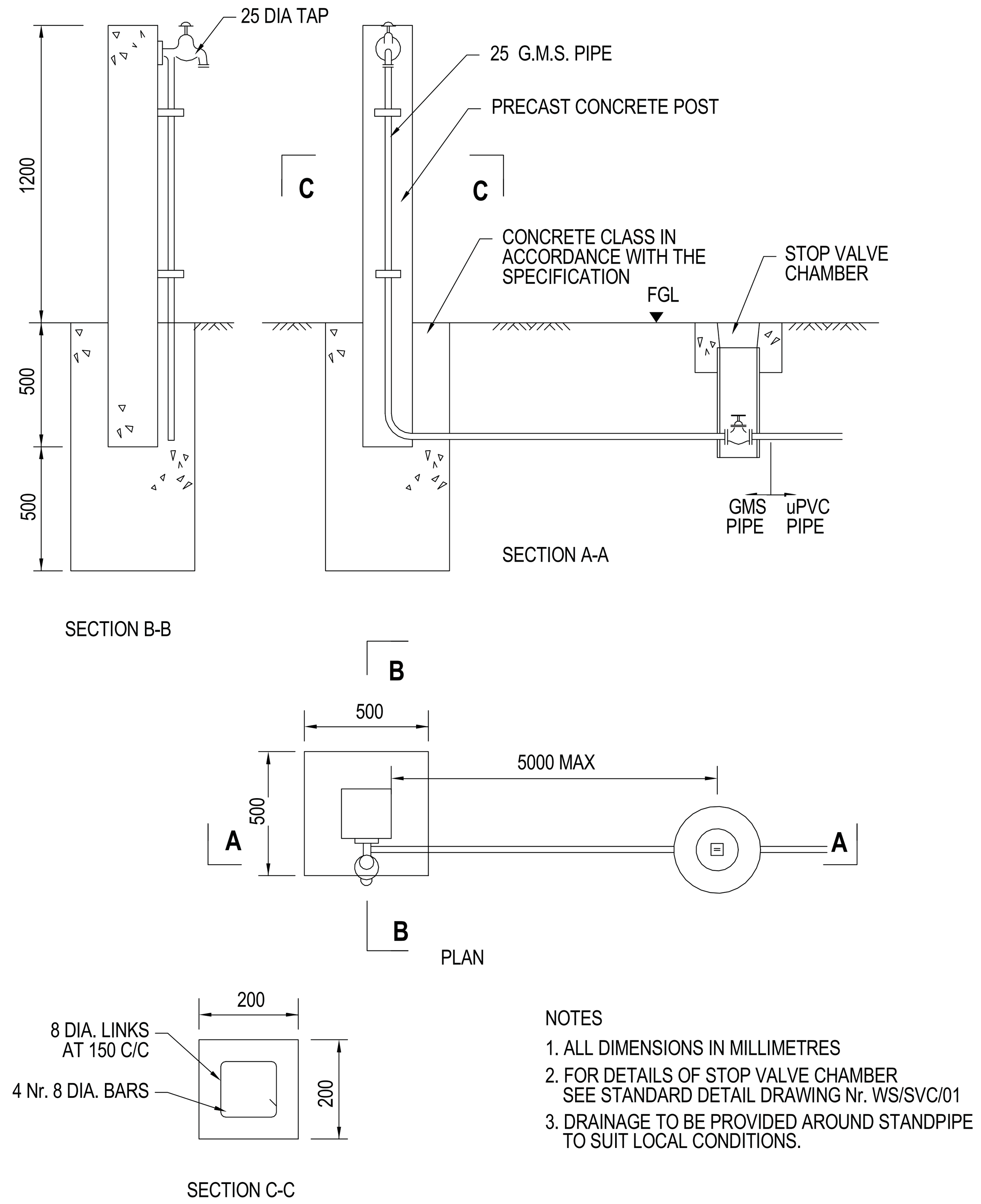
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - KHALAVHA

DRAWING DESCRIPTION
RAIN WATER HARVESTING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C06
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C06

K1/2607/1-C06



1 STAND PIPE DETAIL

1 : 1

STAND PIPE - TPYE 1

STAND PIPE - TPYE 2

No	DATE	REVISION	ISSUED BY

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CLIENT DATE

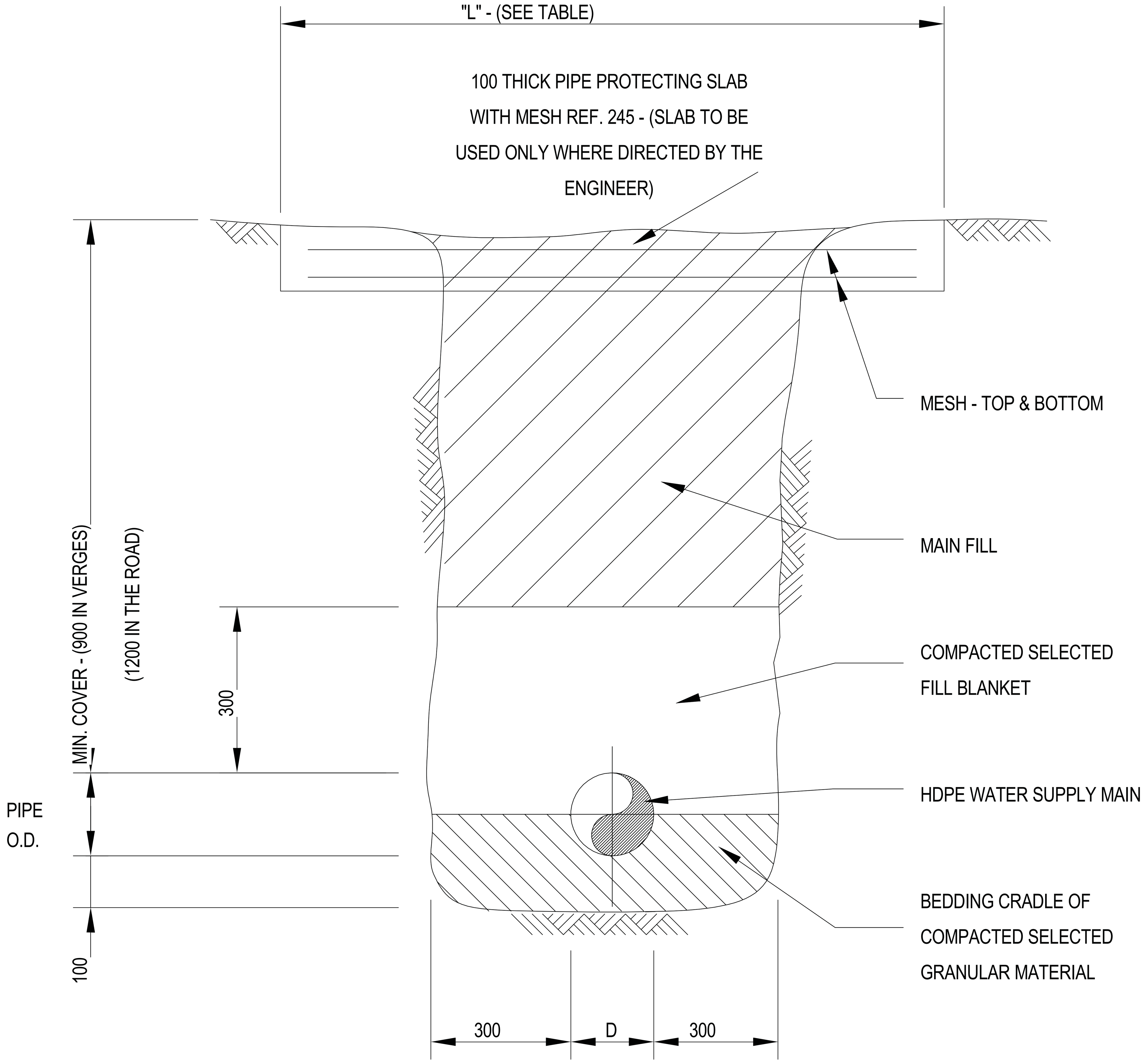
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C07
DATE	SCALE
JANUARY 2018	1 : 1
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE				
PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS
1 : 65

No	DATE	REVISION	ISSUED BY

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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C08
DATE JANUARY 2018	SCALE 1 : 65
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C08

K1/2607/1-C08

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

HOMESTEAD GARDEN - WATERING SYSTEM CONSISTING OF FLEXIBLE HOSE PIPE CONNECTED TO A WATER HAVERST TANK OR STAND PIPE

No	DATE	REVISION	ISSUED BY

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DESIGNED BY	Designer
CHECKED BY	Checker

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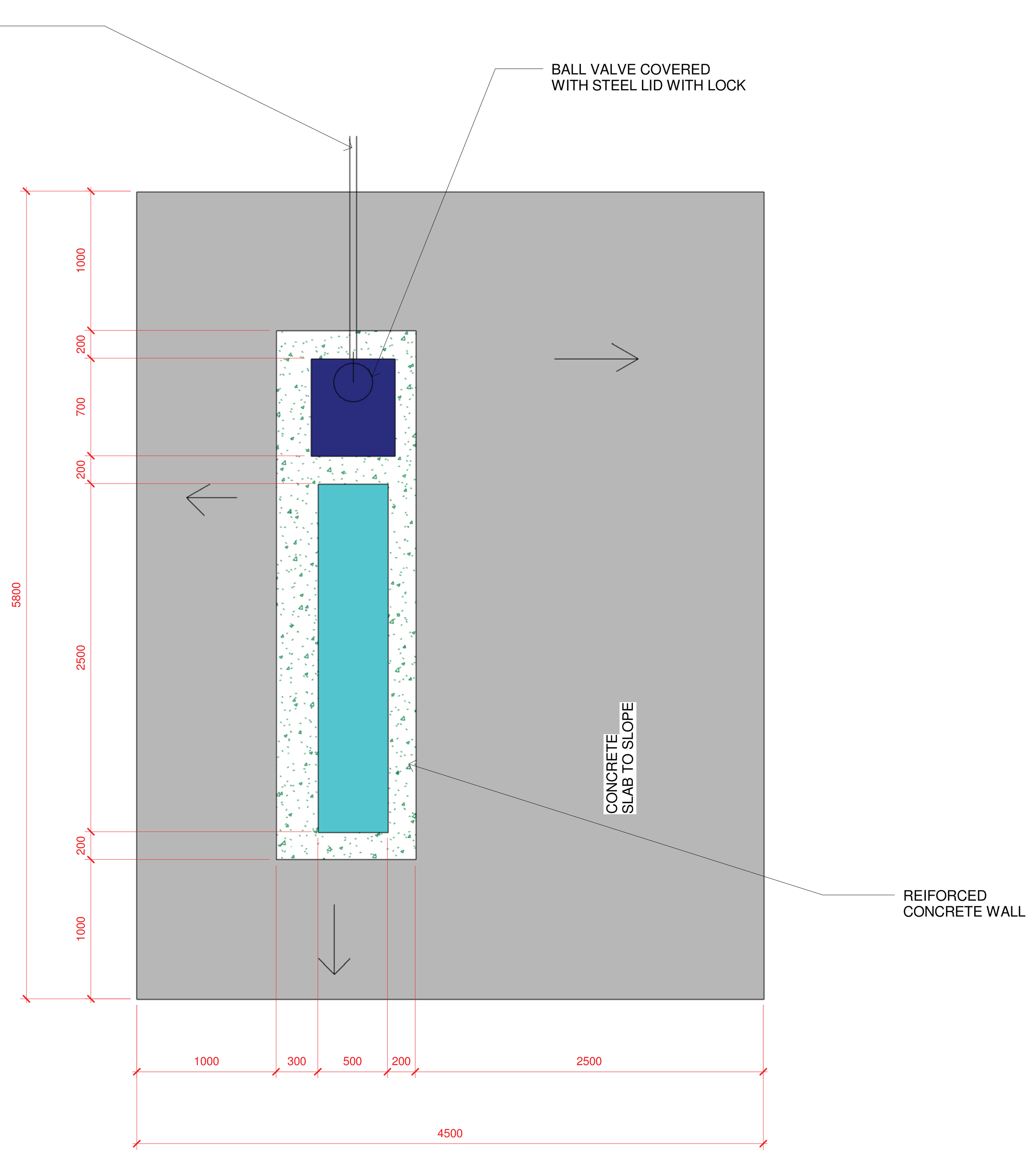
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

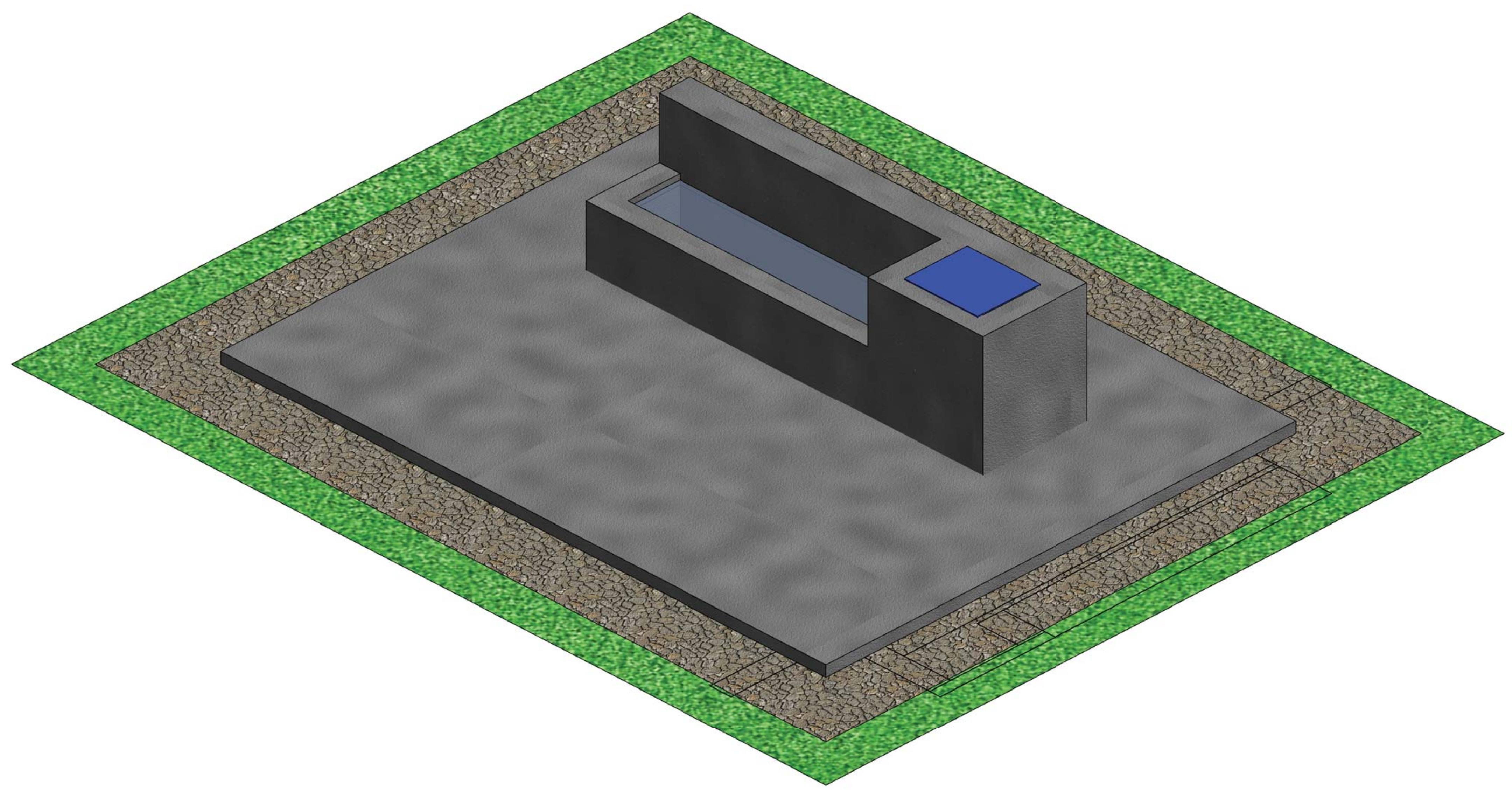
DRAWING DESCRIPTION
HOMESTEAD GARDENS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C09
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C09

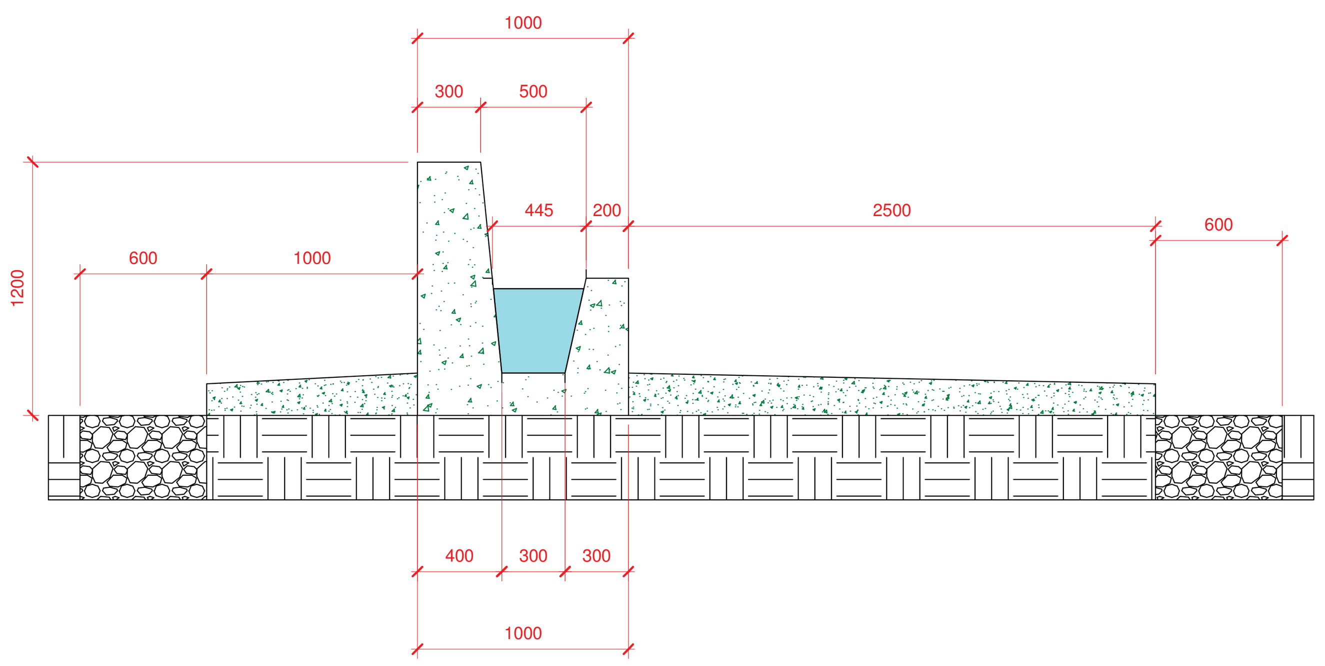
K1/2607/1-C09



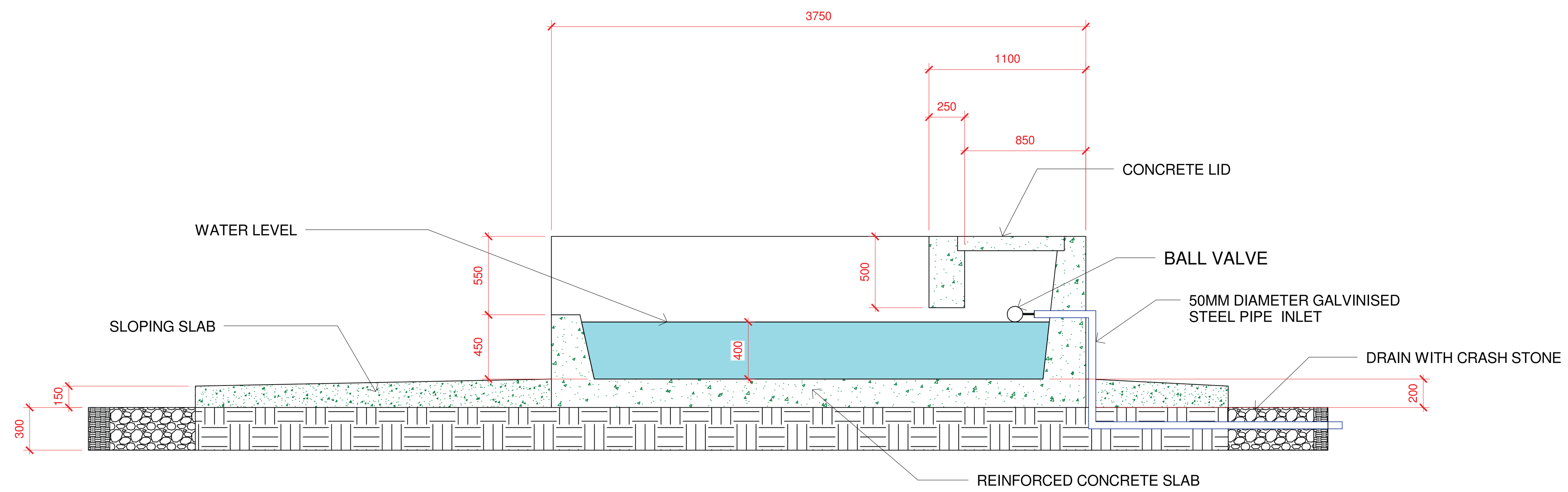
3 FLOOR PLAN
1 : 30



4 3D VIEWS



1 SECTION BB
1 : 30



2 SECTION AA
1 : 30

No	DATE	REVISION	ISSUED BY

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DESIGNED BY	Designer
CHECKED BY	Checker

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CLIENT DATE

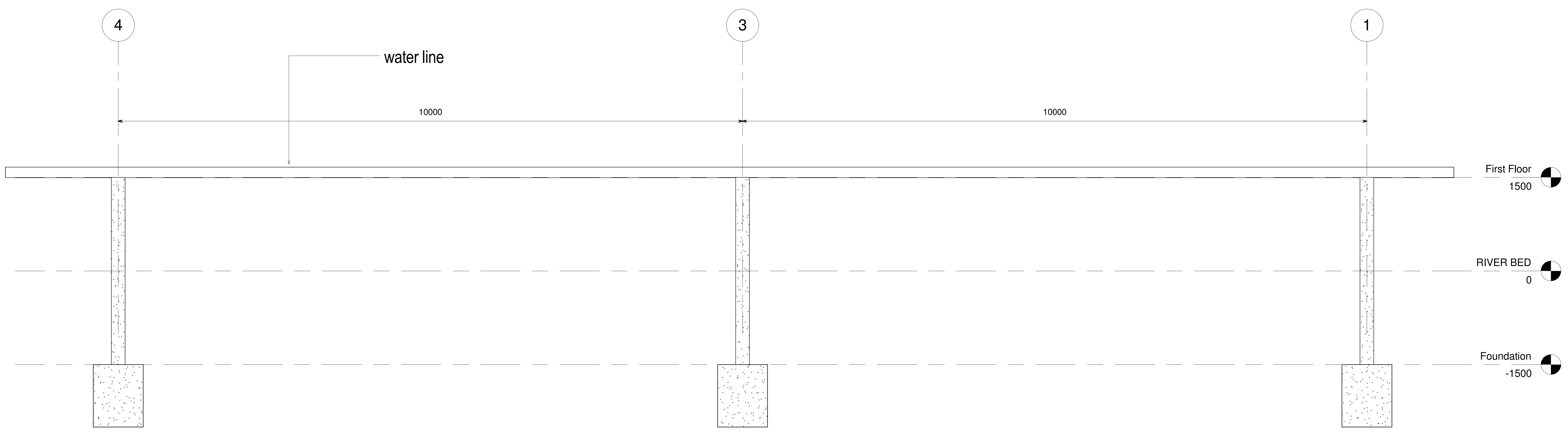
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVA

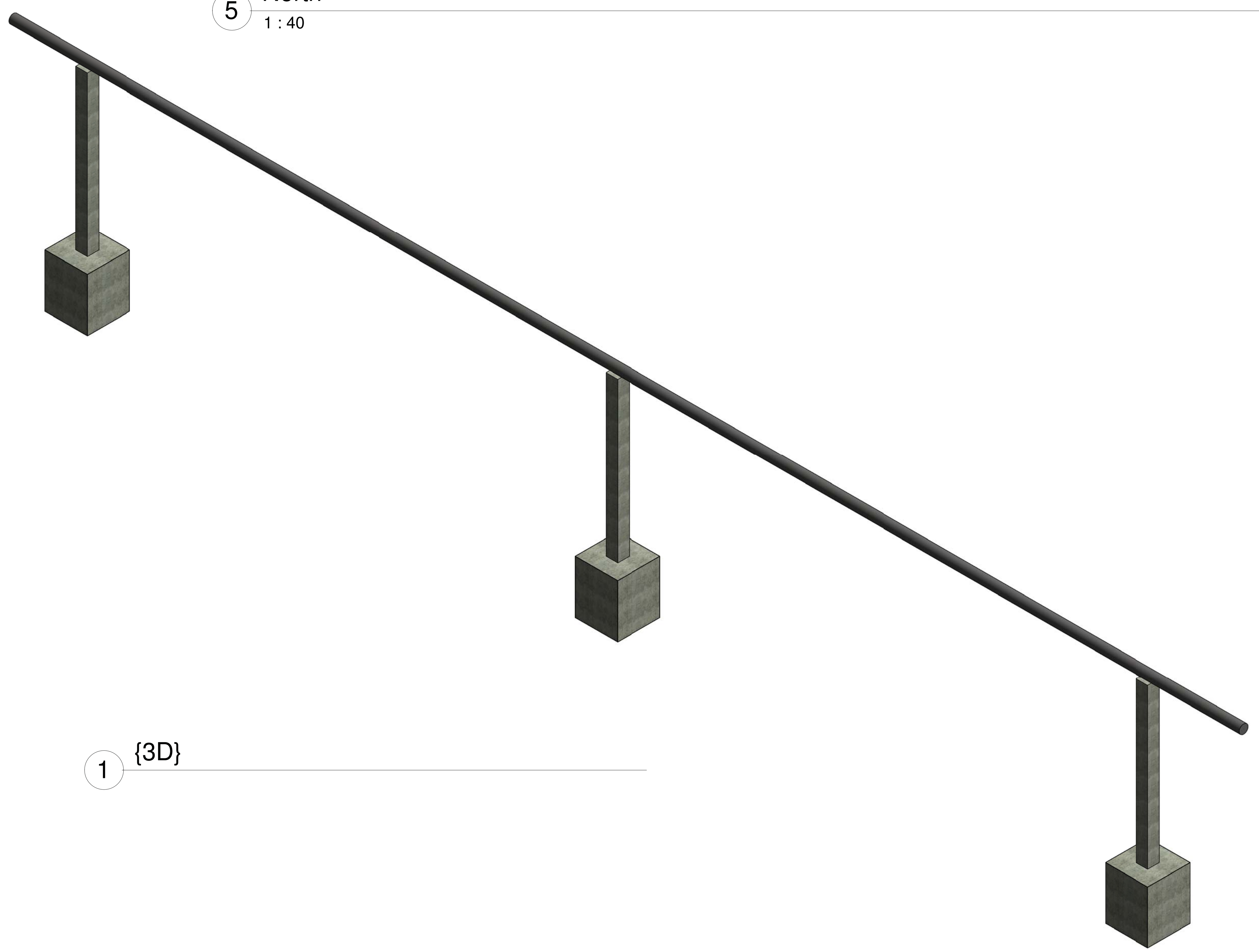
DRAWING DESCRIPTION
LIVESTOCK DRINKING TROUGH -500LITRE

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C10
DATE	SCALE
JANUARY 2018	1 : 30
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C10

K1/2607/1-C10



5 North
1 : 40



1 {3D}

NOTES:
1.Grade of concrete to be 25Mpa
2Column size is 300mm X 300mm
3 Base sizes is 800mmX800mmX100deep
4.water line to be held in place on top of the concrete columns by steel clamps cast in concrete at one end

No	DATE	REVISION	ISSUED BY

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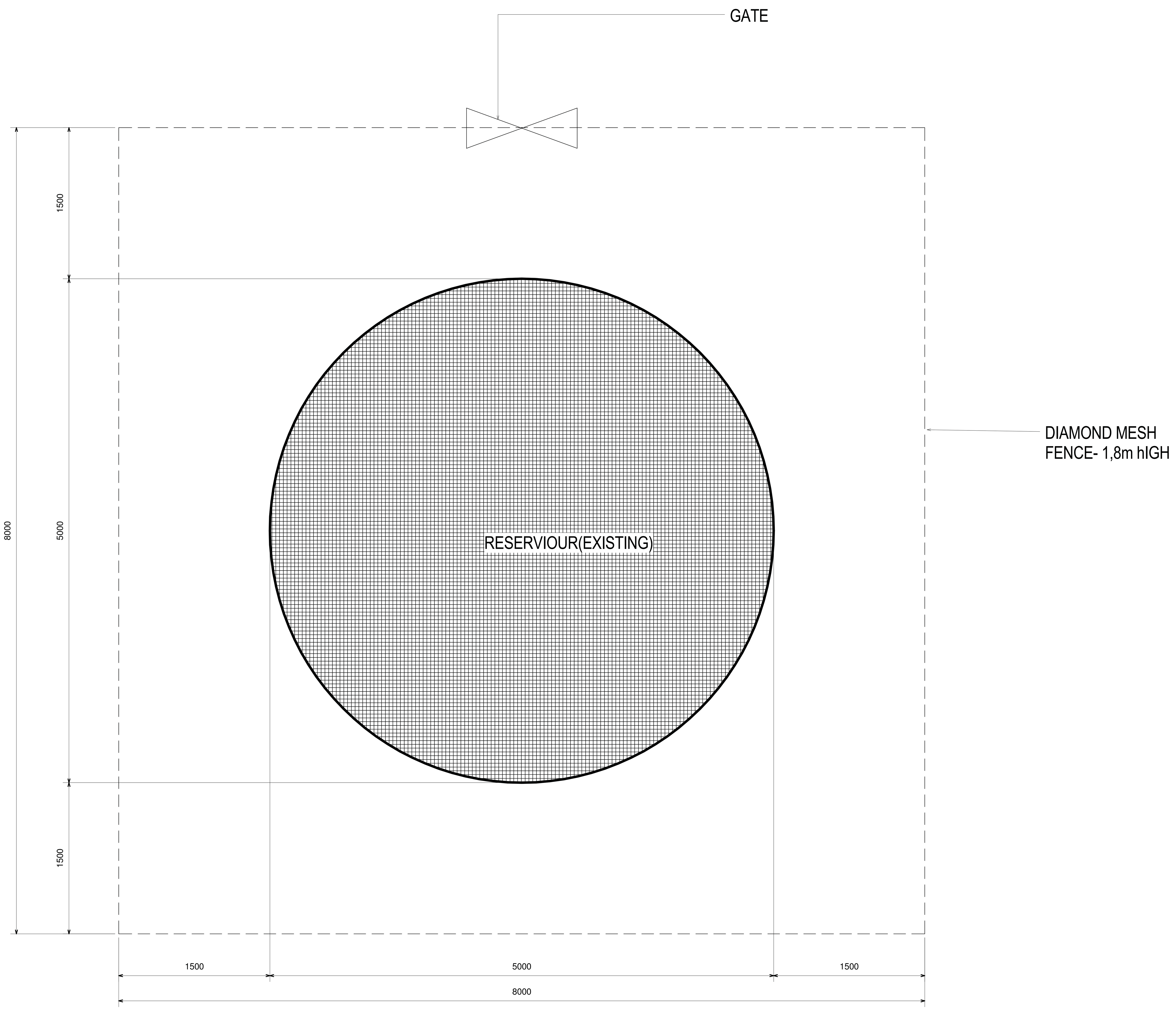
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - KHALAVHA

DRAWING DESCRIPTION
PIPELINE DETAIL AT RIVER CROSSING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C11
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C11

K1/2607/1-C11



1 TANK FENCING
1 : 25

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CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - KHALAVHA

DRAWING DESCRIPTION
WATER STORAGE FENCING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C12
DATE JANUARY 2018	SCALE 1 : 25
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C12

K1/12607/1-C12

Appendix 5

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft Design information for Phiring

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

❖ FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

A. PHIRING

B. GA-MOKGOTHO

C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

❖ MAKHADO LOCAL MUNICIPALITY

A. TSHAKHUMA

B. KHALAVHA

C. HA-GUMBU

Prepared by:

Tsogang Water and Sanitation

P.O. Box 1111

Tzaneen, 0850

Work Design and Summary of the Diagnosis report.

I. Description of the village.

The people from Boomplaas near Lydenburg were forcefully removed to Phiring under the Areas Group Act. Chief Michael Dinkwanyane, a grand parent of the current Kgoshigadi Merriam Naraedi Dinkwanyane formed the Sterkspruit Tribal Authority. There are 415 households in the village with an estimated population of about 2072 people. The white farmer who used to farm that area and who lived near the current tribal hall, left. Currently, the Tribal Authority covers 11 other villages. The separate section Vrystad was already inhabited; the people worked as unpaid farm labourers of the white farmer. After 1994, the Mokoena family of Vrystad successfully lodged a land restitution claim and took over a capital-intensive irrigated farm of about 300 ha alongside the R532 road near the turn-off to Phiring. The family continues fencing and developing 9 ha of land along the gravel road between that farm and Phiring village.

II. Current Water Resources.

a. Domestic water System.

The community domestic water system use borehole as a source, water is used for household consumption and other productive uses. The storage is a concrete reservoir situated on top of the hills above all households and water is distributed to the community through a network of pipelines for reticulation and each yard is connected to the system. The system is maintained and operated by the Sekhukhune District Municipality with the community doing very little to service the system. It is functioning properly with minor problems identified and the demand is very high. Vrystad section is a challenge as there is no reticulation pipeline in the area and newly constructed water projects are not working at all. People in Vrystad use dirty water for stock and stock irrigation for both domestic and productive uses.

b. Irrigation System.

The irrigation system abstract water from a stream flowing from nearby mountains into a big well build concrete dam called Stock & Stock. The system was built by the old Lebowa government through the Department of Agriculture before a democratic government in 1994. The irrigation supply farmers in Phiring and nearby villages like Mapareng and Malaeneng, there are so many problems identified like leaking pipes that cost farmers a lot of water. The system is made up of galvanised, asbestos, UPVC pipes of different sizes and hydrant installed in each field for irrigation. The irrigation water is also used to feed livestock own by members of the community. There are also rivers following through the village and other members of the community own private boreholes.

III. Water quality test.

Sekhukhune District Municipalities collected water samples from water sources in Phiring including Vrystad section. The process of testing water samples is ongoing and the working relationship between the community, Tsogang and the District units responsible for water tests is good,

NB: Water quality tests results the water is good for human consumption and productive use. Water quality test results shared between Tsogang and SDM.

There is ongoing health hazard of malaria diseases in Phiring.

IV. Design horizon for domestic and productive use supplies.

Village name	Current population	Current households	Design population (20 years)	Households at design pop.	Minimum water need (Litres/day)	Currently available source quantity (Q) (Litres/day)	Excess Q Available for MUS over minimum requirement
Phiring domestic	2 075	415	3 083	616	77 075	92 448	15373
Phiring Irrigation	67 farmers		250 hectares		7 500m^3/day	Irrigation calculation: 10 000m^2 * 3mm * 250Ha.	

V. Available water for Multiple Use Water Services, head loss and proposed supply pipe size and class.

Measurements at site									Selected		Calculated		
System	From	Elevation m	To	Elevation m	Elev Diff (H_d) m	Min H m	Q l/s	Pipe length m	Pipe dia. mm	Pipe Class	H_f m/100m	Total head loss m	Residual head m
Phiring	Borehole	2798	Storage	3064	266	10	0.77	800	Existing	GS	2.1	16.8	282.8

VI. Proposed works at source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge.

- **Replace/repair the reticulation pipeline in Mohlatsengwane section**. Activities to be carried out: clearing the site, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), backfill joints after approval and build valve boxes to a distance of about 600m which is 100 tasks of pipe laying from the main supply pipe to Mohlatsengwane section. Materials to be used are HDPE pipes, cement, river & building sand, 19mm stones, fittings, bricks, brick force and control valves.

- **Connect domestic water system rising main to concrete reservoir** previously built for Leboeng village, but never used. The reservoir is at a higher elevation than the one previously used and will supply adequate pressure to the whole reticulation system.

- **Homestead interventions,** community members will identify members to be trained in brick tank stand construction, guttering fitment, tank installation and will assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives agreed for the area.

- **Repair leaks encountered on the borehole elbow**, the close co-operatives will identify and advise on a local welder to be utilised. The welder will prepare, clean, weld and paint the required items. Currently the borehole provide 92 448 litres of water per day and with leaks repaired there can be more water supplied into the reservoir.

- **Fence the reservoir and build valve boxes.** The reservoir in Phiring needs to be fenced for protection against wild animals and vandals from destroying it. Activities to be carried out are: clear the site, mark & dig fence post holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh, concrete, wire, poles, staples and gates.

- **Tsogang will train** community members, MUS project forums, homesteads owners and farmers on basic technical skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, agriculture bookkeeping and Institutional & Social Development.

-

Phiring irrigation System.

- **Connect water from stock & stock irrigation system to livestock camp on the R532 road.** Activities to carried out by workers are: clearing the site, mark tasks, dig trenches, lay bedding, connect pipes, backfill, attach pipe into the bridge (leaving joints exposed), backfill joints after approval. Distance of 600m which is 100 tasks of pipe laying from the main supply pipe to livestock camps including valve box. Materials to be used are HDPE pipes, concrete, fittings, clamps and control valves.

- **Phiring Stock & stock irrigation system experience water shortages in dry season especially in winter** when there is less rainfall and farmer's production is affected. During participatory discussions with farmers, they identified alternative water source from a nearby stream called Sethunyane River which flows through the year and if this can be connected to the irrigation system farmers will have water throughout the year. Activities to be carried out are transport of materials from local store, clear site and mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), backfill joints after approval and build an intake structure. The pipeline distance to be built is 2000 m long so 334 tasks, and materials to be used are HDPE pipes, cement, river & building sand, 19mm stones, fittings, bricks, brick force and control valves.

- **Repair Phiring stock & stock irrigation system leaks on the pipeline to avoid further water losses.** The number of leaks to be repaired on the irrigation system in Phiring and nearby villages is thirty in different pipeline spots and 120 hydrants rubbers. Close Co-operatives will clear the site, dig trenches, remove broken section of pipe, install pipe bends and pipes to by-pass damaged section, fix clamps to concrete bridge, fit clamp to AC pipe leak, inspect repairs with Tsogang.

Vrystad Section.

- Currently there is a water project in Vrystad section for 36 households but the system is not working because the works are incomplete. The Water Services Authority, Sekhukhune District Municipality was engaged and they are aware of the problem. The contractor was not paid and that is why the work was not finished, the borehole pump is locked and the system is not working at all. The District has no immediate plan to get the problem solved in

Vrystad, they tried to apply for roll over of funds which was not approved, and currently there are no plans to get things working.

- The proposal made by the community during consultative meetings was to **connect a pipeline from Phiring domestic water system to Vrystad** area. Activities to be carried out are as follows, site clearing, mark tasks, dig trenches, lay bedding, connect pipes and backfill after approval to cover a reticulation system for about 50 households to cover a distance of 3000m equals to 500 task of pipe-laying with three standpipes installed at communal spots.. Materials to be used are HDPE pipes, concrete, stand pipes, taps, fittings and control valves.

VII. Implementation phase, time frame and the methodology.

The scope of works will be implemented in six months using community labour from Phiring and experts for activities that require special skills and knowledge. Workers the will be recruited from the community using a legal entity called close co-operatives in the village to manage the implementation at local level and provide stipend with the help of Tsogang Water and Sanitation's supervision.

VIII. Procurement of Goods and Services.

Materials and services for the multiple use water services project will be procure in Limpopo Province using local suppliers and nearby towns like Polokwane, Burgersfort, Thohoyandou and Jane Furse. Purchasing will only take place outside the Province for things that cannot be found or procured in Limpopo. Orders will be placed as per village and more than three quotations will be gathered using a shopping exercise. All the procurement documents including quotations and close co-operatives documents will be submitted to the Water Research Commission for procurement.

IX. Project Costs, Lots of materials and Stipend rates.

Below is a summary of costs to increase the availability of water in the village for domestic and irrigation, refurbish the existing infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small business

Phiring

Lot number	Item	Material costs	Lots material	Stipend	Total	Remarks on Stipend.
1	**Water Source Development in,VRYSTAD(Material & Labour)**	60 451.33	2X Galvanised Elbow, 1X50mmValve Ball x 50mm, 100X42.5 ppc cement, 3X19mm Concrete 3 cubes Load, 3XRiver sand 3 cubes load, 40XY12 reinforcement, 3000XMaxi Bricks, 2XConcrete Plastic Sheet, 1XRed Oxide Paint x 10 l , 1XElectricity Supply.	9 250.00	69 701.33	Builder= 5000.00, Plumber 4800.00, Assistance =1600.00
2	**Water Storage Fencing.**	16 150.90	2XWelded Mesh 1.8m x 30m0, 9XSecurity Post Pole 2.4m, 8XStandard Security Pole 2.4m, 10XStay 2.4 Hd, 10X Stay Bolt M10 x 100, 1XPlain wire 4mm x 50kg, 1XPlain wire 1.6mm x 5kg, 1XSecurity Gate 1.8m single, 1XLabour.	3 200.00	19 350.90	Team leader= 2000.00 and Assistance = 1200.00
3	**Irrigation Alternative Source.**	49 645.38	5X110mm HDPE cls 6, 4X110mm Couplings, 5X90mm HDPE Cls 6 x 100m, 4X90m HDPE couplings, 5X75m HDPE cls 6 x 100m, 4X75m HDPE couplings, 2X110mm x 90mm reducer, 2X90mm x 75mm reducer.	25 000.00	74 645.38	1500m /6m = 500 X R100.00= 25000.00
4	**Stock & Stock Irrigation and Livestock Pipeline Repair Leaks.**	48 045.38	3XUPVC 140mm x 6m x clas 6, 3XUPVC 160mm x 6m x clas 6, 5XUPVC 140mm x clas 6 straight joint, 5XUPVC 160mm x clas 6 straight joint,10X342-356 Asbestos Cascade Full Clamp, 6X40mm HDPE cls 6, 5X40mm HDPE coupling, 2X40mm HDPE Female Adaptor, 120X50mm Stand Pipe Heads/Rubbers, 10X140mm Galvanised Clamps, 10X40mm Galvanised Clamps.	10 000.00	58 045.38	600/6=100x100=10000.00
5	**Water Reticulation Pipeline (Mohlatsengwana section)**	145 500.04	6X75mm HDPE cls 10 x 100m, 5X75mm Couplings, 4X40mm HDPE Cls 6 x 100m, 3X40m HDPE couplings,10X75mm x 40 mm saddle,10X40mm male adaptor, 50X40mm x 20mm saddle, 50X40mm x 20mm male adaptor, 30X40mm HDPE cls 10 x 100m, 29X40mm Couplings, 4X20mm Galv standpipe, 4X20mm galv elbows, 0X25mm x 20 Female adaptor, 4X20 Cobra taps, 1XAir valve, 1XSocket Reducer Galv 50mm x40mm.	50 000.00	195 500.04	3000m /6m X 500 X R100.00
6	**Homesteads Intervention.**	49 196.92	15X2500 litres Jojo Tank & Materials	10 500.00	59 696.92	Builder =7500.00, Assistance=3000.00
7	**Valve box**	11 869.20	4XValve Ball x 100mm, 30X42.5 ppc ceme	7 400.00	19 269.20	Builder =5000.00, Assistance =2400.00
8	**Store Room**	9 000.00	6 Months X Store room	-	9 000.00	N/A
9	**Plant Hire**	16 200.00	6 X Months Plant hire		16 200.00	N/A
	Total	406 060	-	115 350.00	521 410	

NB: Project Cost Including Vat R521 410

X. Please find below a drawing booklet for Phiring Project.

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - PHIRING
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - PHIRING

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02
LAYOUT DRAWING	00	1 OF 1	K1/12607/1-C03
VALVE BOX	00	1 OF 1	K1/12607/1-C04
RESERVIOUR FENCING DETAILS	00	1 OF 1	K1/12607/1-C05
RAIIN WATER HARVESTING	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILS	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT DATE

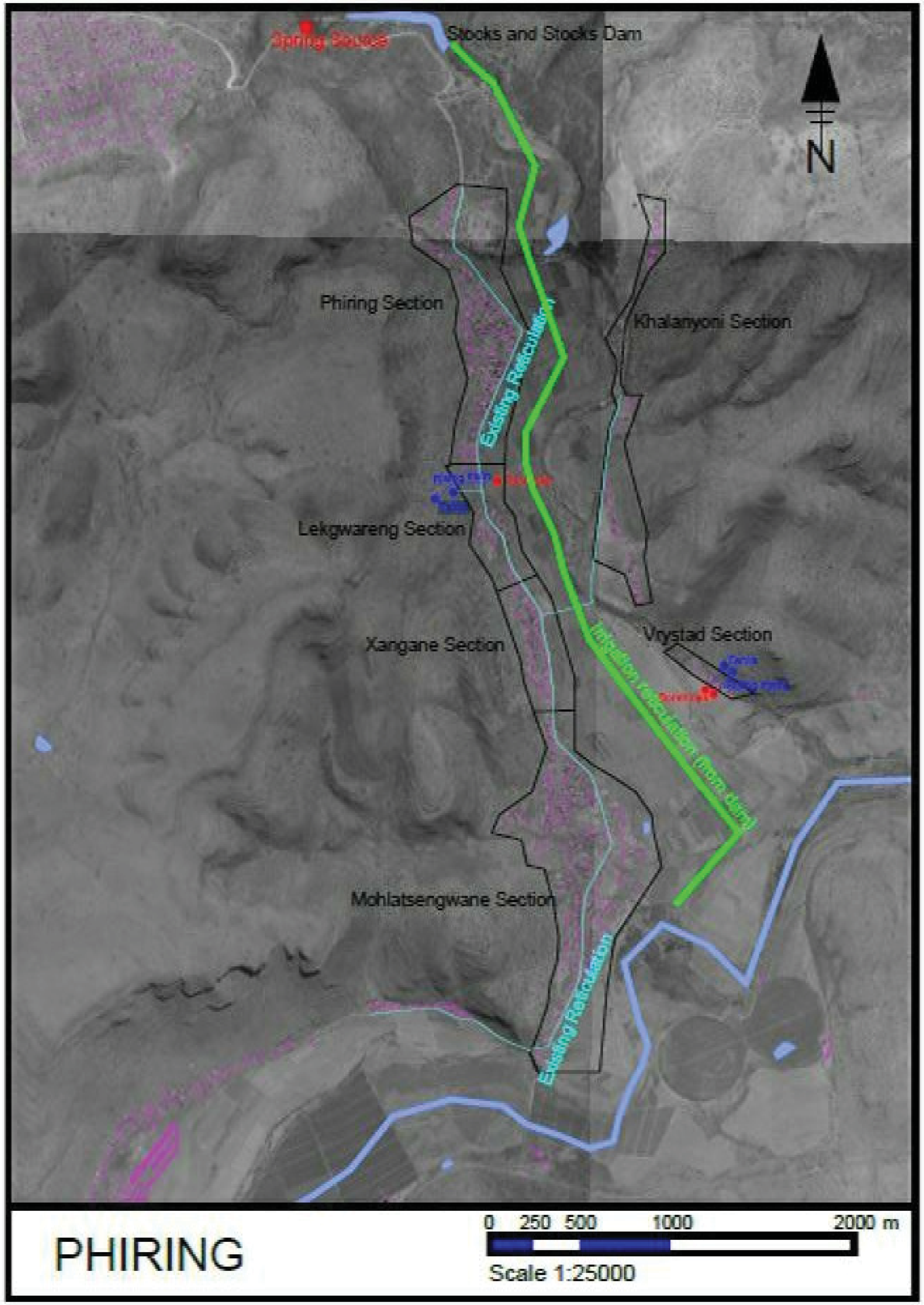
CONSULTING ENGINEER DATE

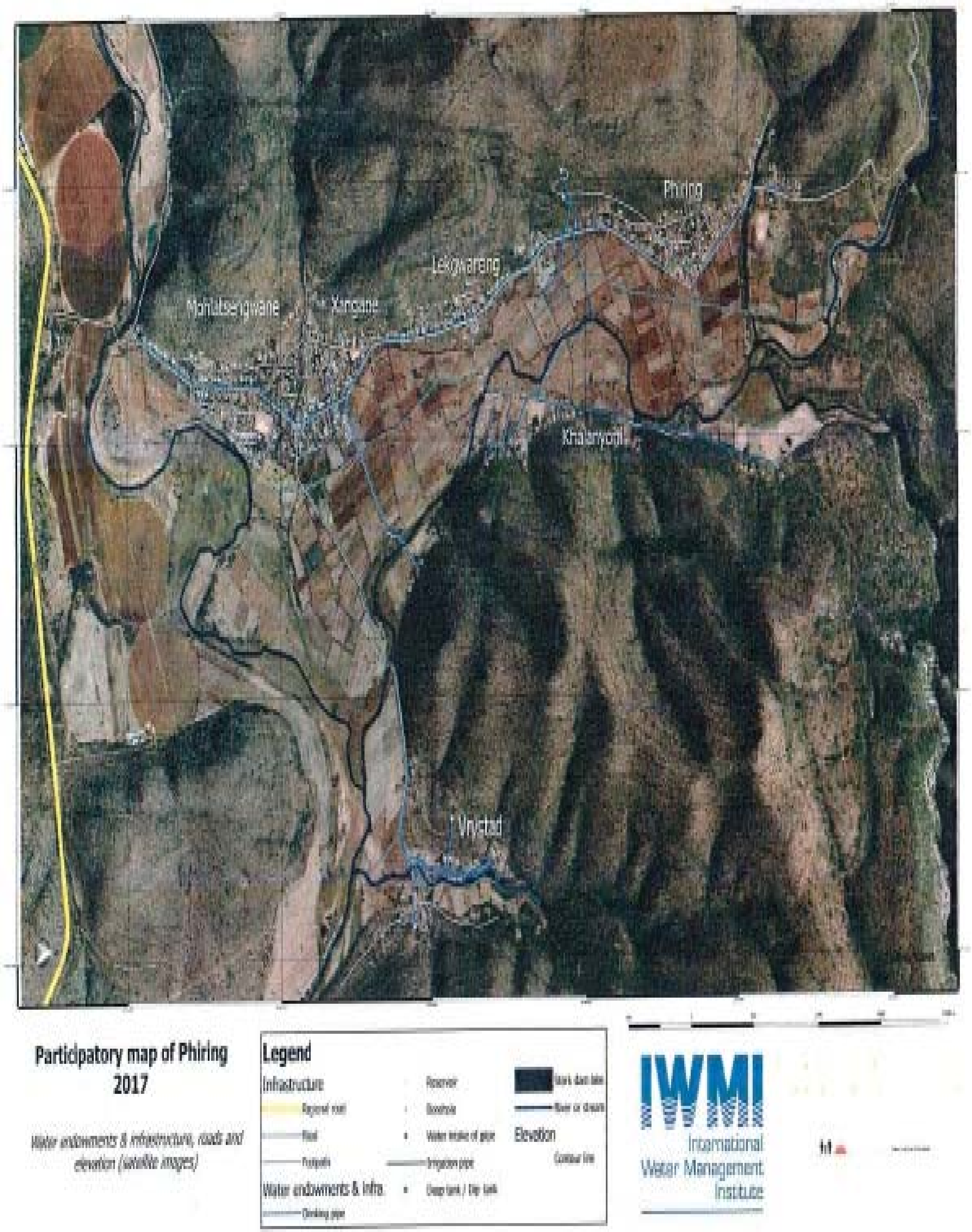
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - PHIRING

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01

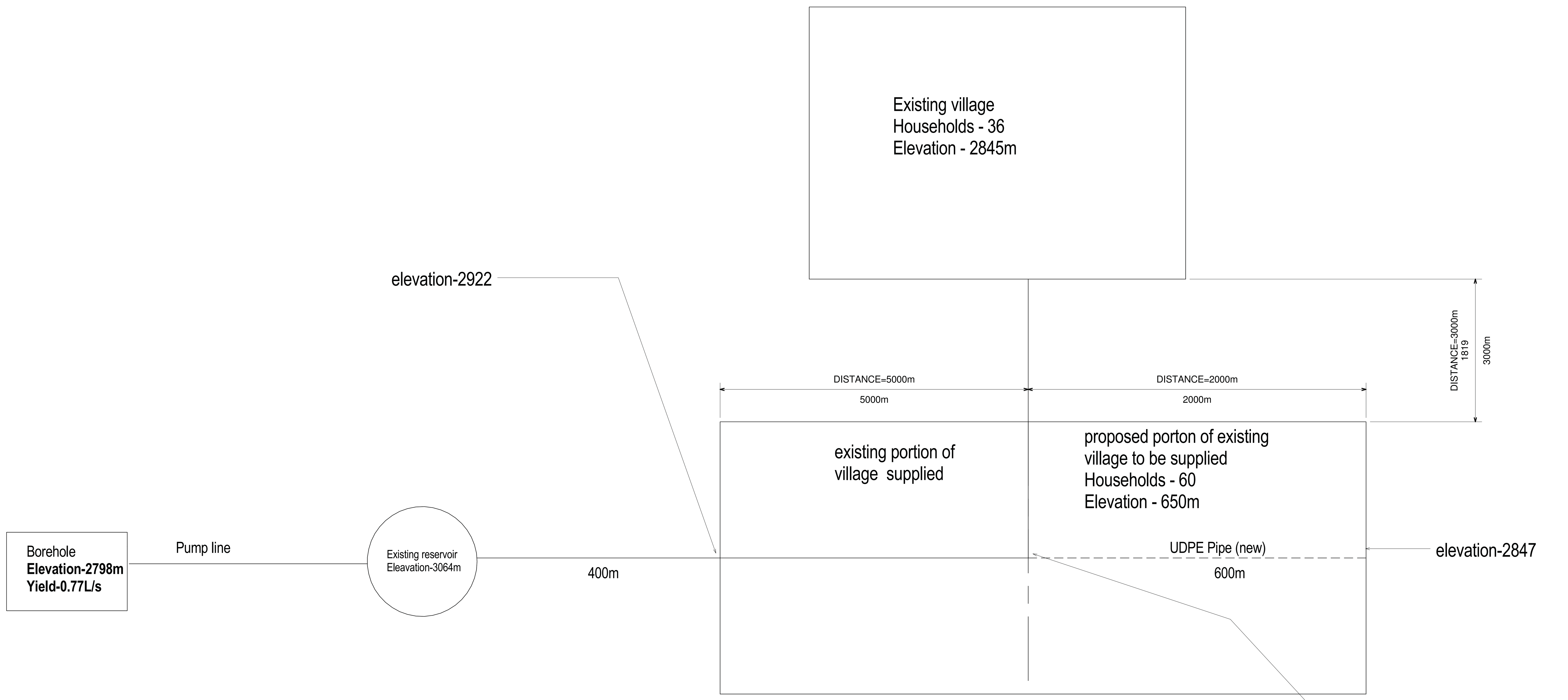




DRAWN BY	L.M	TSOGANG WATER AND SANITATION P O BOX 1111 TZANEEN 0850 Tel: 015 307 2673 Fax: 015 307 5299 Email: tsogang@pixie.co.za	CLIENT / DATE	**PROJECT DESCRIPTION** MULTIPLE USE WATER SERVICES (MUS) - PHIRING	PROJECT STATUS: CONSTRUCTION SHEET: K1/2607/1-C02
CHECKED BY	M.K.Phasha				DATE: JANUARY 2018 SCALE
DESIGNED BY	L.M		CONSULTING ENGINEER / DATE	**DRAWING DESCRIPTION** LOCALITY PLAN	PROJECT NUMBER: K1/2607/1 DRAWING NUMBER: K1/2607/1-C02
CHECKED BY	M.K.Phasha				

No	DATE	REVISION	ISSUED BY

K1/2607/1-C02



WATER AVAILABLE

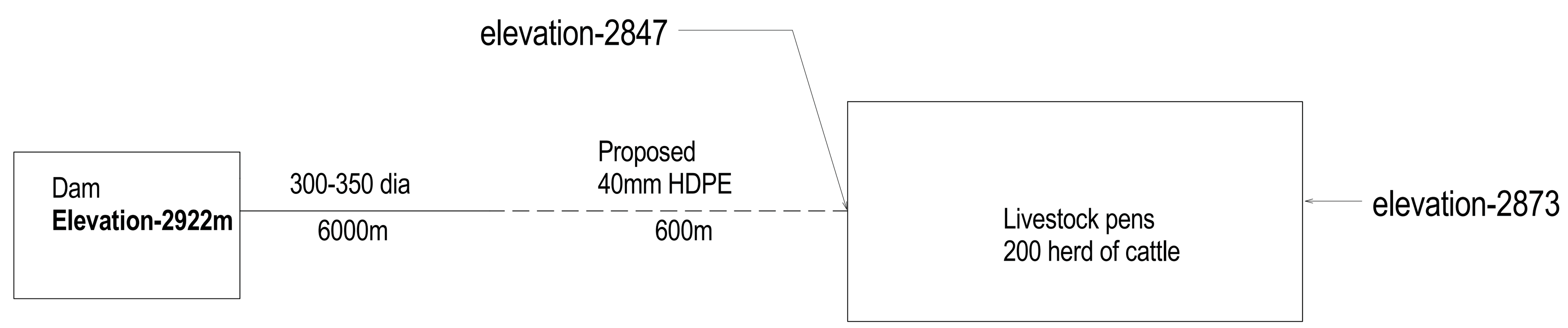
0,77 l/S x 60x60x12=33,26 kL/Day
33264/415=80L/HH/Day
80 L/6=13,3 L/Head/Day

LEGEND

existing water lines
new water lines

PHIRING DOMESTIC SECTION

REGIONAL WATER PROJECT GRAVITY MAIN SIZES AND DESIGN FLOWS			Page 1						
RESERVOIR LOCATION AND PIPELINE ROUTE	LENGTH	ELEVATION	SUMMER PEAK DEMAND - YEAR 2017 RATE OF FLOW = 2 x AADD(60)/24/3600*1.5*1.1 l/c/s						
	(m)	AMSL (m)	NUMBER OF PEOPLE SERVED	DESIGN FLOW (l / s)	DESIGN VELOCITY (m / s)	PIPELINE (Nom. dia.) & Class (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
HA-GUMBA Borehole Watertank	168	396 410		2.35	0.53	Class 6 75	14.00	0.70	410.70 410.00
Watertank A B	817 1174	410 382 398	1,140 300	2.61 0.69	0.41 0.16	Class 6 90 Class 6 75	28.00 12.00	1.69 0.50	410.00 408.31 407.81
A C	1643	382 401	300	0.69	0.16	Class 6 75		0.70	408.31 407.61
LUKAU Stream Watertank	400	926 838		3.50	0.79	Class 9 75	88.00	3.46	926.00 922.54
Watertank Village	661	838 462	1,260	2.89	0.65	Class 9 75	376.00	4.01	838.00 833.99
TSHAKUMA VILLAGE Borehole Watertank	1000	670 743		2.45	0.55	Class 9 75	73.00	4.47	747.47 743.00
Watertank Village	694	743 636	1,290	2.96	0.67	Class 12 75	0.00 107.00	4.40	743.00 738.60
KHALAVHA Stream Watertank	1600	1123 1091		1.10	0.56	Class 6 50	0.00 32.00	11.72	1,123.00 1,111.28
Watertank Village	2690	1091 889	546	1.25	0.64	Class 18 50	0.00 202.00	25.02	1,091.00 1,065.98



PROPOSED WORKS

1. Construct valve box to protect valve at the reservoir as per drawing K1/2607-C04
2. Fence the reservoir as per drawing - K1/2607-C05
3.Replace sections of damaged existing water lines - K1/2607-C08
4. Construct rainwater harvesting structures as per drawing- K1/2607-C06
5. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
6. Lay new pipeline as per drawing - K1/2607-C08

PHIRING IRRIGATION SECTION

REGIONAL WATER PROJECT PUMPSTATION, RISING MAIN SIZES & DESIGN FLOWS									
LOCATION OF PUMPSTATION AND RESERVOIR SERVED	LENGTH (m)	ELEVATION AMSL (m)	SUMMER PEAK DEMAND - YEAR 2008 RATE OF FLOW = AADD(80)/24/3600*1.5*1.1 l/c/s						
			NUMBER OF PEOPLE SERVED	DESIGN FLOW (l / s)	DESIGN VELOCITY (m / s)	PIPELINE (Nom. dia.) & Int. Dia (mm)	STATIC HEAD (m)	FRICTION LOSS (m)	HYDRAULIC GRADIENT (m)
LETLABELA GA-MOELA Reservoir	900	1531 1606		1.50	0.34	Class 9 75	75.00	1.62	1,531.00 1,529.38
GAPUDI GA-MOELA Reservoir	500	1624 1654		1.00	0.51	Class 6 50	30.00	3.07	1,624.00 1,620.93
MABUSA GA-MOELA Reservoir	1000	1673 1711		1.00	0.51	Class 6 50	38.00	6.14	1,673.00 1,666.86

No	DATE	REVISION	ISSUED BY

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IWMI

CLIENT — DATE

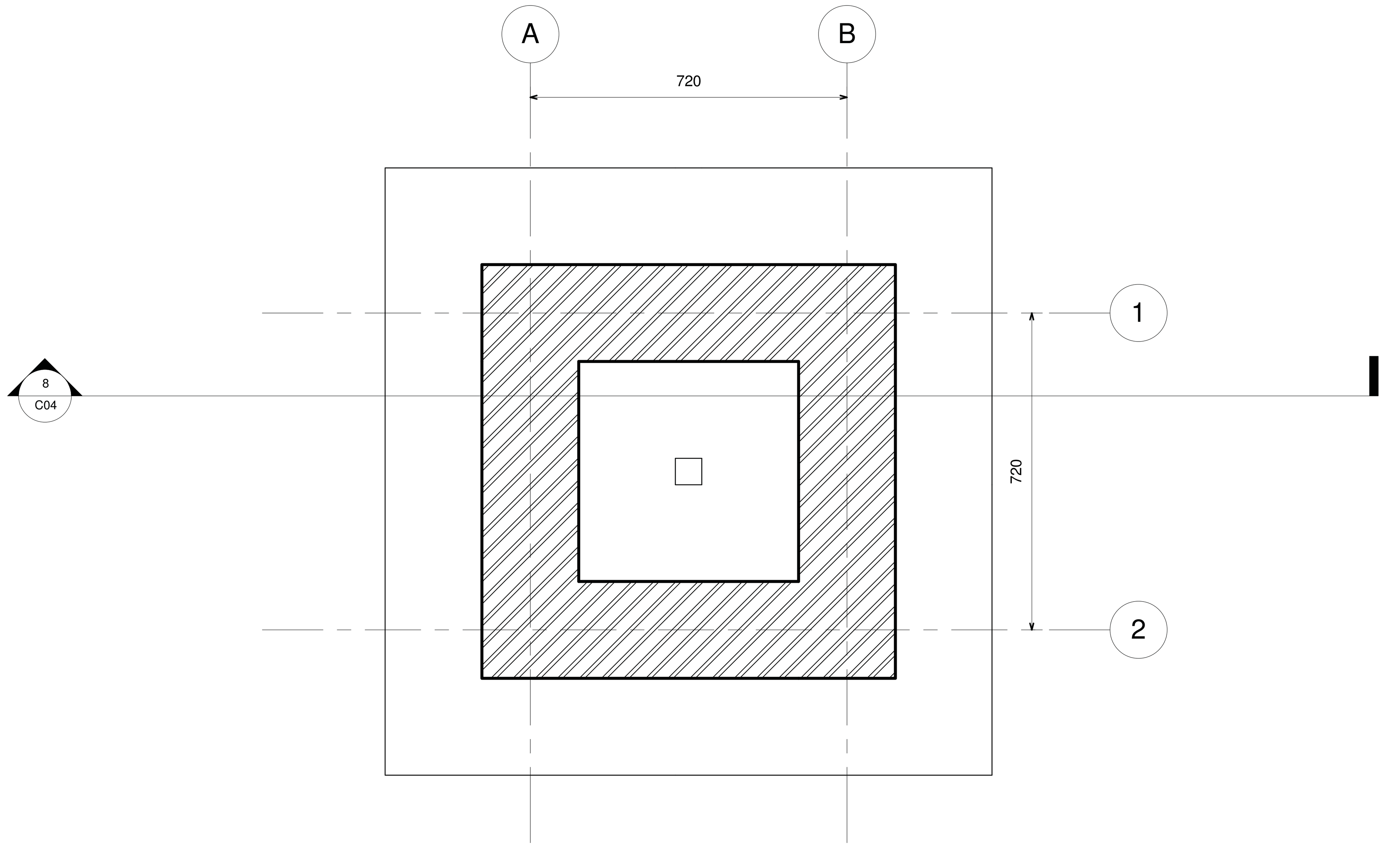
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - PHIRING

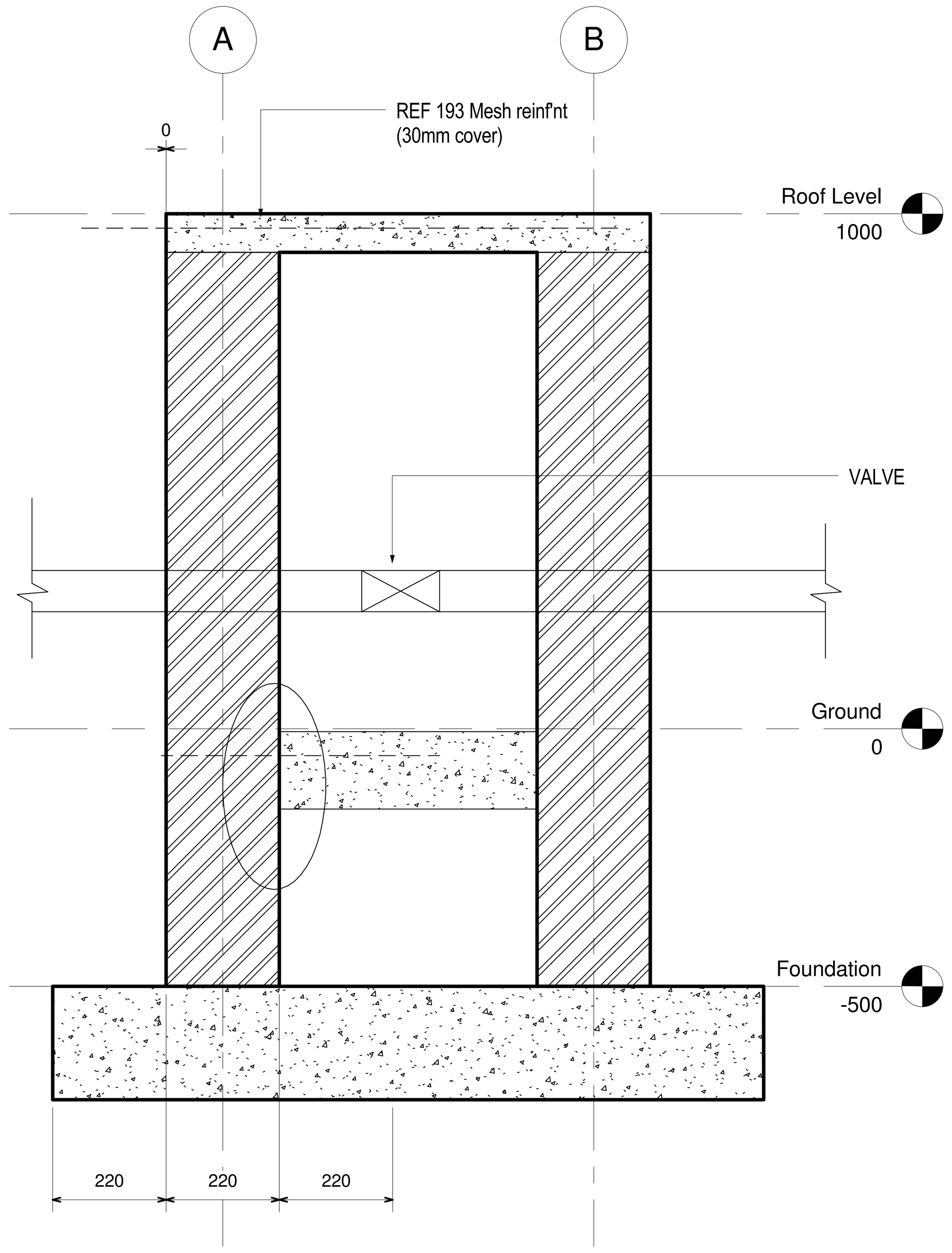
DRAWING DESCRIPTION
LAYOUT DRAWING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03

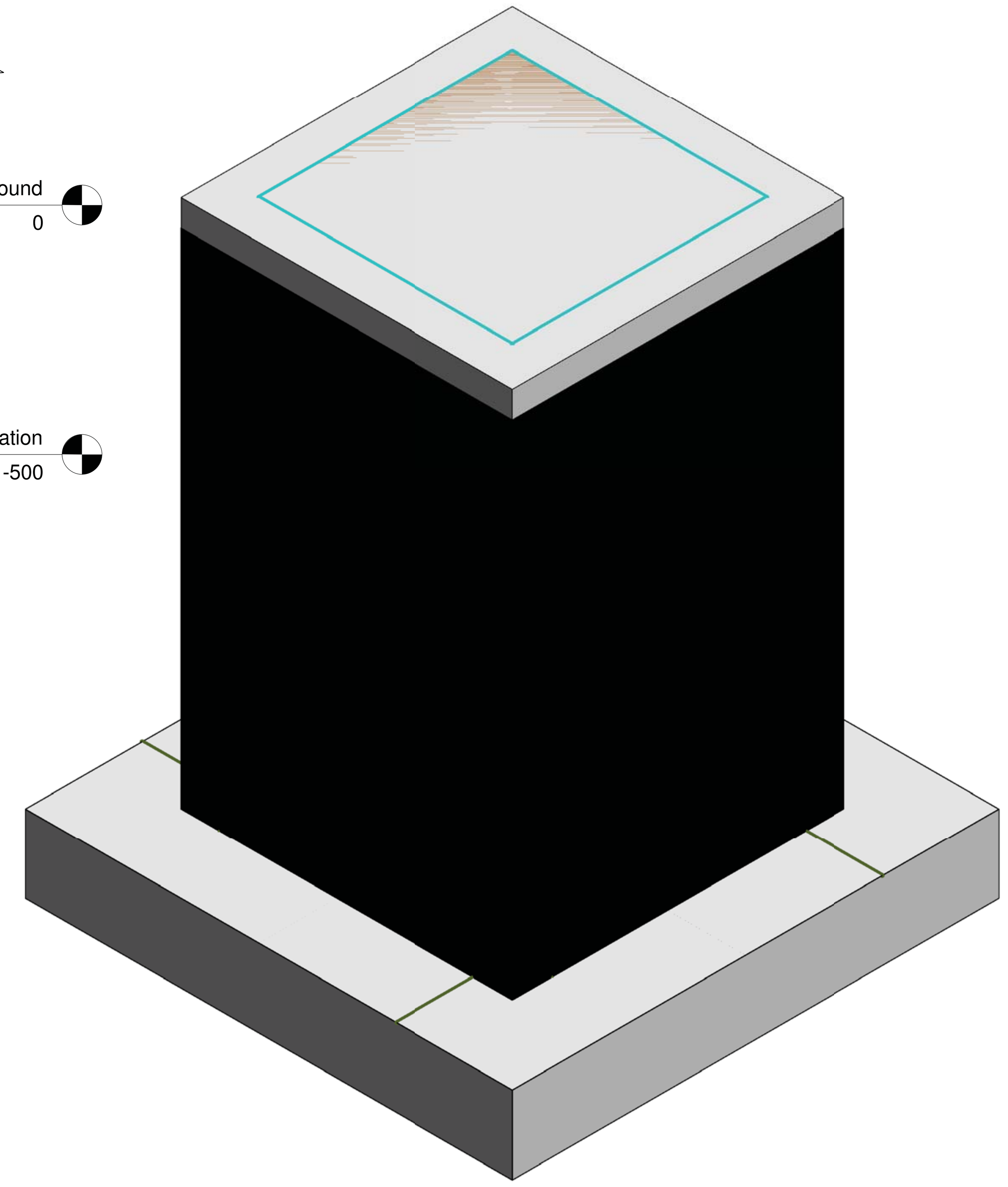
K1/2607/1-C03



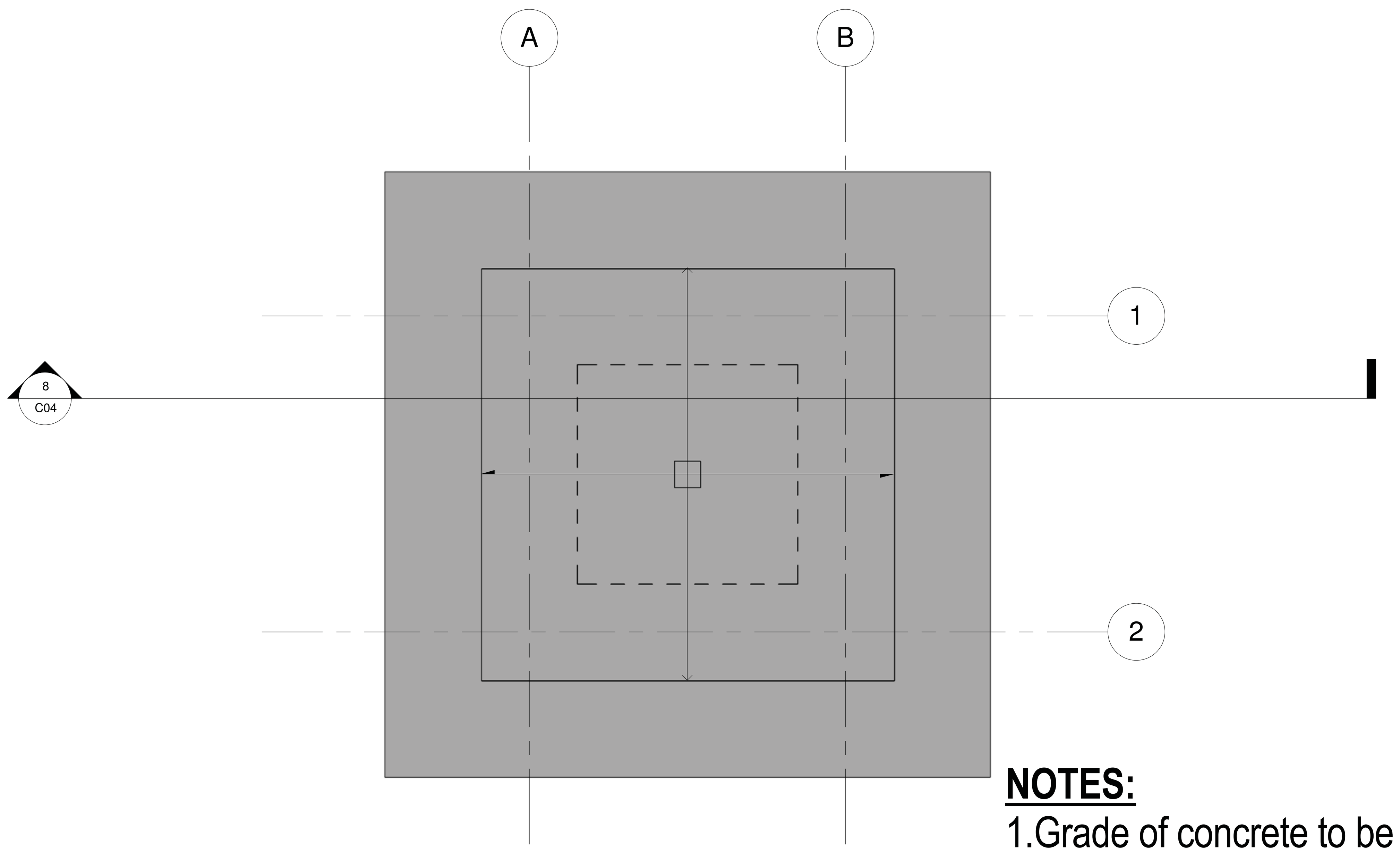
6 00 Foundation (TOF)
1 : 10



8 Section 1
1 : 10

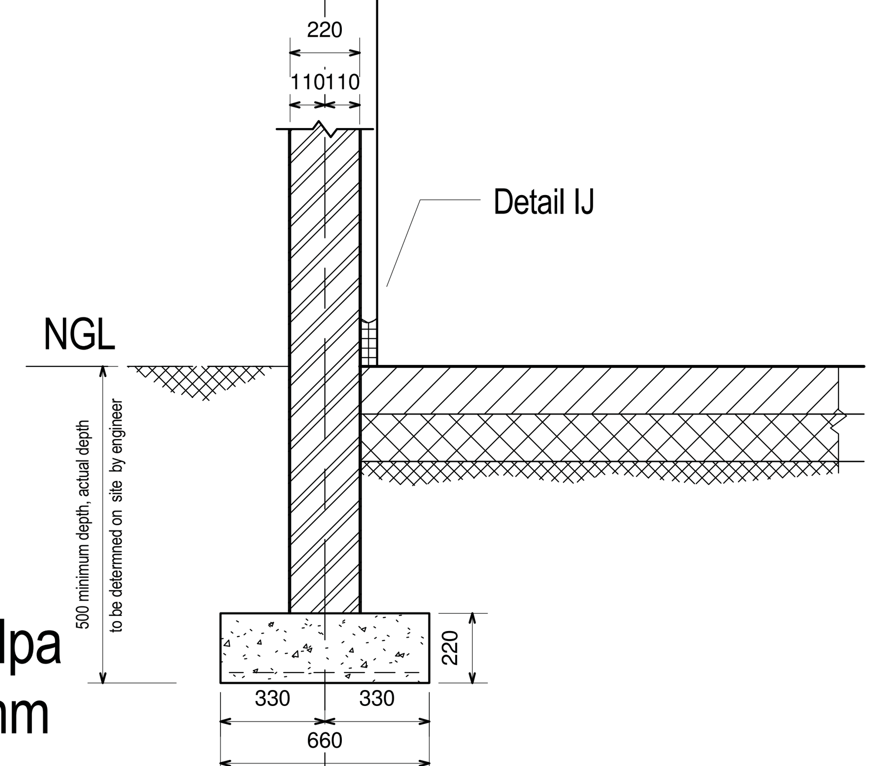


7 {3D}

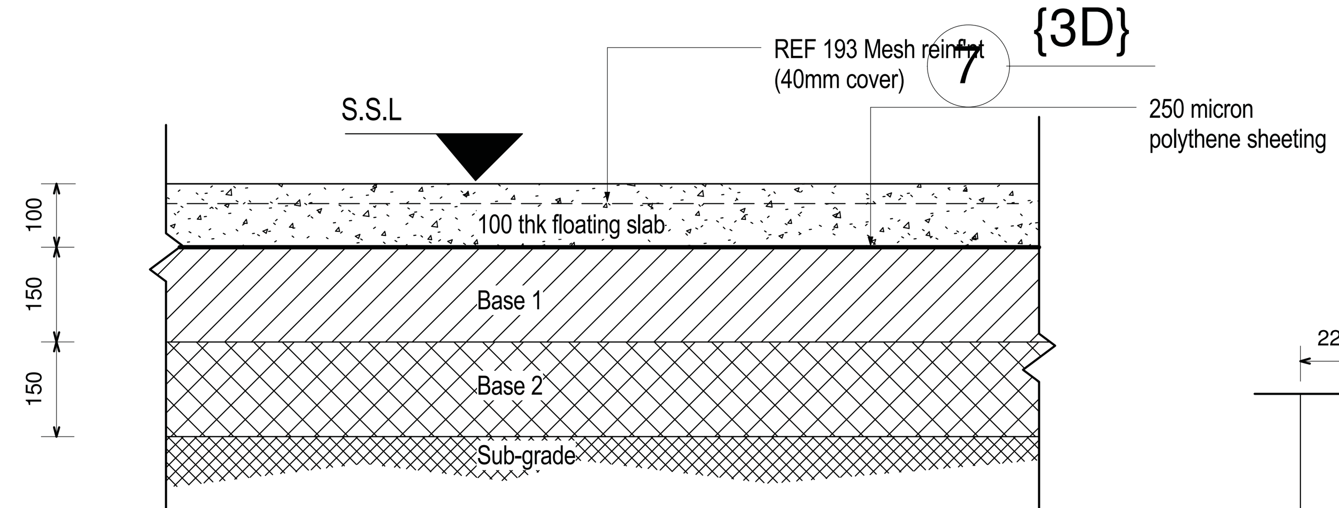


5 00 Roof Slab
1 : 10

NOTES:
1.Grade of concrete to be 25Mpa
2.R floor slab thickness is 75mm

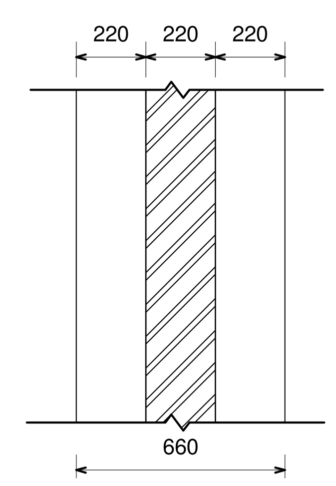


1 Typical cross section detail through external wall
1 : 20



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

2 Floating slab detail
1 : 10



3 Strip footing/wall plan detail
1 : 20

No	DATE	REVISION	ISSUED BY

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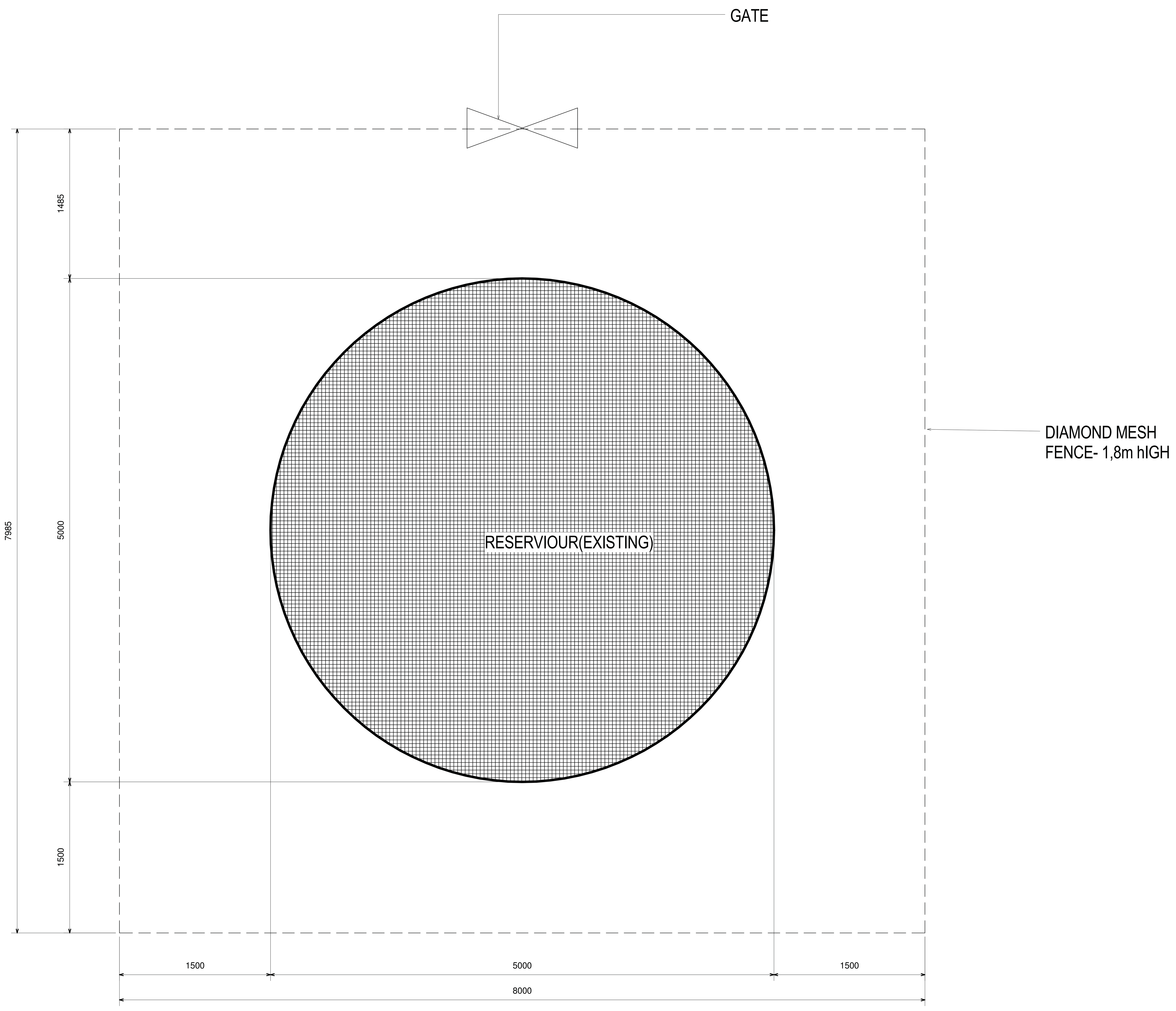
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - PHIRING

DRAWING DESCRIPTION
VALVE BOX

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C04
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C04

K1/12607/1-C04



1 TANK FENCING
1 : 25

No	DATE	REVISION	ISSUED BY

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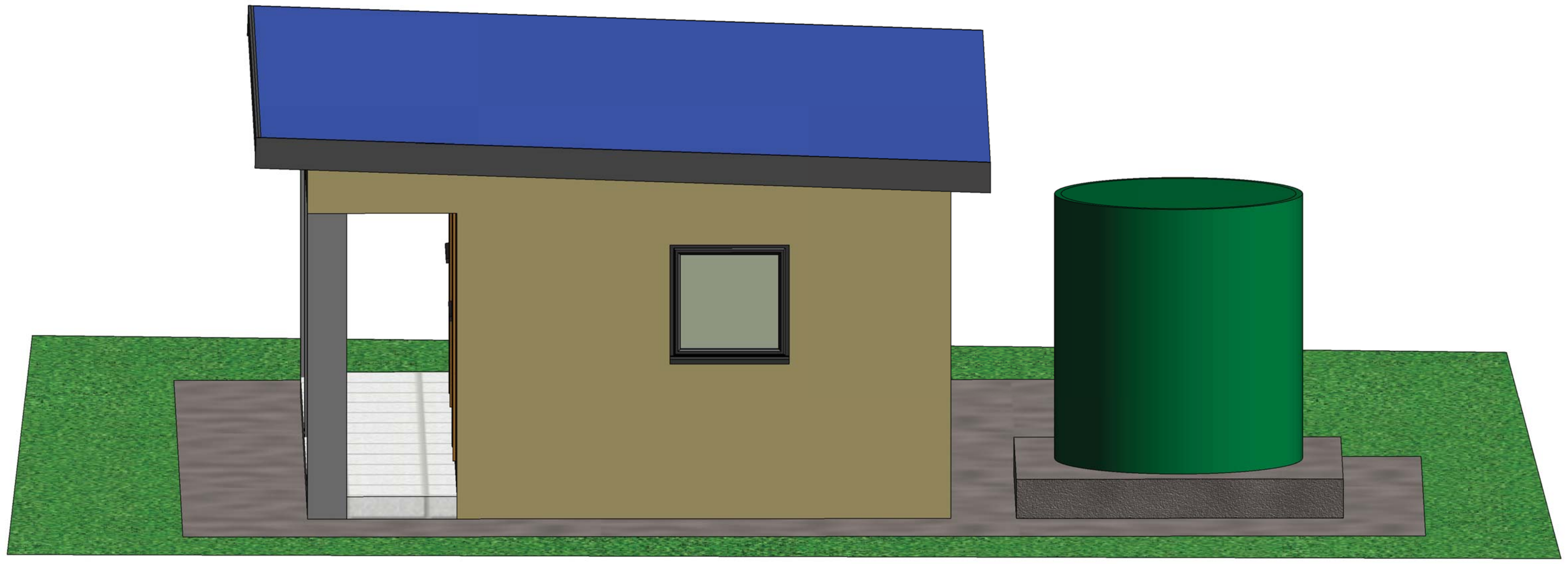
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - PHIRING

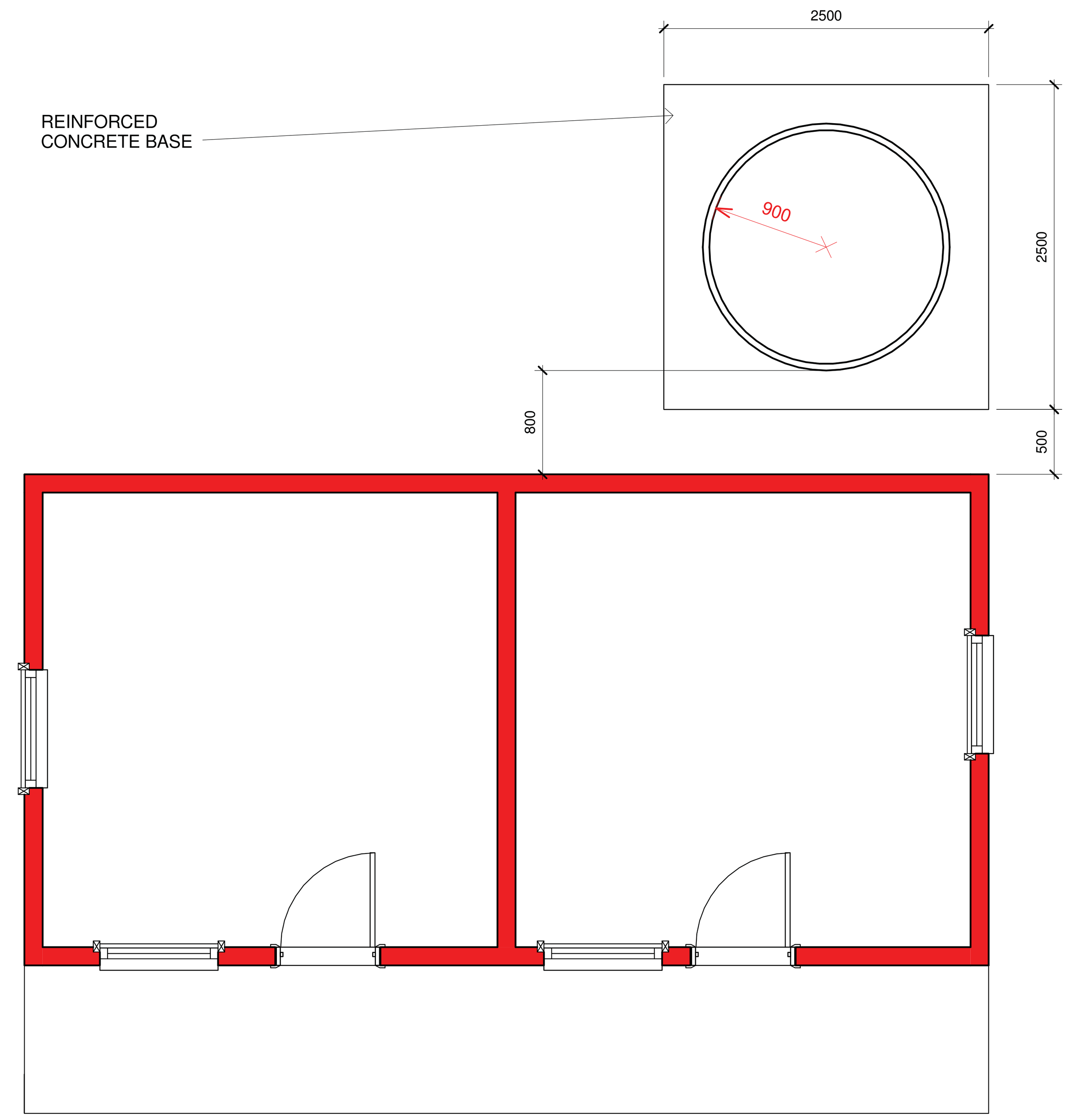
DRAWING DESCRIPTION
RESERVOIR FENCING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C05
DATE JANUARY 2018	SCALE 1 : 25
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C05

K1/12607/1-C05



2 PERSPECTIVE VIEW



1 FLOOR PLAN

1 : 40

3 SIDE ELEVATION

1 : 30

No	DATE	REVISION	ISSUED BY

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DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT DATE

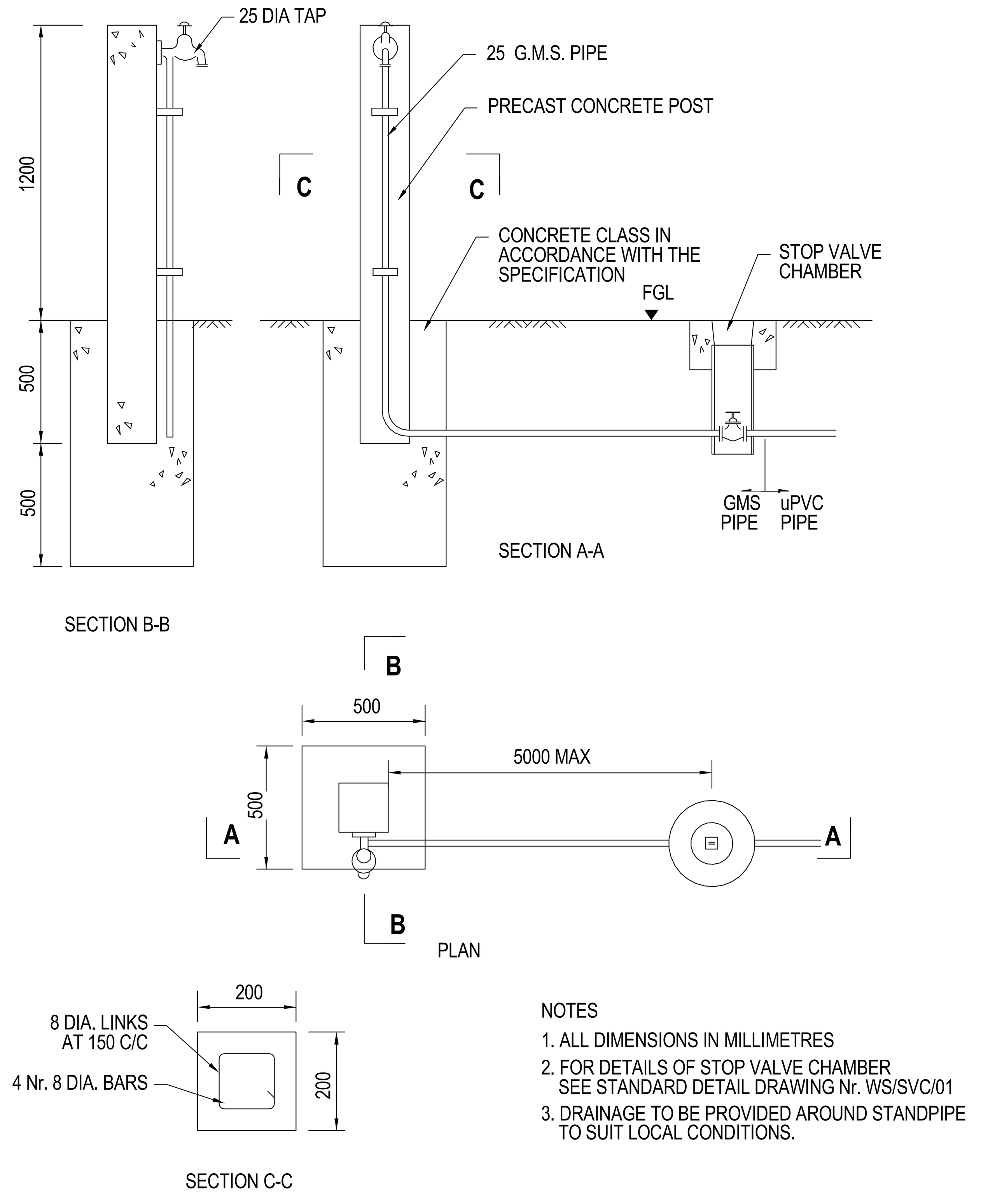
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - PHIRING

DRAWING DESCRIPTION
RAIN WATER HARVESTING

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C06
DATE JANUARY 2018	SCALE As indicated
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C06

K1/2607/1-C06



NOTES
1. ALL DIMENSIONS IN MILLIMETRES
2. FOR DETAILS OF STOP VALVE CHAMBER SEE STANDARD DETAIL DRAWING Nr. WS/SVC/01
3. DRAINAGE TO BE PROVIDED AROUND STANDPIPE TO SUIT LOCAL CONDITIONS.

1 STAND PIPE DETAIL

1 : 1

Stand Pipe - Type 1

Stand Pipe - Type 2

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT DATE

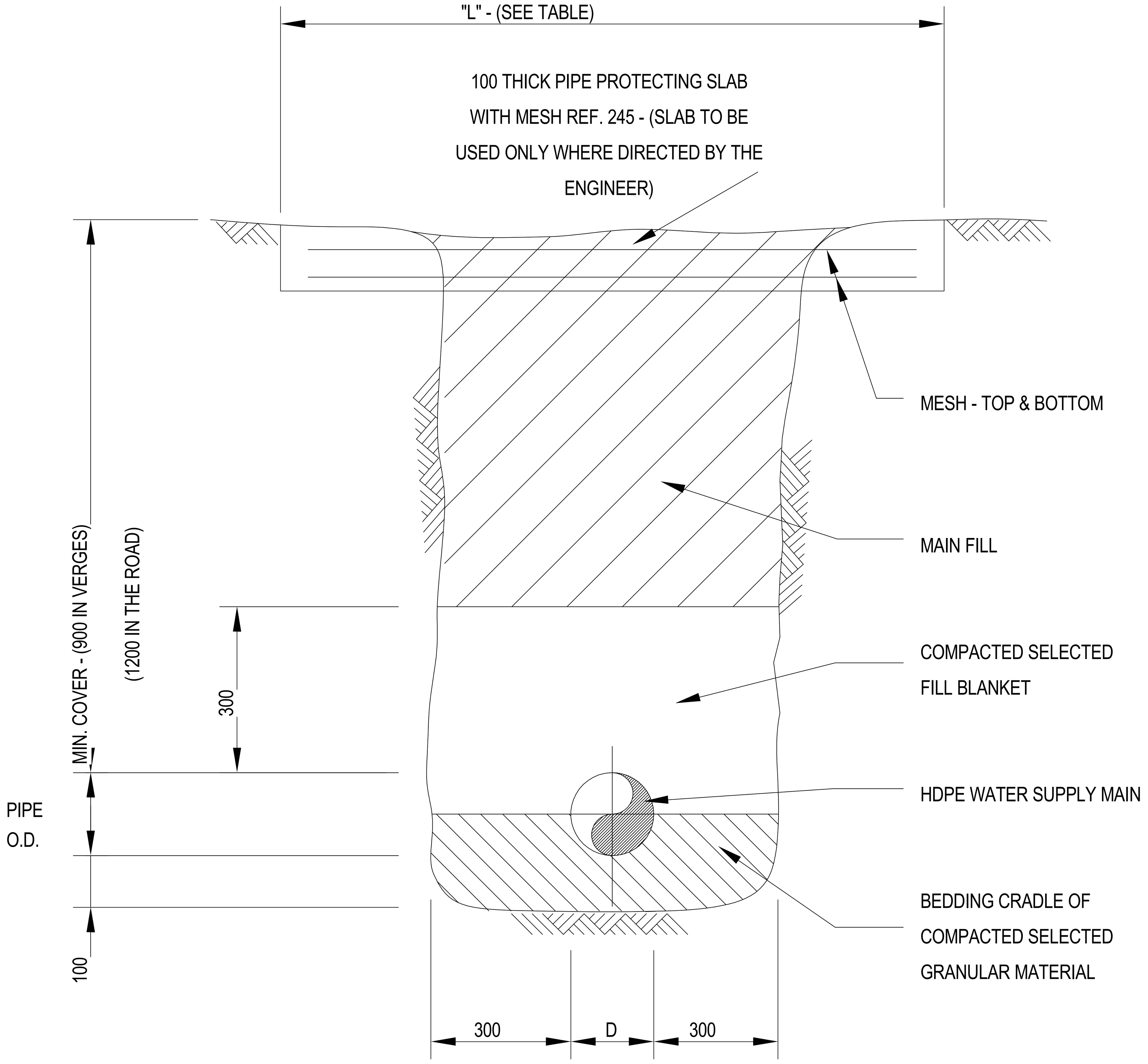
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - PHIRING

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C07
DATE	SCALE
JANUARY 2018	1 : 1
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE				
PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS
1 : 65

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

WATER RESEARCH COMMISSION

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CLIENT DATE

CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - PHIRING

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C08
DATE	SCALE
JANUARY 2018	1 : 65
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C08

K1/2607/1-C08

Appendix 6

OPERATIONALISING MULTIPLE USE WATER SERVICES (MUS) IN SOUTH AFRICA

Draft design information for Tshakhuma

1. SEKHUKHUNE DISTRICT MUNICIPALITY.

   - FETAKGOMO/GREATER TUBATSE LOCAL MUNICIPALITY.

     A. PHIRING

     B. GA-MOKGOTHO

     C. GA-MOELA

2. VHEMBE DISTRICT MUNICIPALITY.

   - MAKHADO LOCAL MUNICIPALITY

     A. TSHAKHUMA

     B. KHALAVHA

     C. HA-GUMBU

Prepared by:

Tsogang Water and Sanitation

P.O. Box 1111

Tzaneen, 0850

Work Design and Summary of the Diagnosis report.

Description of the village.

Tshakhuma, ward 6 in Makhado Local Municipality, Vhembe District, is a large village of over 4000 households along the main road R524 between Makhado and Thohoyandou. Pre-1994, Tshakhuma was at the border of the former Venda homeland and the white Republic of South Africa. In the latter, extensive large-scale irrigated agriculture and forestry took place, both fed by good rains and by the LevhuvhuRiver that passes south of Tshakhuma. After removal from the former white Republic of South Africa, population density is high and continues to grow in this peri-urbanizing area. There are 11 sections in Tshakhuma. In most cases, the boundaries between the sections are streams. Mulangaphuma, Muhovhoya, Maswie, Thondoni, Tswiswiswini, Mutshidoni, Mathavha, Lukau, and Dzananwa(which participate in the MUS project) and Luvhalani and Tshitavhadulu (which do not participate).Luvhalani is at the centre and includes the vibrant post-1994 fresh market; this section was not interested to participate in the MUS project (However, the small northern part of Luvhalani shares the scheme of Muhovhoya). Tshitavhadulu is situated south of the road and uses water from boreholes; the project did not include this section. The total number of households in the nine participating sections is 3260 with an estimated total population of about 16300.

Current Water Resources.

Ten of the eleven water systems(excluding Maswie) depend on streams, springs and rivers flowing from the mountains for water. Water sources are protected with concrete catchments to allow intake to abstract water into the pipeline connecting the source to the storage. The storage is made up 10 000 to 5,000 litre jojo tanks which each community use to store water, water is distributed throughoutlet pipelines made up of poly pipes into individual households. People in each households use water for various water uses to improve their livelihoodslike homesteads gardens, livestock, orchards trees, poultry and small businesses.

There is a Bulk water system established, owned, operated and maintained by Vhembe District Municipality but residents are not happy with its service. Residents get water sporadically, and the community has not been involved at all. Commercial farmers' concrete water canal providing water to nearby farms crosses the village, and locals use water from this resource for other multiple use water services like car wash etc.

Water Quality test.

Vhembe District Municipality officials collected water samples in January 2018 and conducted tests for both chemical and bacteriological contamination from all eleven water schemes including Maswie borehole. The results are back and officialsidentified problems in Mulangapuma and Mohuvhoya water sources, the problems are not serious as communities are currently using water for domestic and other productive uses.As part of the interventions in Mulangaphuma and Mohuvoya, Tsogang will work with other stakeholders and the community to raise awareness and implement water treatment mechanisms at household level.

Design horizon for domestic and productive use supplies.

Village name	Current population	Current households	Design population (20 years)	Minimum water need (Litres/day)	Currentlyavailable source quantity (Q) (Litres/day)	Excess Q Available for MUS over minimum requirement
Tshakhuma						
Lukau Source 1 & 2	**1 050**	**210**	**1 560**	**39 000**	**328320**	**289 320**
Thondoni	3 750	750	5 572	139 300	604 800	585 500
Mulangapuma 2	1 700	340	2 526	63 150	70 848	7 698
Mulangapuma 1	1 310	262	1 947	48 675	151 200	102 525
Muhovhoya 2.	1 750	3250	2 600	65 000	51 840	-13 160
Muhovhoya 1.	1 500	300	2 229	55 725	151 200	95 475
Maswie	1 075	215	1 597	39 925	105 840	65 915
Matavha	525	105	780	19 500	4 320	-15 180
Mutshindoni	1 160	232	1 724	43 100	39 744	-3 356
Dzananwa	1 410	282	2095	52 375	50 112	-2263
Tshiswiswini source	645	129	958	23 950	302 400	278 450

Available water for Multiple Use Water Services, delivery pipe size and head loss calculations

Measurements at site									Selected		Calculated		
System	From	Elevation m	To	Elevation m	Elev Diff (H_d) m	Min H m	Q l/s	Pipe length m	Pipe dia. mm	Pipe Class	H_f m/100m	Total head loss m	Residual head m
Tshakhuma Maswie	Borehole	670	Storage	741	71	10	2.45	700	50	9	3.2	22.4	93.4
Tshakhuma Lukau	Spring 1	926	Storage	836	90	10	3.5	600	32	9	5.3	31.8	58.2
Tshakhuma Lukau	Spring 2	876	Storage	836	40	10	0.3	500	32	6	0.6	3	37
Tshakhuma Thondoni	stream	912	Storage	868	44	10	7	1000	75	6	3.1	31	13
Tshakhuma Dzanawa	Spring	753	Storage	724	29	10	0.58	600	32	6	1.9	11.4	17.6
Tshakhuma Mtshundoni	Spring	836	Storage	759	77	10	0.46	800	25	6	4.2	33.6	43.4
Tshakhuma Matavha	Spring	847	Storage	764	83	10	0.5	750	25	9	4.9	36.75	46.25
Tshakhuma Tshiswiswini	Spring	875	Storage	828	47	10	3.5	900	63	6	2	18	29
Tshakhuma Mulangapuna 1	Stream	855	Storage	750	105	10	1.75	2000	50	9	1.7	34	71
Tshakhuma Mulangapuna 2	Stream	730	Storage	715	15	10	0.82	1500	50	6	0.4	6	9
Tshakhuma Muhovhoya 1	Stream	810	Storage	801	9	10	1.75	700	75	6	0.25	1.75	7.25
Tshakhuma Muhovhoya 2	Spring	956	Storage	845	111	10	0.6	800	25	9	6.9	55.2	55.8

Proposed works at source, conveyance, storage and reticulation based on the demographic forecast and MUS design discharge.

a. Lukau Section.

- **Two springs require refurbishment of a collection chamber;**activities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. Two sources combined provide 328320 litres of water per 24 hours to supply 225 households projected to be in the area. Once the system has been improved each household will have access to 1459 litres of water per day for domestic and multiple use water services. Leading to each person receiving 292 litres per person per day from this system alone as opposed to infrequent and unreliable supply from the government system.

- **Water Storage,** currently the community uses 4 x 5 000 litres jojo tanks for storage and it is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. Two water sources provide 328320 litres of water per day and during participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increased to 30 000 litres of water per day meaning each household can collect 133 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 400m from the source to the storage translating into 67 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley.

- **Household yard Connections**, refurbish existing water connections to individual household yards for about 225 households.Water is used for domestic and productive use. This will also make water more accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Lukau need to be fenced to protect the resource against wild animals and from vandals destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried out are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

b. Thondoni.

- **One Stream requires refurbishment of a collection chamber,** activities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. Two sources combined provide 604800 litres of water per 24 hours to supply750 households projected to be in the area. Once the system has been improved each household will access 806 litres of water per day for domestic and multiple use water services. Leading to each person getting 161 litres per person per day from this system alone as opposed to infrequent and unreliable supply from the government system.

- **Water Storage,** currently the community uses 4 x 10 000 litres jojo tanks for storage and it is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. Water sources provide 604800 litres of water per day and during participatory consultative meetings members proposed a need for storage to be increased by adding additional 2 x 10 000 litres jojo tanks. After the refurbishment the storage will be increased to 60 000 litres of water per day meaning each household can collect 80 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 2400m from the source to the storage translating into 400 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley**.**

- **Household yard Connections**, refurbish existing water connections to individual household yards for about 750 households, water is used for domestic and productive use. Already community members have water connected to their yards but improvements need to be done to stop leakages. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the storage tanks.** The storage tanks in Thodoni need to be fenced to protect the resource against wild animals and strangers from destroying the resource. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

c. Mulangapuma 2.

- **Two springs require refurbishment.** For a collection chamber**,** activities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. Two sources combined provide 70848 litres of water per 24 hours to supply 340 households projected to be in the area. Once the system has been improved each household will have access to more than 208 litres of water per day for domestic and multiple use water services.

- **Water Storage,** currently the community uses 4 x 5 000 litres plus 1 x1000 litres jojo tanks for storage, this is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough and people share water. During participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increased to 30 000 litres of water per day meaning each household can collect 133 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 1250m from the source to the storage translating into 208 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas where the pipeline crosses dongas and valley**.**

- **Household yard Connections**, refurbish existing water connections to individual household yards for about 340 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source,** the source in Mulangapuma 2 needs to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

d. Mulangapuma 1.

- **One stream source requires refurbishment** of a collection chamber**. A**ctivities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. One source provide 151200 litres of water per 24 hours to supply 262 households projected to be in the area. Once the system has been improved each household will have access to 577 litres of water per day for domestic and multiple use water services. Leading to each person getting 115 litres per person per day from this system alone as opposed to infrequent and unreliable supply from the government system.

- **Water Storage.C**urrently the community uses 5 x 5 000 litres jojo tanks for storage and it is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. A sources provides 151200 litres of water per day and with improvement done on the source more water will be available. During participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increase to 35 000 litres of water per day meaning each household can collect 133 litres of water per day from the storage.

- **Replace damaged leaking pipeline from the source to storage. T**he pipeline length is 3558m from the source to the storage translating into 593 tasks of pipe laying to be constructed. Activities to be carried out are as follows: site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley.

- **Household yard Connections**, refurbish existing water connections to individual household yards for about 262 households including those who are not connected, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the storage tanks.** The storage site in Mulangapuma 1 needs to be fenced to protect the resource against wild animals and strangers from destroying the resource. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

e. **Muhovhoya 2.**

- **One**s**pring requires refurbishment of a** collection chamber**. A**ctivities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. The source provide 51840 litres of water in 24 hours to supply 350 households projected to be in the area. Once the system has been improved each household including the once without access will get enough water.

- **Water Storage,** currently the community uses 4 x 5 000 litres jojo tanks for storage and it is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. One water source provide 51840 litres of water per day and with improvement done on the source more water will be available and during participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increase to 30 000 litres of water per day meaning each household can collect 86 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 2100m from the source to the storage translating into 350 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connections**. Refurbish existing water connections to individual household yards including those not benefiting for about 350 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Muhovhoya 2 need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

f. **Muhovhoya 1**. This is a complicated water scheme, privately owned and community members pay a subscription fee on monthly basis. Lately the owner decided to withdraw from the programme. The proposed scope of work will help individual households that cannot afford to pay monthly contributions and don't have access to water at all.

- **One**s**pring requires refurbishment of a collection chamber.** Activities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. One source provides151200 litres of water in 24 hours to supply 350 households projected to be in the area. Once the system has been improved each household will have access to 1459 litres of water per day for domestic and multiple use water services.
- **Water Storage,** currently there is no storage at all. During participatory consultative meetings members proposed a need for storage to allow them to store water. The proposed storage are 2 x 5000 litres jojo tanks installed above the village.

- **Install a new pipeline from the source to storage,** the pipeline length will be 1624 m from the source to the storage translating into 271 tasks of pipe laying to be constructed. Activities to be carried out are; site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connection**, Households undertook to buy materials and provide labour to have this activity completed. The main reason being communal stand pipes are not sustainable, children play with them and there are issues of vandalism. This will also make water accessible to more community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Mohuvhoya 1 need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

g. Maswie.

This section is different from the other water schemes in the area because Maswie water source is a borehole drilled by Vhembe District Municipality. Tsogang received permission from the Municipality to connect the pipeline.

- **Install the main pipelinefrom the Municipality borehole to the storage tanks**, the pipeline will provide water services to 215 households in the area. Activities to be conducted are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval to cover a distance of 1000m from the borehole to the jojo tank, the distance is translated into 167 tasks of pipe laying to be layed in the area.

- **Water storage**, Maswie borehole provides 105840 litres of water in 12 hours, the proposed storage system for Maswie section is 4 x 5000 litres jojo tanks = 20 000 litres which is enough and meant to supply water to 215 households in the area. So each household will collect 93 litres per day. Activities to be carried out include the following site clearing, dig foundation, transport materials, cast concrete slabs, erect steel tank stands, install jojo tanks with anchor ties, connect source pipe and delivery connections.

- **Reticulation Pipeline** from the storage to household section covers a distance of about 1500 m, activities are as follows, site clearing, mark tasks, dig trenches, lay bedding, connect pipes and backfill after approval to cover a reticulation system for about 1500m with is equal to 250 task of pipelaying with standpipes installed at RDP standard, 200m away from each households.

h. Matavha.

- **One spring requires refurbishment of a collection chamber.** Activities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. With renovations done the source yield will improve and be able to meet water demand.

- **Water Storage,** currently the community uses 2 x 5 000 litres jojo tanks for storage, this is not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. During participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increase to 20 000 litres of water per day meaning each household can collect 190 litres of water from the tanks.
-
- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 1648m from the source to the storage translating into 275 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley**.**

- **Household yard Connections**, refurbish existing water connections to individual household yards for about 105 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Mathavha need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried out are; clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

i. Mutshindoni.

- **One**s**pring requires refurbishment of a collection chamber. A**ctivities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. Once the system has been improved each household will have access to more than 1500 litres of water per day for domestic and multiple use water services.

- **Water Storage,** currently the community uses 4 x 5 000 litres jojo tanks for storage and it is not enough to supply water to all households. The water system is used rotationally because the storage is not enough. One source provide 43200 litres of water per day but with refurbishment done this can be improved. And during participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks leading to 30 000 litres of water per daymeaning each household can collect 133 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 2970m from the source to the storage translating into 495 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connection**s. Refurbish existing water connections to individual household yards including those not connect for about 232 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Mutshindoni need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

j. Dzananwa.

- **One spring requires refurbishment at a collection chamber. A**ctivities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. The source provides51840 litres of water in 24 hours to supply 282 households projected to be in the area. Once the system has been improved each household will have access to more than 15000 litres of water per day for domestic and multiple use water services.

- **Water Storage,** currently the community uses 5 x 5 000 litres jojo tanks for storage, the fifth jojo tank is damaged andjojo tanks are not enough to supply water to all households. The water system is operated rotationally because the storage is not enough. During participatory consultative meetings members proposed a need for storage to be increased by adding additional 2x 5000 litres jojo tanks. After the refurbishment the storage will be increased to 30 000 litres of water per day meaning each household can collect 133 litres of water per day.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 782m from the source to the storage translating into 130 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connection**, refurbish existing water connections to individual household yards for about 282 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source and storage tanks.** The source and storage tanks in Dzananwa need to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

k. Tshiswiswini.

- **Two springs require refurbishment of a collection chamber. A**ctivities to be carried out are: clear the site, transport materials to spring site from store, dig new foundation for water collection chambers, lay concrete for retaining wall, install steel reinforcing to concrete structure, build walls, cast cover slabs for collection chambers, lay supply pipe from source to collection chambers plus overflow and delivery pipes. Two sources combined provide more than 302400 litres of water in 24 hours to supply 129 households projected to be in the area. Once the system has been improved each household will have access to 2344 litres of water per day for domestic and multiple use water services.

- **Water Storage,** currently the community uses 7 x 5 000 litres jojo tanks for storage, it is fenced andenough to supply water to all households. The water system is operated none stop and the community has water 24 hours, there is no need for additional storage in this area.

- **Replace damaged leaking pipeline from the source to storage,** the pipeline length is 1212 m from the source to the storage translating into 202 tasks of pipe laying to be constructed. Activities to be carried out are as follows site clearing, mark tasks, dig trenches, lay bedding, connect pipes, backfill (leaving joints exposed), and backfill joints after approval. Build pipeline supports at areas were the pipeline crosses dongas and valley

- **Household yard Connection**, refurbish existing water connections to individual household yards including those who don't access water for about 129 households, water is used for domestic and productive use. This will also make water accessible to community members and allow people to engage in multiple use activities without having to transport from communal stand pipes. Materials to use are HDPE pipes, fittings, stand pipes, taps and control valves.

- **Fence the source,** the source in Tshiswiswini needs to be fenced to protect the resource against wild animals and strangers from destroying the resource. An amount of water will be allowed to pass the collection point for streams to continue flowing and provide small animals drinking earth dams. Activities to be carried are to clear the site, mark & dig fence holes, install fence poles with concrete, erect wire & diamond mesh and install a gate. Materials to be used are diamond mesh wire, concrete, blue wire, poles, staples and gates.

l. Other Multiple and Productive Uses.

- **Homestead interventions,** community memberswill identify members to be trained in brick tank stand construction, guttering fitment, tank installation and assist households to connect water to homestead gardens, poultry, small businesses and other MUS initiatives in the area.

- **Tsogang will train** community members on basic technical skills like the identification of quality material, operation & maintenance, project management, water quantity and quality tests, bookkeeping and Institutional & Social Development.

m. Implementation Phase, time frames and methodology.

- The scope of works in Tshakhuma's eleven sections include the following, install the pipeline from the source to the storage, connect water to households, extend the reticulation, homestead interventions, capacity building and water storage development including water sources will be implemented in six months using community labour from Tshakhuma and officials from Tsogang for activities that require special skills and knowledge. Workers will be recruited from the community using a legal entity called close co-operatives in the village to manage the implementation at local level and pay stipends based on tasks completed with the help of Tsogang Water and Sanitation's supervision.

n. Procurement of Goods and Services.

- Materials for the multiple use water services project will be procured in Limpopo Province using local suppliers in the area and nearby towns like Polokwane, Tzaneen, Burgersfort, Thohoyandou and Jane Furse. Purchasing will only take place outside Limpopo Province for items that cannot be found or procured in the area**.** Tshakhuma projectmaterial orders for eleven sections will be placed to suppliers separately from other villages and more than three quotations will be gathered using a shopping exercise. All the procurement documents like quotations and close co-operatives documents will be submitted to the Water Research Commission for the process to start and be finalised. Tsogang will create a filing system to keep all project procurement and other documentation in good order for future references and accountability**.** Tsogang will receive, store and dispatched project material as requested using appropriate documents like deliverable notes etc. See the Proposal note for information.

o. Project Costs.

- Summary of the costs to increase the availability of water in the village, refurbish the existing water infrastructure, support community water innovations & initiatives, connect water to other services like homesteads gardens, livestock, irrigation, community development centres and small businesses.

	1.DZANANWA.					
Lot number	Item	Material costs	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developme	9,586	6xShade Netting 95% 1m x 3m, 20x42.5 ppc cement,1xRiver sand 3 cubes load, 1x19mm Concrete 3 cubes Load, 10xY12 reinforcement, 1000 x Maxi Bricks, 1x50mm HDPE filters, 1x Socket Red Galv 50x40mm, 1xBuilding sand	7,754	17,340	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing.	12,614	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 8xStay 2.4 Hd, 9xStay Bolt M10 x 100,1xPlain wire 4mm x 50kg, 1xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 19mm concreate 3 cubes load.	-	12,614	
3	Water Storage Development.	24,011	2x5000 litre Jojo Tank, 20x 42.5 ppc cement, 2xRiver sand 3 cubes load, 1xFilter Amiad 40mmx200mm, 6x40mm male adaptors, 1000 x Cement Maxi Bricks, 1xBuilding sand, 2x19mm Concrete 3 cubes Load.	-	24,011	
4	Water Storage Fencing.	12,614	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 8xStay 2.4 Hd, 9xStay Bolt M10 x 100,1xPlain wire 4mm x 50kg, 1xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 19mm concreate 3 cubes load.	-	12,614	
5	Water Mainline & Reticul	5,157	2x20mm HDPE pipe cls 6, 5x50mm HDPE climb, 4x40mm HDPE climb, 4x32mm HDPE climb, 5x 50mm HDPE straight joint, 4x40mm HDPE straight joint, 4x32mm HDPE straight joint,1x 40mm Air valve, 20x40mm male adaptor, 10x 40mm ball valves.	-	5,157	
	Total	63,982	-	7,754.00	71,736	

	2.MUTSHINDONI					
Lot number	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developme	9,259	10xShade Netting 95% 1m x 3m, 10x42.5 ppc cement,1xRiver sand 3 cubes load, 1x19mm Concrete 3 cubes Load, 10xY12 reinforcement, 1000 x Maxi Bricks, 1x50mm HDPE filters, 1x Socket Red Galv 50x40mm, 1xBuilding sand	7,754	17,013	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing.	12,740	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 9xStay 2.4 Hd, 9xStay Bolt M, 9 x 100,1xPlain wire 4mm x 50kg, 1xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 19mm concreate 3 cubes load.	-	12,740	
3	Water Storage Development.	23,152	2x5000 litre Jojo Tank, 20x 42.5 ppc cement, 2xRiver sand 3 cubes load, 1xFilter Amiad 40mmx200mm, 6x40mm male adaptors, 1000 x Cement Maxi Bricks, 1xBuilding sand, 2x19mm Concrete 3 cubes Load.	-	23,152	
4	Water Storage Fencing.	12,740	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 9xStay 2.4 Hd, 9xStay Bolt M, 9 x 100,1xPlain wire 4mm x 50kg, 1xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 19mm concreate 3 cubes load.	-	12,740	
5	Water Mainline & Reticul	1,220	20x40mm HDPE climb, 10x40mm HDPE straight joint,2x 40mm Air valve, 18x40mm male adaptor, 10x 40mm ball valves.	-	1,220	
	Total	59,112	-	7,754.00	66,866	

	3.MATAVHA					
Lot numbe	**Item**	**Material cost**	**Lots material**	**Stipend**	**Total**	**Remarks on Stipend.**
1	**Water Source Developme**	14,787	10xShade Netting 95% 1m x 3m, 50x42.5 ppc cement,1xRiver sand 3 cubes load, 1x19mm Concrete 3 cubes Load, 10xY12 reinforcement, 1000 x Maxi Bricks, 1x40mm HDPE filters, 1x Socket Red Galv 50x40mm, 1xBuilding sand	7,754	22,541	This amount covers stipend for all activities in this water scheme.
2	**Water Source Fencing.**	12,061	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 8xStay 2.4 Hd, 8xStay Bolt M10 x 100,0.5xPlain wire 4mm x 50kg, 0.5xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 19mm concreate 3 cubes load.	-	12,061	
3	**Water Storage Development.**	23,152	2x5000 litre Jojo Tank, 20x 42.5 ppc cement, 2xRiver sand 3 cubes load, 1xFilter Amiad 40mmx200mm, 6x40mm male adaptors, 1000 x Cement Maxi Bricks, 1xBuilding sand, 2x19mm Concrete 3 cubes Load.	-	23,152	
4	**Water Storage Fencing.**	12,061	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 9xStandard security Pole 2.4m, 8xStay 2.4 Hd, 8xStay Bolt M 10 x 100,0,5xPlain wire 4mm x 50kg, 0,5xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 x19mm concreate 3 cubes load.	-	12,061	
5	**Water Mainline & Reticul**	2,845	1x32mm HDPE pipe cls 6, 15x32mm HDPE climb, 8x32mm HDPE straight joint,2x 40mm Air valve, 16x40mm male adaptor, 8x 40mm ball valves.	-	2,845	
	Total	64,907	-	7,754.00	72,661	

	4.MASWIE, Water Source is a Borehole.					
Lot number	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Fencing.	11,480	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 6xStandard security Pole 2.4m, 8xStay 2.4 Hd, 8xStay Bolt M10 x 100,0.5xPlain wire 4mm x 50kg, 0.5xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 x19mm concreate 3 cubes load.	7,760	19,240	This amount covers stipend for all activities in this water scheme.
2	Water Storage Development.	21,071	3x5000 litre Jojo Tank, 10x 42.5 ppc cement, 1xRiver sand 3 cubes load,, 1x 19mm crushers stonex 3cubes load, 1x filter amiad 40mm x 200 mm, socket red galv 50mm x 40mm.	-	21,071	
3	Water Storage Fencing.	11,480	1xWeld Mesh 1.8m x 30m, 5xSecurity post pole 2.4m, 6xStandard security Pole 2.4m, 8xStay 2.4 Hd, 9xStay Bolt M10 x 100,0.5 xPlain wire 4mm x 50kg, 0.5xPlain wire 1.6mm x 5kg, 1xSecurity Gate 1.8m single, 1x River sand, 0.5 x19mm concreate 3 cubes load.	-	11,480	
4	Water Mainline & Reticul	10,810	5x50mm HDPE pipe clas 10, 5 x 50mm Coulping, 1x 40mm Air valve, 12x40mm male adaptor, 6x 40mm ball valve.	-	10,810	
	Total	54,841	-	7,760.00	62,601	

	5.MULANGAPUMA TWO					
Lot numbe	**Item**	**Material cost**	**Lots material**	**Stipend**	**Total**	**Remarks on Stipend.**
1	**Water Source Developement**	10611	5 X Shade Netting 95% 1m x 3m, 8 X42.5 ppc cement, 1 X River sand 3 cubes load, 1 X19mm Concrete 3 cubes Load, 10 X Y12 reinforcement, 1000 X Maxi Bricks, 1 X 50mm HDPE filters, 2 X Filter Amiad 40mmx200mm, 1 X Socket Red Galv 50x40mm	7,754	18,365	This amount covers stipend for all activities in this water scheme.
2	**Water Source Fencing**	10201	Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 10 X Standard security Pole 2.4m, 9 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		10,201	
3	**Water Storage Fencing**	10201	1 X Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 10 X Standard security Pole 2.4m, 9 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single, Labour		10,201	
4	**Water Storage Development**	15,871	**2 X 5000 litre Jojo Tank**, 10 X**42.5 ppc cement, 1 X River sand 3 cubes load, 1 X19mm Concrete 3 cubes Load, 6 X Y12 reinforcement, 1 X Filter Amiad 40mmx200mm, 1 X Socket Red Galv 50x40mm**		15,871	
5	**Water Main & Reticulatio**	26025.78	2 X 75mm HDPE pipe cls6, 2 X 63mm HDPE piple cls6, 2 X50mm HDpe pipe cls 6, X 40mm HDPE pipe cls 6, 2 X 32mm HDPE pipe cls 6, 2 X20mm HDPE pipe cls 6, 1 X 75mm to 63mm reducer, 1 X 63mm to 50mm reducer, 1 X 50mm to 40mm reducer, 1 X 40mm to 32mm reduce, 1 X 32mm to 20mm reducer, 1 X 75mm HDPE clamps, 4 X 63mm HDPE clamps, 4 X 50mm HDPE clamps, 1 X 40mm HDPE clamps, 3 X 32mm HDPE clamps, 3 X 20mm HDPE clamps, 1 X 40mm Air Valve, 8 X 40mm ball valve, 1 X 40mm male adaptor		26,026	
	Total	72,910	-	7,754.00	80,664	

	6.MULANGAPUMA ONE					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developement	10984.66	6 X Shade Netting 95% 1m x 3m, 10 X 42.5 ppc cement, 1 X River sand 3 cubes load, 1 X 19mm Concrete 3 cubes Load, 10 X Y12 reinforcement, 1000 X Maxi Bricks, 1 X 50mm HDPE filters, 2 X Filter Amiad 40mmx200mm, 2 X Socket Red Galv 50x40mm	7,754	18,739	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing	5728.2	5 X Security post pole 2.4m, 10 X Standard security Pole 2.4m, 9 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		5,728	
3	Water Storage Fencing	10201.15	1 X Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 10 X Standard security Pole 2.4m, 9 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.50 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		10,201	
4	Water Storage Development.	23152.44	**2 X** 5000 litre Jojo Tank, 20 X 42.5 ppc cement, 2 X River sand 3 cubes load, 1 X Filter Amiad 40mmx200mm, 6 X 40mm male adaptors, 1000 X Maxi Bricks, 1 X Building sand, 2 X 19mm Concrete 3 cubes Load		23,152	
5	Water Main & Reticulatio	25009.33	1 X 75mm HDPE pipe cls6, 2 X 63mm HDPE piple cls6, 2 X 50mm HDpe pipe cls 6, 2 X 40mm HDPE pipe cls 6, 2 X32mm HDPE pipe cls 6, 5 X20mm HDPE pipe cls 6, 1 X75mm to 63mm reducer, 1 X 63mm to 50mm reducer, 1 X50mm to 40mm reducer, 1 X 40mm to 32mm reduce, 1 X 32mm to 20mm reducer, 2 X 75mm Clamps, 10 X 63mm HDPE Clamps, 7 X 50mm HDPE Clamps, 4 X 40mm HDPE Clamps, 5 X 32mm HDPE Clamps, 10 X 20mm HDPE Clamps, 2 X 40 mm Air valves, 8 X 40mm ball valves, 16 X 40mm male adaptors		25,009	
	Total	75,076	-	7,754.00	80,830	
		75,075.78		7,754.00	82,829.78	

	7.THONDONI					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developement	7742.54	6 X Shade Netting 95% 1m x 3m, 10 X 42.5 ppc cement, 1 X River sand 3 cubes load, 1 X 19mm Concrete 3 cubes Load, 10 X Y12 reinforcement, 2 X Filter Amiad 40mmx200mm, 4 X Socket Red Galv 50x40mm	7,754	15,497	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing	9881.04	1 X Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 9 X Standard security Pole 2.4m, 8 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		9,881	
3	Water Storage Fencing	5408.09	5 X Security post pole 2.4m, 9 X Standard security Pole 2.4m, 8 X Stay 2.4 Hd, 9 X Stay Bolt M10 x 100, 0.5 Plain wire 4mm x 50kg, 0.50 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		5,408	
4	Water Main & Reticulatio	16334.64	2 X 75mm HDPE pipe cls 10, 1 X 75mm coupling, 1 X 50mm HDPE filters, 2 X 40mm Air valve, 1000 X Maxi Bricks, 8 X 40mm ball valve, 10 X 40mm male adators		16,335	
	Total	39,366	-	7,754.00	47,120	

	8. LUKAU					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developement	13592.98	5 X Shade Netting 95% 1m x 3m, 10 X 42.5 ppc cement, 1 X River sand 3 cubes load, 1 X 19mm Concrete 3cubes Load, 10 X Y12 reinforcement, 1 X 90mm HDPE pipes cls6, 1 X 50mm HDPE filters, 1 X Filter Amiad 40mmx200mm, 1 X Socket Red Galv 50x40mm	7,754	21,347	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing	10684.18	1 X Weld Mesh 1.8m x 30m, 8 X Security post pole 2.4m, 10 X Standard security Pole 2.4m, 10 X Stay 2.4 Hd, 10 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg		10,684	
3	Water Storage Fencing	11226.12	1 X Weld Mesh 1.8m x 30m, 8 X Security post pole 2.4m, 10 x Standard security Pole 2.4m, 10 x Stay 2.4 Hd, 10 x Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		11,226	
4	Water Storage Development.	23152.44	2 X 5000 litre Jojo Tank, 20 x 42.5 ppc cement, 2 x River sand 3 cubes load, 1 x Filter Amiad 40mmx200mm, 6 X 40mm male adaptors, 1000 X Maxi Bricks, 1 X Building sand, 2 X 19mm Concrete 3 cubes Load		23,152	
5	Water Reticulation Pipeli	14654.02	1 X 75mm HDPE pipes cls6, 1 X 63mm HDPE pipe cls 6, 1 X 50mm HDPE pipe cls 6, 1 X 90mm to 75mm HDPE reducer, 1 X 75mm to 63mm HDPE reducer, 1 X 63mm to 50mm HDPE reducer, 5 X 50mm climbs, 1000 X Maxi Bricks, 1 X 40mm Air valve, 1 X 40mm ball valve, 1 X 40mm male adaptor		14,654	
	Total	73,310	-	7,754.00	81,064	

	9. TSHISWISWINI					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developement	6181.16	10 X 42.5 ppc cement, 1 X River sand 3 cubes load, 1 X 19mm Concrete3 cubes Load, 10 X Y12 reinforcement, 1 x 50mm HDPE filters, 1 X Filter Amiad 40mmx200mm, 2 X Socket Red Galv 50x40mm	7,754	13,935	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing	20887.52	2 X Weld Mesh 1.8m x 30m, 10 X Security post pole 2.4m, 20 X Standard security Pole 2.4m, 20 X Stay 2.4 Hd, 20 X Stay Bolt M10 x 100, 1 X Plain wire 4mm x 50kg, 1X Plain wire 1.6mm x 5kg, 2 X Security Gate 1.8m single, 2 X Shade Netting 95% 1m x 3m		20,888	
3	Water Storage Fencing	20674.53	2 X Weld Mesh 1.8m x 30m, 10 X Security post pole 2.4m, 20 X Standard security Pole 2.4m, 20 X Stay 2.4 Hd, 20 X Stay Bolt M10 x 100, 1 X Plain wire 4mm x 50kg, 1 X Plain wire 1.6mm x 5kg, 2 X Security Gate 1.8m single		20,675	
4	Water Storage Development.	17952.49	1 X 5000 litre Jojo Tank, 20 X 42.5 ppc cement, 2 X River sand 3 cubes load, 1 X Filter Amiad 40mmx200mm, 6 X 40mm male adaptors, 1000 X Maxi Bricks, 1 x Building sand, 2 X 19mm Concrete 3 cubes Load		17,952	
5	Water Main & Reticulatio	10348.51	3 X 40mm HDPE pipe cls 6, 3 X 20mm HDPE pipe cls 6, 5 X 50mm HDPE climb, 5 X 40mm HDPE climb, 5 X 20mm HDPE climb, 5 X 50mm HDPE straight joint, 5 X 40mm HDPE straight joint, 5 X 20mm HDPE straight joint, 1000 X Maxi Bricks, 1 x 40mm ball valves, 15 X 40mm male adaptor, 3 x 40mm Air Valve		10,349	
	Total	76,044	-	7,754.00	83,798	

	10. MUHUVHOYA TWO					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Water Source Developement	10297.7	20 X 42.5 ppc cement, 1 x River sand 3 cubes load, 1 x 19mm Concrete 3 cubes Load, 12 x Y12 reinforcement, 1000 X Maxi Bricks, 1 x 50 mm HDPE filters, 1 x Filter Amiad 40mmx200mm, 2 X Socket Red Galv 50x40mm	7,754	18,052	This amount covers stipend for all activities in this water scheme.
2	Water Source Fencing	9677.66	1 X Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 8 x Standard security Pole 2.4m, 8 X Stay Bolt M10 x 100, 8 X Stay 2.4 Hd, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		9,678	
3	Water Storage Fencing	9677.66	1 X Weld Mesh 1.8m x 30m, 5 X Security post pole 2.4m, 8 X Standard security Pole 2.4m, 8 x Stay 2.4 Hd, 8 X Stay Bolt M10 x 100, 0.5 X Plain wire 4mm x 50kg, 0.5 X Plain wire 1.6mm x 5kg, 1 X Security Gate 1.8m single		9,678	
4	Water Storage Development	23152.44	2 X 5000 litre Jojo Tank, 20 x 42.5 ppc cement, 2 x River sand 3 cubes load, 1 x Filter Amiad 40mmx200mm, 6 x 40mm male adaptors, 1000 x Maxi Bricks, 1 X Building sand, 2 X 19mm Concrete 3 cubes Load		23,152	
5	Water Main & Reticulatio	19046.24	1 X 32mm HDPE Pipe Cls 6 rolls, 4 X 50mm HDPE Pipe cls 6 rolls,1 X 40mm HDPE pipe cls 6 rolls, 1 X 75mm HDPE pipe cls 6 rolls, 5 X 50mm HDPE coupling, 1 X 50mm to 40mm HDPE reducer, 1 X 40mm to 32mm HDPE reducer, 1 x 75mm to 50mm HDPE reducer, 10 x 50mm nylon straight joint cls3, 15 X 40mm nylon straight joint cls3, 20 x 32mm nylon straight joint cls3, 20 x 50mm climbs, 30 X 40mm climbs, 40 X 32mm climbs, 2 X 40mm Air valve, 4 x 40mm ball valve, 8 X 40mm male adaptors		19,046	
	Total	71,852	-	7,754.00	79,606	

	11. MUHUVHOYA ONE					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
1	Source Developement	6106.49	10 X 42.5 ppc cement, 1 x River sand 3 cubes load, 1 x 19mm Concrete 3 cubes Load, 10 X Y12 reinforcement, 1 X 40mm ball valve, 1 X Filter Amiad 40mmx200mm, 1 X Socket Red Galv 50x40mm	7,754	13,860	This amount covers stipend for all activities in this water scheme.
2	Source Fencing	20606.47	**2 X** Weld Mesh 1.8m x 30m, 15 X Security post pole 2.4m,**12** Standard security Pole 2.4m, 20 X Stay 2.4 Hd, 20 X Stay Bolt M10 x 100, 1 x Plain wire 4mm x 50kg, 1 X Plain wire 1.6mm x 5kg, 2 X Security Gate 1.8m single		20,606	
3	Storage Fencing	20606.47	2 X Weld Mesh 1.8m x 30m, 15 X Security post pole 2.4m, 12 X Standard security Pole 2.4m, 20 XStay 2.4 Hd, 20 X Stay Bolt M10 x 100, 1 x Plain wire 4mm x 50kg, 1 x Plain wire 1.6mm x 5kg, 2 x Security Gate 1.8m single		20,606	
4	Water Storage	12752.54	**2 X** 5000 litre Jojo Tank, 20 X 42.5 ppc cement, 2 X River sand 3 cubes load, 1 X Filter Amiad 40mmx200mm, 6 x 40mm male adaptors, 1000 x Maxi Bricks, 1 x Building sand, 2 x 19mm Concrete 3 cubes Load		12,753	
5	Pipeline	26895.83	1 X 75mm HDPE pipe cls 6, 3 X 63mm HDPE pipe cls6, 4 X 50mm HDPE pipe cls6, 4 x 32mm HDPE pipe cls 6, 3 X 25mm HDPE pipe cls 6, 1 X 75mm HDPE coupling, 2 X 63mm HDPE coupling, 2 X 50mm HDPE coupling, 5 X 32mm HDPE coupling, 2 X 25mm HDPE coupling, 1 X 75mm valve control, 1 x 25mm valve control, 1000 X Maxi Bricks, 1 X 40mm Air valve		26,896	
	Total	86,968	-	7,754.00	94,722	

	12. HOMESTEADS INTERVENTIONS, PLANT and STORE ROOM.					
Lot numbe	Item	Material cost	Lots material	Stipend	Total	Remarks on Stipend.
4	Homesteads Interventions	79595.89	20 X 2500 litres Jojo Tank and fittings	14,000	93,596	Builder =10000.00, Assistance= 4000.00
7	Store room.	9,000	1500.00 x six months	-	9,000	N/A
8	Plant hire	16,200	2700.00 x six months		16,200	N/A
	Total	104,796	-	14,000.00	118,796	
					942,464	

NB: Total Project Cost including vat is R942 464.

P. Please find below a drawing booklet for Tshakhuma Project.

WATER RESEARCH COMMISSION

CONTRACT NUMBER. K1/2607/1

MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA
BOOK OF DRAWINGS

PREPARED BY:-

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MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

LIST OF DRAWINGS

DESCRIPTION	REV NO	SHEET	DRAWING NUMBER
COVER PAGE	00	1 OF 1	K1/12607/1-C00
LIST OF DRAWINGS	00	1 OF 1	K1/12607/1-C01
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02-1
LOCALITY PLAN	00	1 OF 1	K1/12607/1-C02-2
LAYOUT DRAWING - MASIWE SECTION	00	1 OF 1	K1/12607/1-C03-1
LAYOUT DRAWING - LUKAU SECTION	00	1 OF 1	K1/12607/1-C03-2
LAYOUT DRAWING - DZANANWA SECTION	00	1 OF 1	K1/12607/1-C03-3
LAYOUT DRAWING - MATAVHA SECTION	00	1 OF 1	K1/12607/1-C03-4
LAYOUT DRAWING - MOTSHINDONI SECTION	00	1 OF 1	K1/12607/1-C03-5
LAYOUT DRAWING - MUHOVHOYA SECTION	00	1 OF 1	K1/12607/1-C03-6
LAYOUT DRAWING - TSHISWISWIWI SECTION	00	1 OF 1	K1/12607/1-C03-7
LAYOUT DRAWING - THONDONI SECTION	00	1 OF 1	K1/12607/1-C03-8
LAYOUT DRAWING - MULANGAPUMA 1 SECTION	00	1 OF 1	K1/12607/1-C03-9
LAYOUT DRAWING - MULANGAPUMA 2 SECTION	00	1 OF 1	K1/12607/1-C03-10
CONCRETE SLAB FOR JOJO TANKS	00	1 OF 1	K1/12607/1-C04
SPRING PROTECTION AND SPRING BOX	00	1 OF 1	K1/12607/1-C05
PUMP HOUSE FENCINGND SPRING BOX	00	1 OF 1	K1/12607/1-C06
STAND PIPE DETAILSIG	00	1 OF 1	K1/12607/1-C07
PIPE LAYING DETAILS	00	1 OF 1	K1/12607/1-C08
FENCING TO WATER STORAGE TANKS	00	1 OF 1	K1/12607/1-C09

LIST OF DRAWINGS

	REV NO	SHEET	DRAWING NUMBER

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

WATER RESEARCH COMMISSION

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CLIENT — DATE

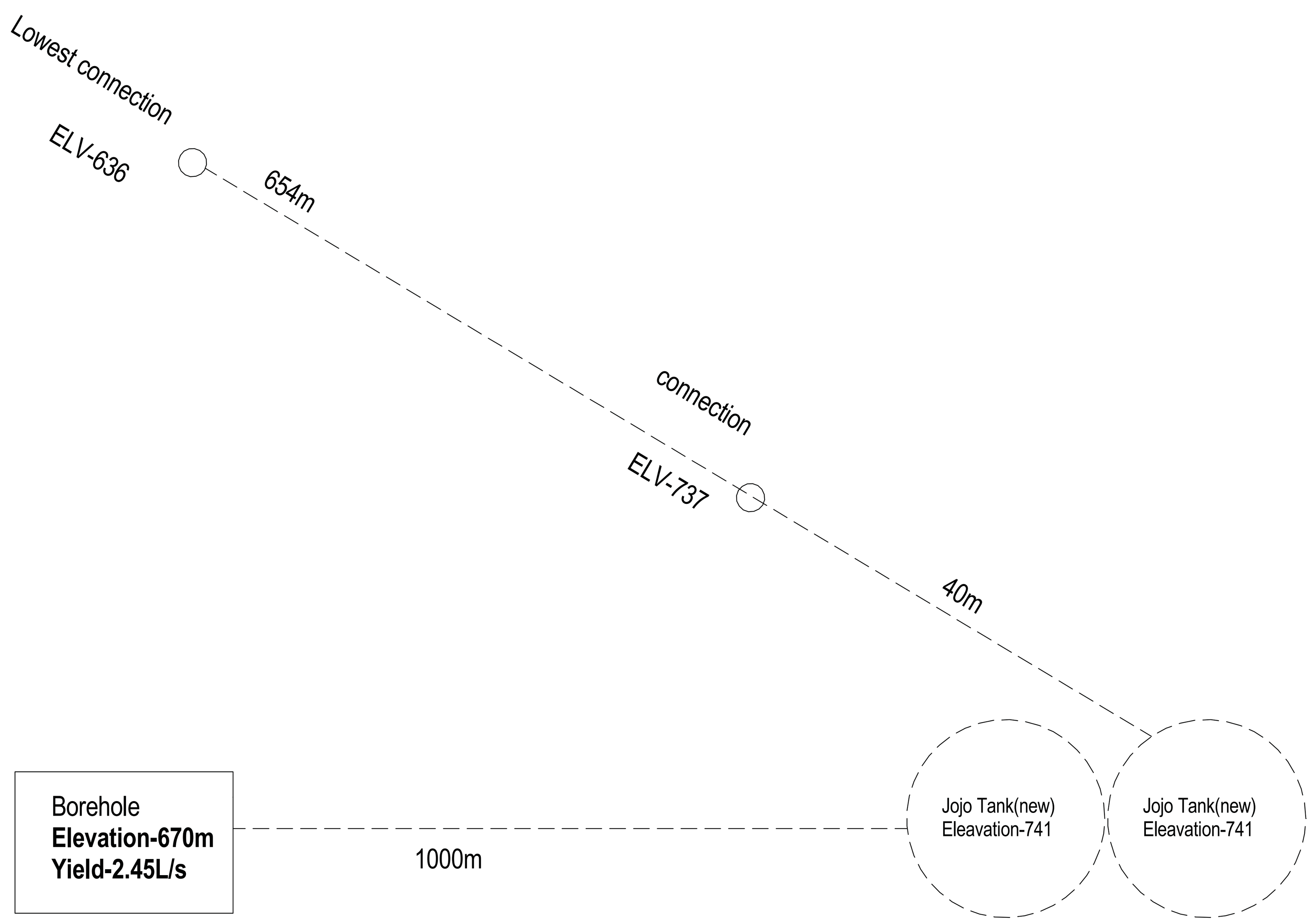
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
LIST OF DRAWINGS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C01
DATE JANUARY 2018	SCALE
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C01

K1/2607/1-C01



WATER AVAILABLE

2.45x60x60x12=105 840 L/Day
105 840/215=492L/HH/Day
=492/6=82L/Day
Assuming 50L/P/Day required,
that would leave 41,34 kl/Day for
Agricultural use

LEGEND

- - - - - - proposed
——— existing

PROPOSED WORKS

1. Construct concrete slabs on the ground for 3 jojo tanks at identified positions on site as per drawing - K1/2607-C04
2. Install fence, diamond mesh, 1,8m high) to the pump house as per drawing - K1/2607-C06
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
5. Lay new pipeline as per drawing K1/2607-C08

215 HOUSE HOLDS

1 MASIWE-LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.PHASHA
DESIGNED BY	L.M
CHECKED BY	M.K.PHASHA

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CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
LAYOUT DRAWING - MASIWE SECTION

PROJECT STATUS: CONSTRUCTION	SHEET: K1/2607/1-C03-1
DATE: JANUARY 2018	SCALE: 1 : 35
PROJECT NUMBER: K1/2607/1	DRAWING NUMBER: K1/2607/1-C03-1

K1/2607/1-C03-1

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT — DATE

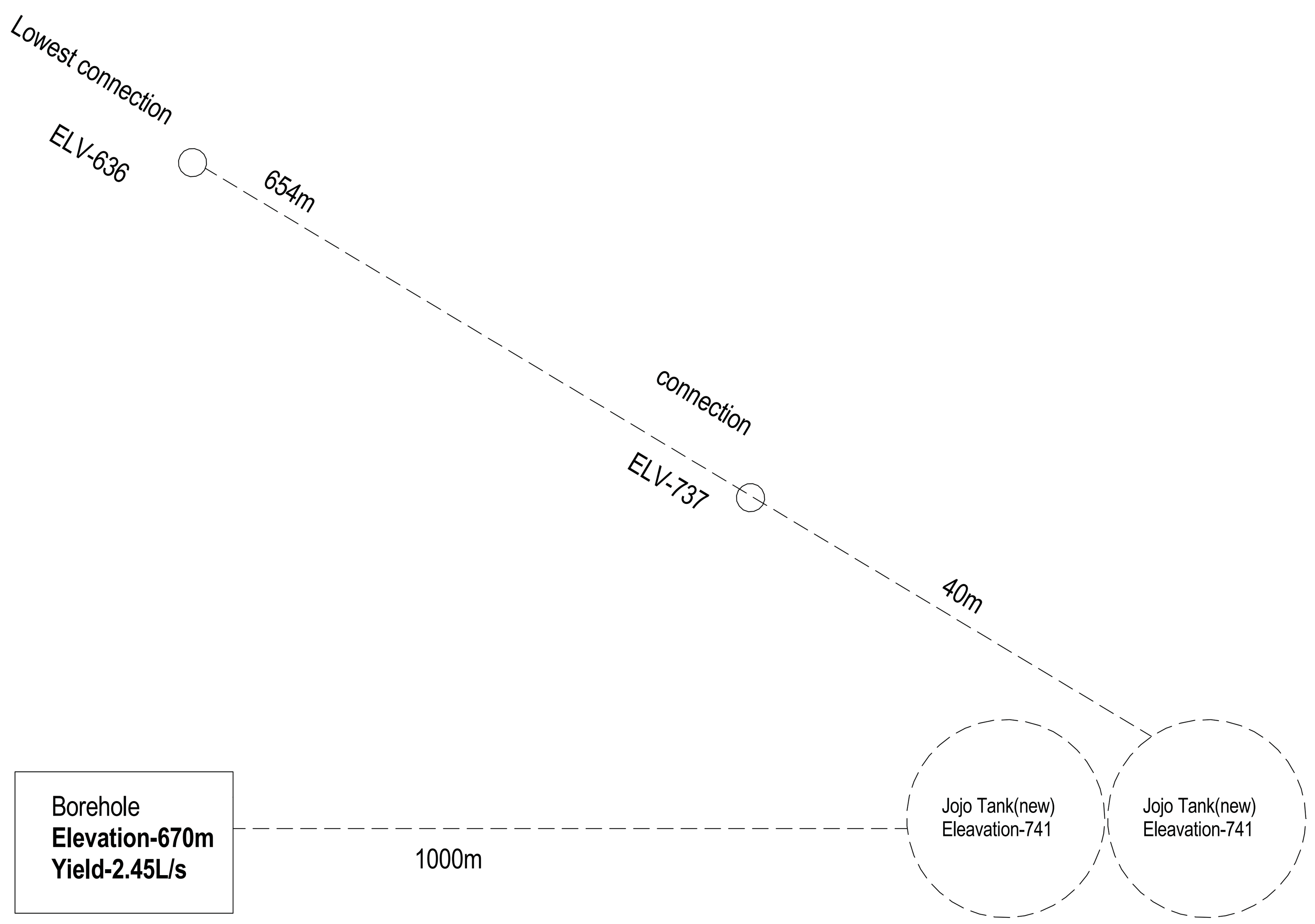
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA	PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C02-2
	DATE JANUARY 2018	SCALE
DRAWING DESCRIPTION LOCALITY PLAN 2	PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C02-2

K1/2607/1-C02-2

WATER AVAILABLE

2.45x60x60x12=105 840 L/Day
105 840/215=492L/HH/Day
=492/6=82L/Day
Assuming 50L/P/Day required, that would leave 41,34 kl/Day for Agricultural use



LEGEND

proposed
existing

PROPOSED WORKS

1. Construct concrete slabs on the ground for 3 jojo tanks at identified positions on site as per drawing - K1/2607-C04
2. Install fence, diamond mesh, 1,8m high) to the pump house as per drawing - K1/2607-C06
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
5. Lay new pipeline as per drawing K1/2607-C08

1 MASIWE-LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.PHASHA
DESIGNED BY	L.M
CHECKED BY	M.K.PHASHA

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CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

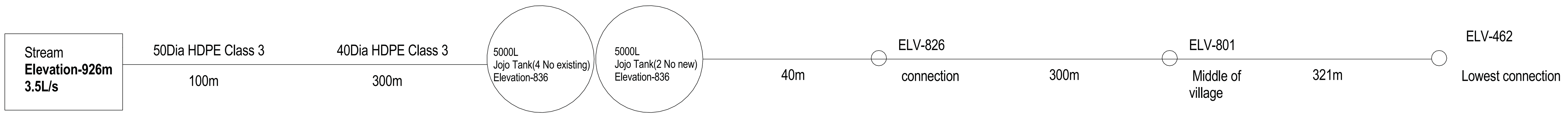
DRAWING DESCRIPTION
LAYOUT DRAWING - MASIWE SECTION

PROJECT STATUS CONSTRUCTION	**SHEET** K1/2607/1-C03-1
DATE JANUARY 2018	**SCALE** 1 : 35
PROJECT NUMBER K1/2607/1	**DRAWING NUMBER** K1/2607/1-C03-1

K1/2607/1-C03-1

WATER AVAILABLE

3.5L/s x60x60x24=302 400 L
302 400L/210=1440L/HH/Day
1440/6=240L/P/P/Day
If we allow 50 Per Person,
We still have 190L for
productive use such as
poultry, cattle, small gardens etc



LEGEND

- – – – – – proposed
- ——— existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water sorage tank as per drawing K1/2607-C09

210 HOUSE HOLDS

1 LUKAU SECTION
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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CLIENT DATE

CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

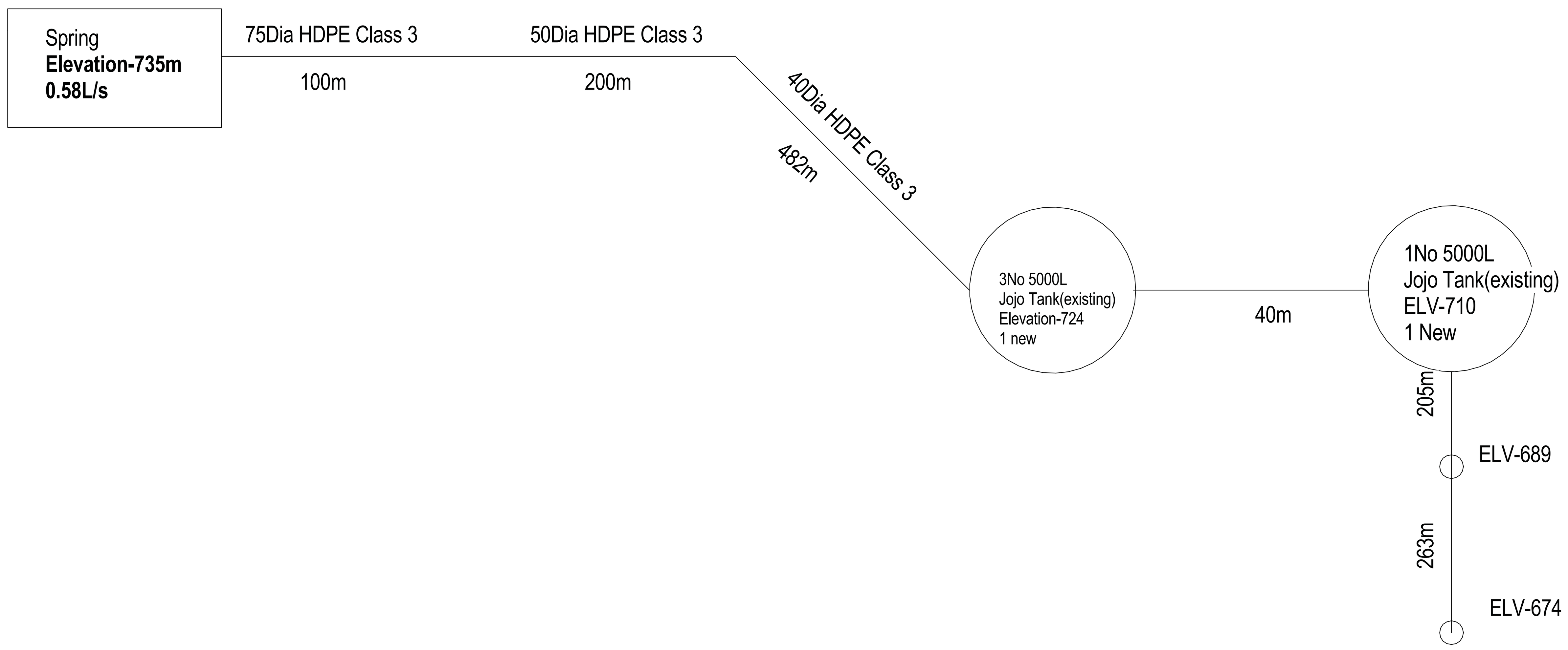
DRAWING DESCRIPTION
LAYOUT DRAWING - LUKAU SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-2
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-2

K1/2607/1-C03-2

WATER AVAILABLE

0.58L/s
Water availability in 24hrs=50 112L
50 112L/282H/H=178L per Household
178L per H/H /6 = 30L/Person/Day
Therefore, water scheme is operated rotational



LEGEND

- - - - - - proposed
——— existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water sorage tank as per drawing K1/2607-C09

1 DZANANWA SECTION LAYOUT
1 : 35

282 HOUSEHOLDS

No	DATE	REVISION	ISSUED BY

DRAWN BY	Author
CHECKED BY	Checker
DESIGNED BY	Designer
CHECKED BY	Checker

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IWMI International Water Management Institute
TSOGANG

CLIENT DATE

CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
LAYOUT DRAWING - DZANANWA SECTION

PROJECT STATUS CONSTRUCTION	**SHEET K1/2607/1-C03-3**
DATE JANUARY 2018	**SCALE 1 : 35**
PROJECT NUMBER K1/2607/1	**DRAWING NUMBER K1/2607/1-C03-3**

K1/2607/1-C03-3

WATER AVAILABLE

0.05L/s
Water availability in 24hrs=4 320L
4320L/105H/H=41L per Household
41L per H/H /6 = 7L/Person/Day
Therefore, water scheme is operated rotational

LEGEND

proposed
existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water storage tank as per drawing K1/2607-C09
6.Replace valves as instructed on site

105 HOUSE HOLDS

1 MATAVHA SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L,M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

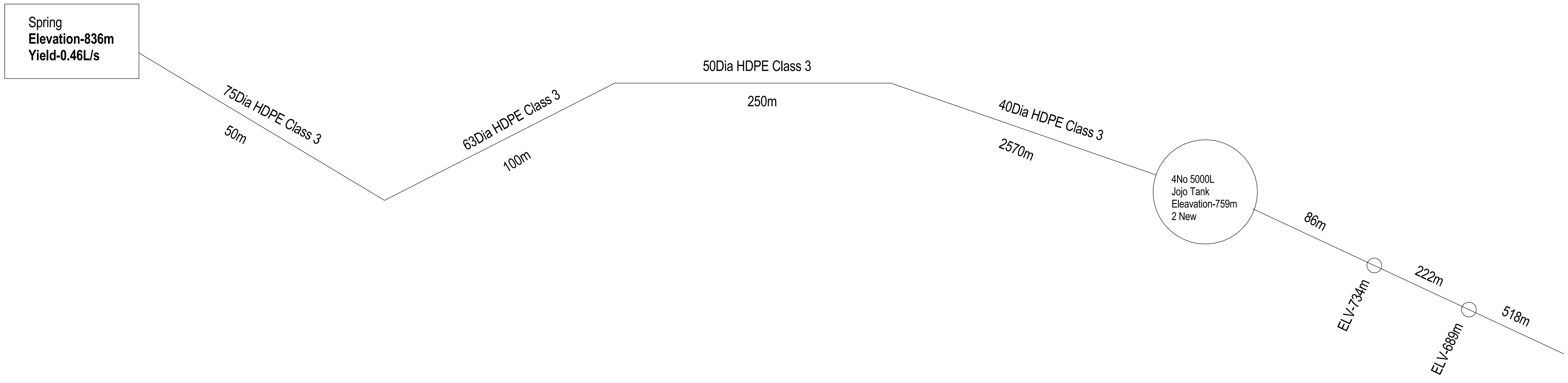
DRAWING DESCRIPTION
LAYOUT DRAWING - MATAVHA SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-4
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-4

K1/2607/1-C03-4

WATER AVAILABLE

0.5L/s
Water availability in 24hrs=39 744L
39 744L/232H/H=171L per Household
171L per H/H /6 = 29L/Person/Day
Therefore, water scheme is operated rotationally



LEGEND

– – – – – – proposed
———— existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified
positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water sorage tank as per drawing K1/2607-C09
6.Replace valves as instructed on site

232 HOUSE HOLDS

1 MOTSHINDONI SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT DATE
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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

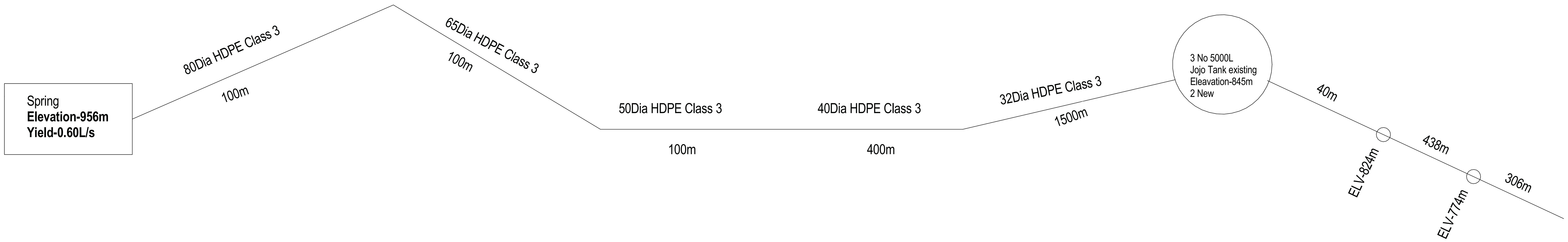
DRAWING DESCRIPTION
LAYOUT DRAWING - MOTSHINDONI SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-5
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-5

K1/2607/1-C03-5

WATER AVAILABLE

0.60L/s
Water availability in 24hrs=51 840L
51 840L/350H/H=148L per Household
148L per H/H /6 = 25L/Person/Day
Therefore, water scheme is operated rotationally



LEGEND

proposed
existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water storage tank as per drawing K1/2607-C09
6.Replace valves as instructed on site

350 HOUSE HOLDS

1 MUHOVHOYA SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY L.M
CHECKED BY M.K.Phasha
DESIGNED BY L.M
CHECKED BY M.K.Phasha

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CLIENT DATE
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

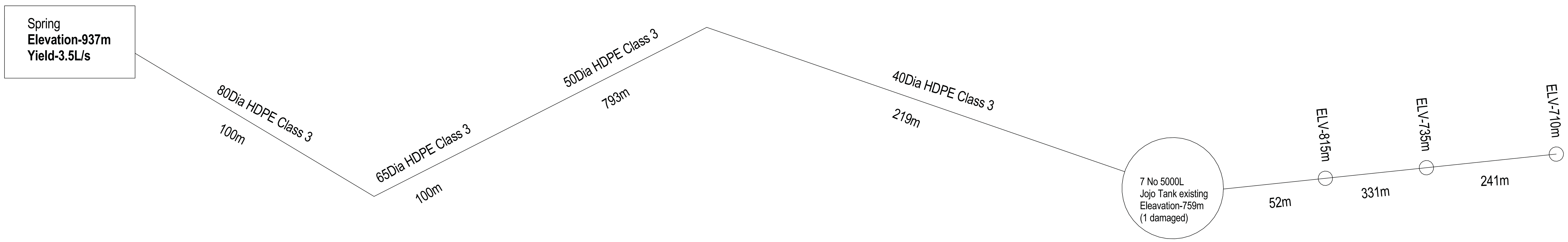
DRAWING DESCRIPTION
LAYOUT DRAWING - MUHOVHOYA SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-6
DATE	SCALE
JANUARY 2018	1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-6

K1/2607/1-C03-6

WATER AVAILABLE

3.5L/s
Water availability in 24hrs=302 400L
302 400L/129H/H=23 44L per Household
2344L per H/H /6 = 39L/Person/Day



LEGEND

proposed
existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified
positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5.Replace valves as instructed on site

129 HOUSE HOLDS

1 TSHISWISWINI SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

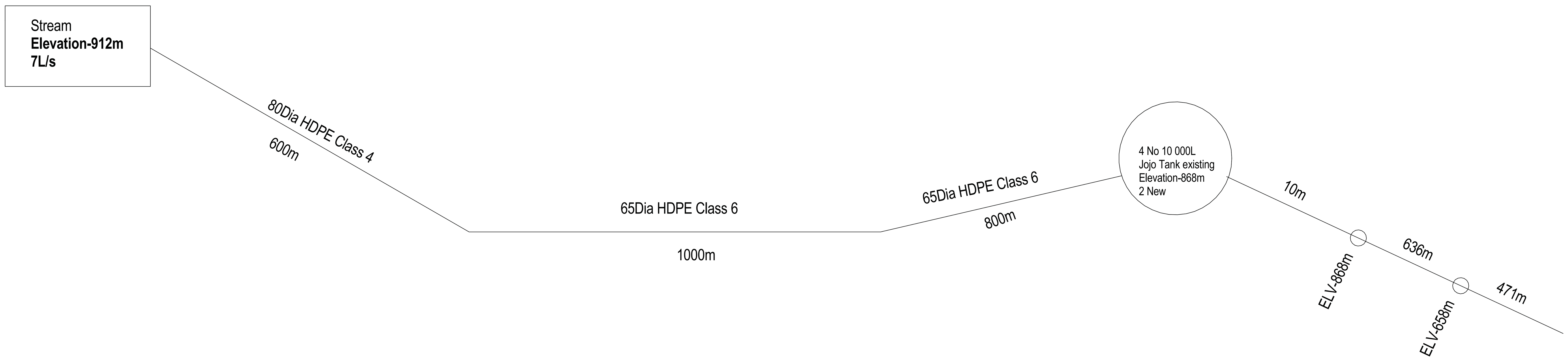
DRAWING DESCRIPTION
LAYPUT DRAWING - TSHISWISWINI SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-7
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-7

K1/2607/1-C03-7

WATER AVAILABLE

7L/s
Water availability in 24hrs=604 800L
604 800L/750H/H=806L per Household
806L per H/H /6 = 134.40L/Person/Day
Therefore, water scheme is operated rotationally



LEGEND

proposed
existing

PROPOSED WORKS

1.Refurbish water source as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water storage tank as per drawing K1/2607-C09
6.Replace valves as instructed on site

750 HOUSE HOLDS

1 THONDONI SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT — DATE
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

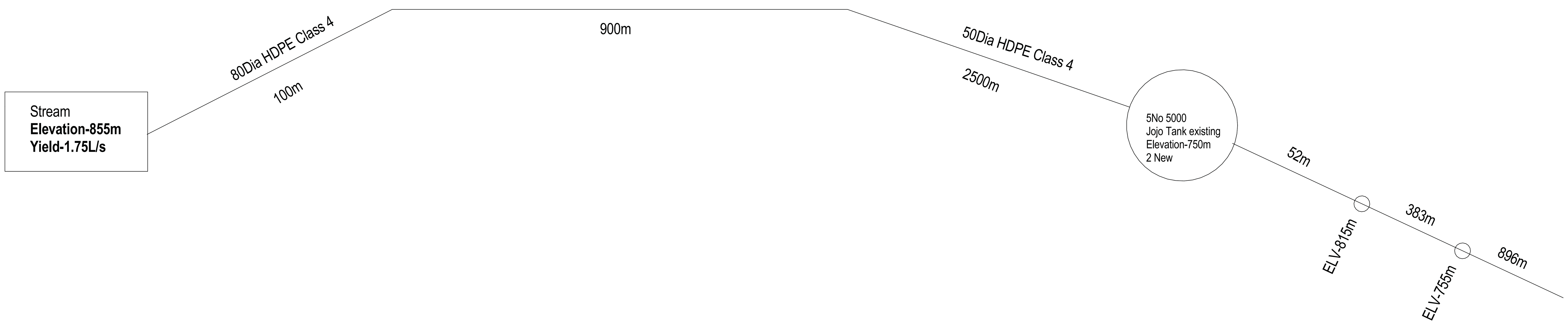
DRAWING DESCRIPTION
LAYOUT DRAWING - THONDONI SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-8
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-8

K1/2607/1-C03-8

WATER AVAILABLE

1.75L/s
Water availability in 24hrs=151 200L
151 200L/262H/H=577L per Household
577L per H/H /6 = 96L/Person/Day
Therefore, water scheme is operated rotationally



LEGEND

– – – – – –	proposed
————	existing

PROPOSED WORKS

1.Protect spring with fencing as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5.Replace valves as instructed on site

262 HOUSE HOLDS

1 MULANGAPUMA 1 SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

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CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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CLIENT — DATE
CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

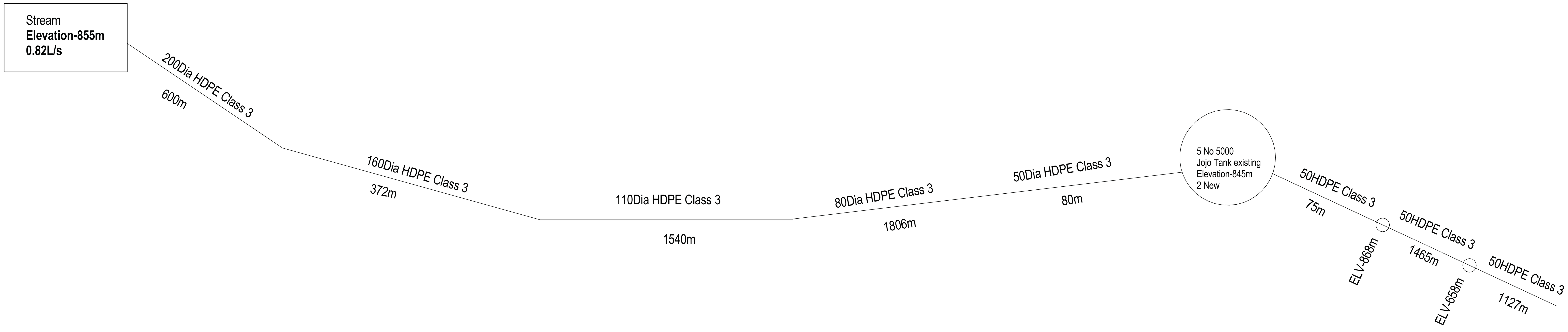
DRAWING DESCRIPTION
LAYOUT DRAWING - MULANGAPUMA 1 SECTION

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C03-9
DATE JANUARY 2018	SCALE 1 : 35
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C03-9

K1/2607/1-C03-9

WATER AVAILABLE

0.82L/s
Water availability in 24hrs=70 848L
70 848L/340H/H=208L per Household
208L per H/H /6 = 34L/Person/Day
Therefore, water scheme is operated rotationally



LEGEND

proposed
existing

PROPOSED WORKS

1.Refurbish water source as per drawing K1/2607-C05
2.Construct concrete slabs on the ground for jojo tanks at identified positions on site as per drawing - K1/2607-C04
3. Install stand pipes at indentified positions on site as per drawing - K1/2607-C07
4. Lay new pipeline as per drawing K1/2607-C08
5. Fence water storage tank as per drawing K1/2607-C09
6.Replace valves as instructed on site

340 HOUSE HOLDS

1 MULANGAPUMA 2 SECTION LAYOUT
1 : 35

No	DATE	REVISION	ISSUED BY

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DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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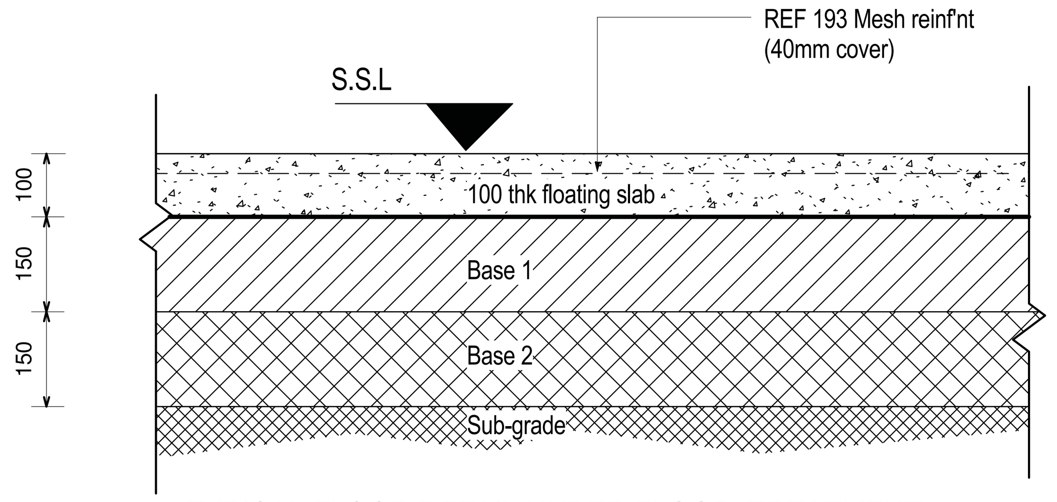
PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
LAYOUT DRAWING- MULANGAPUMA 2 SECTION

PROJECT STATUS CONSTRUCTION	**SHEET** K1/2607/1-C03-10
DATE JANUARY 2018	**SCALE** 1 : 35
PROJECT NUMBER K1/2607/1	**DRAWING NUMBER** K1/2607/1-C03-10

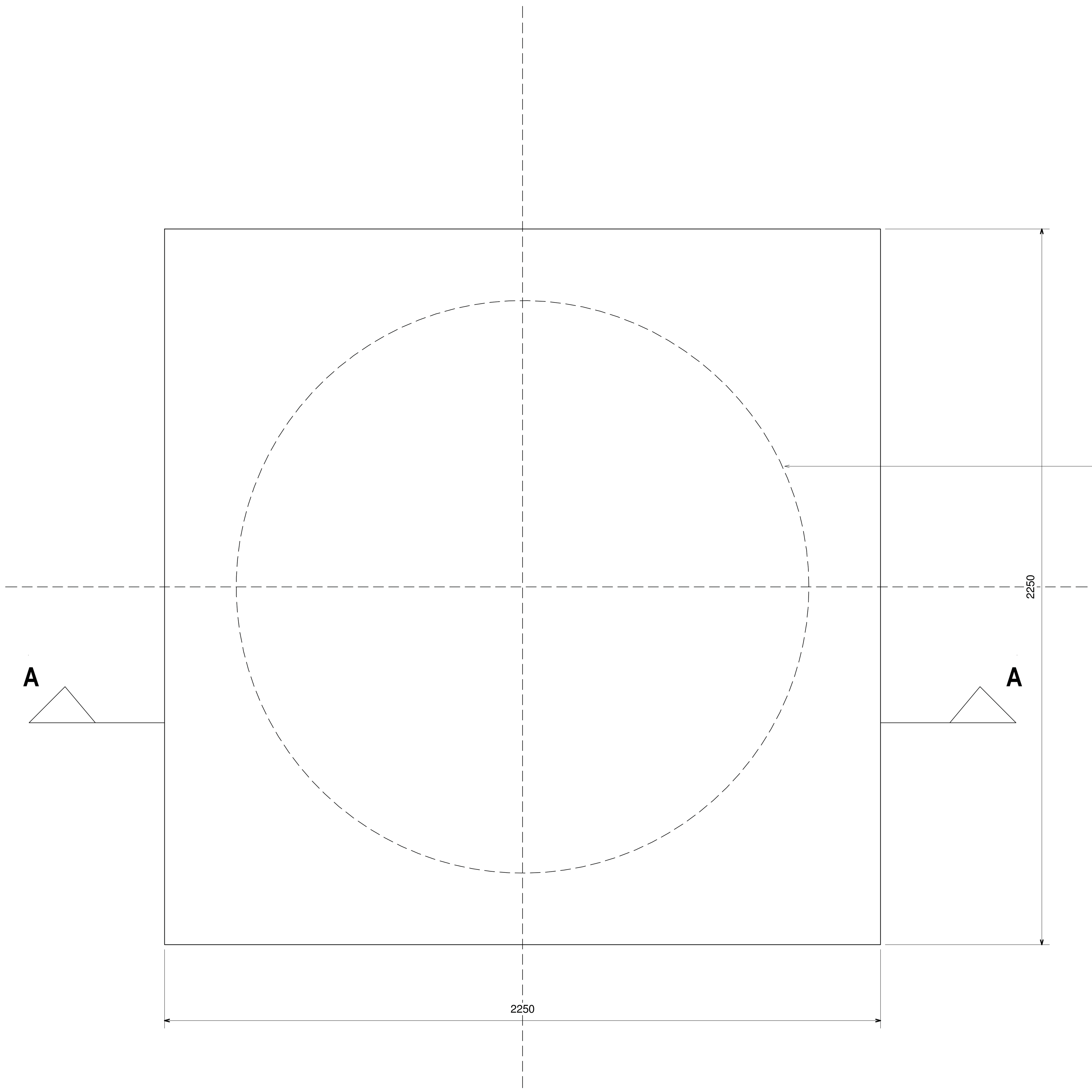
K1/2607/1-C03-10



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

SECTION A-A

NOTES:
1.Grade of concrete to be 25Mpa
2 Ground slab thickness is 100mm



GROUND TANK STAND SLAB
1
1 : 10

No	DATE	REVISION	ISSUED BY

DRAWN BY	L.M
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DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

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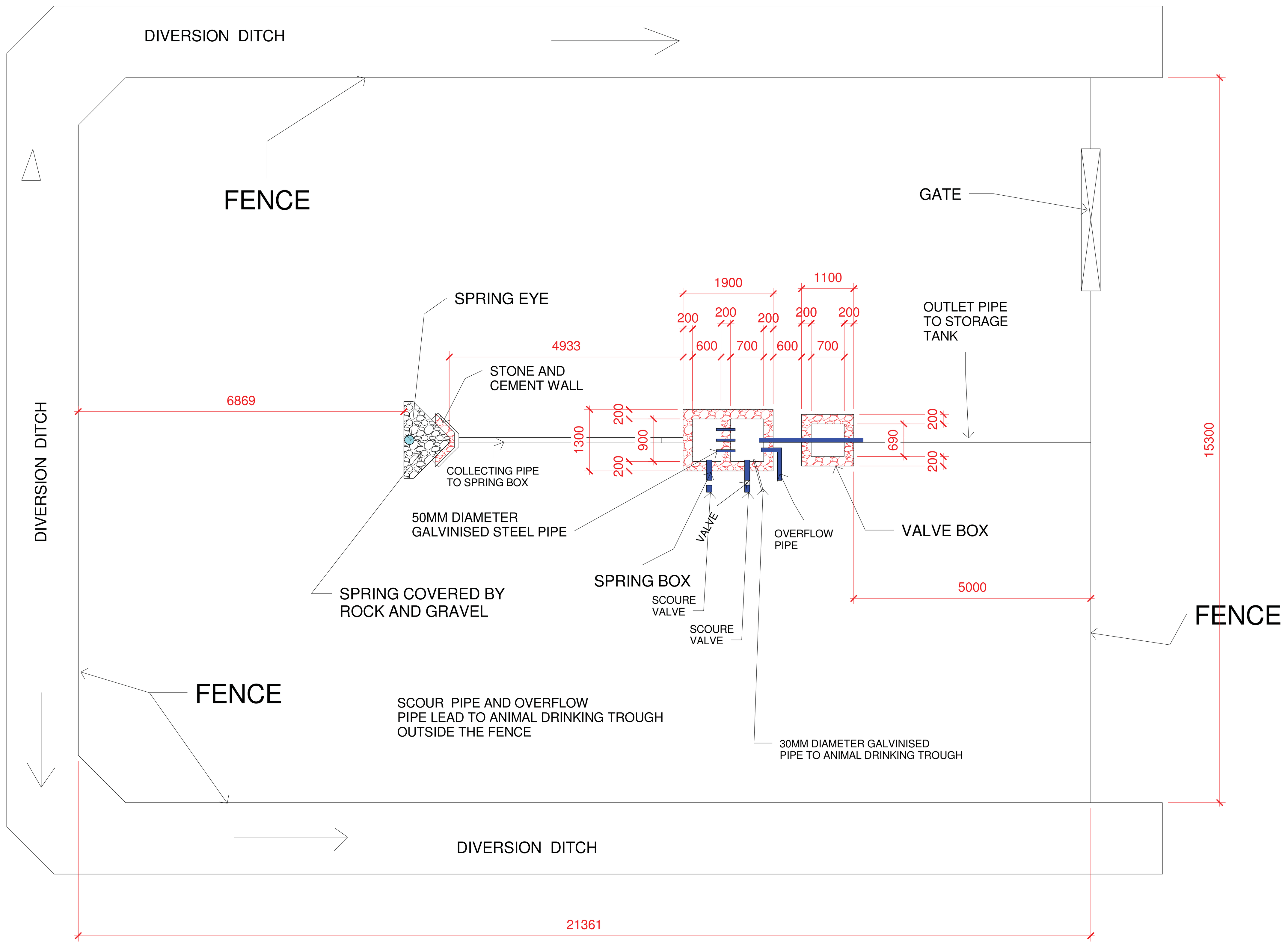
CLIENT DATE
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
CONCRETE GROUND SLAB FOR JOJO TANK

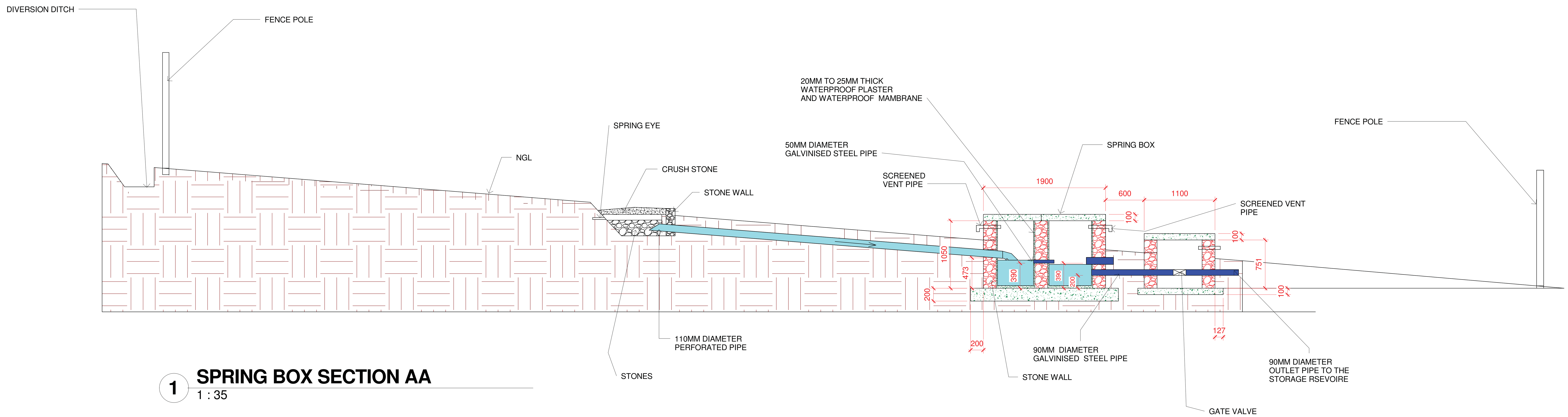
PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C04
DATE	SCALE
JANUARY 2018	1 : 10
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C04

K1/2607/1-C04



2 SPRING BOX AND SPRING PROTECTION PLAN
1 : 80

3 3D VIEW



1 SPRING BOX SECTION AA
1 : 35

No	DATE	REVISION	ISSUED BY

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CHECKED BY	M.K.Phasha
DESIGNED BY	L.M
CHECKED BY	M.K.Phasha

WATER RESEARCH COMMISSION

Owner

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IWMI

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CLIENT — DATE

CONSULTING ENGINEER — DATE

PROJECT DESCRIPTION

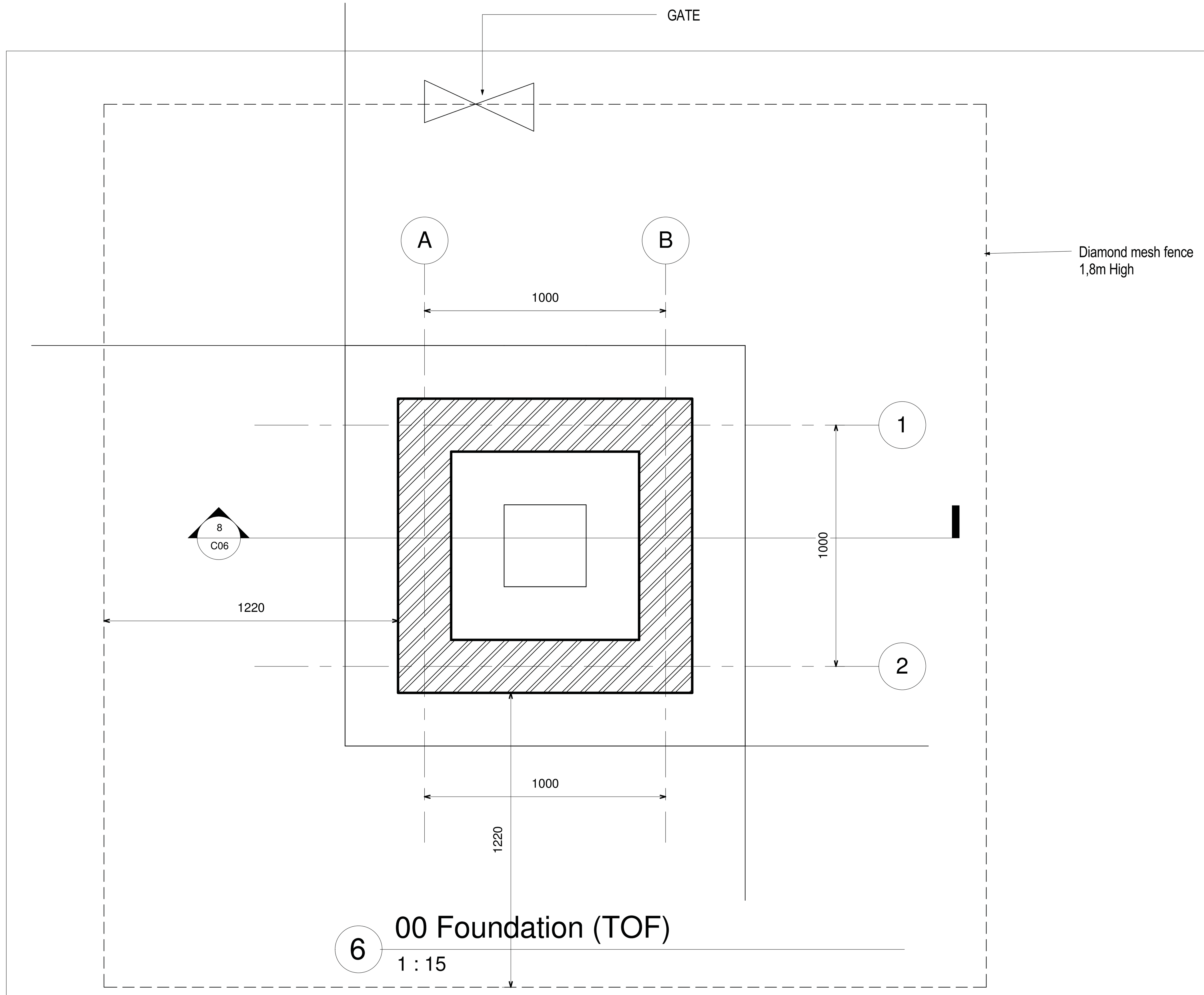
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION

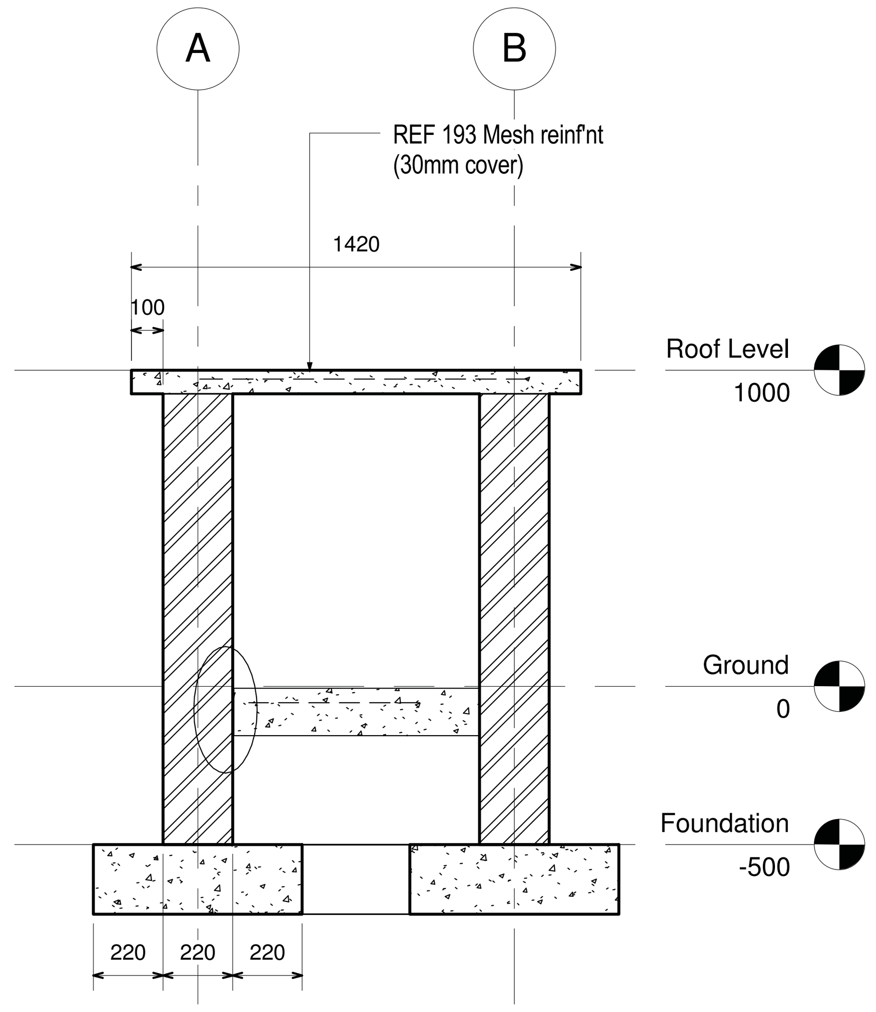
SPRING PROTECTION AND SPRING BOX

PROJECT STATUS	SHEET
CONSTRUCTION	K1/2607/1-C05
DATE	SCALE
JANUARY 208	As indicated
PROJECT NUMBER	DRAWING NUMBER
K1/2607/1	K1/2607/1-C05

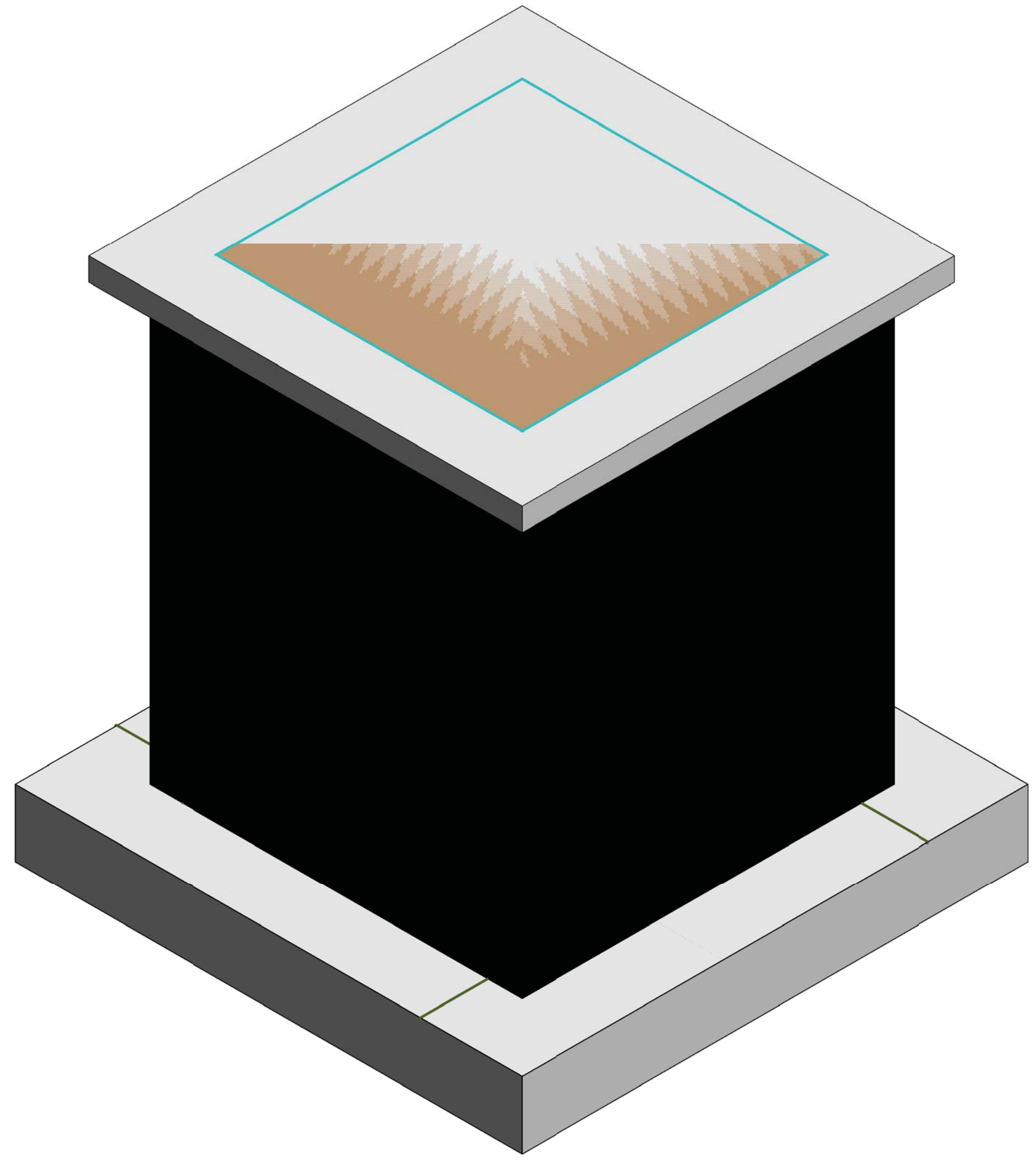
K1/2607/1-C05



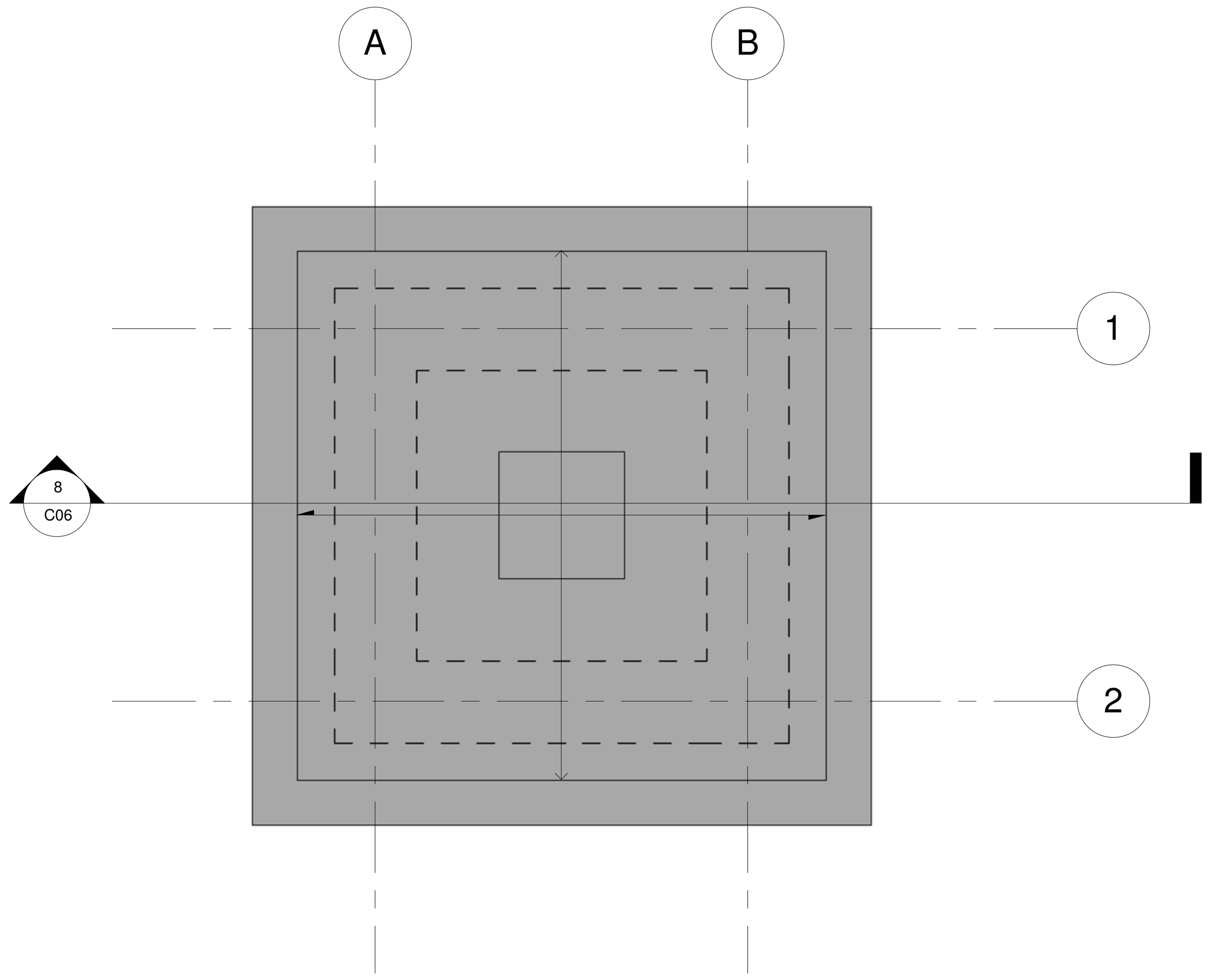
6 00 Foundation (TOF)
1 : 15



8 Section 1
1 : 20



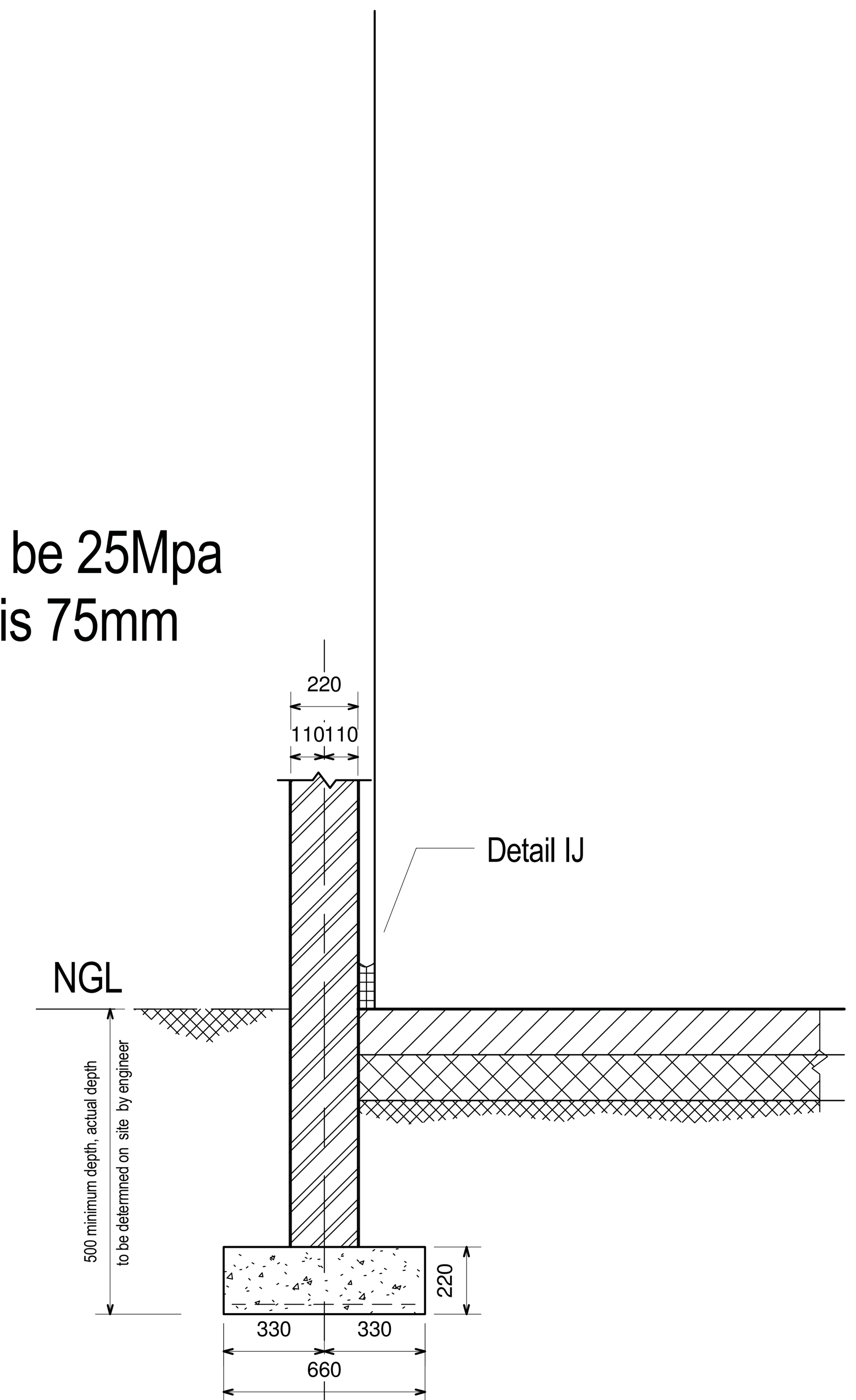
7 {3D}



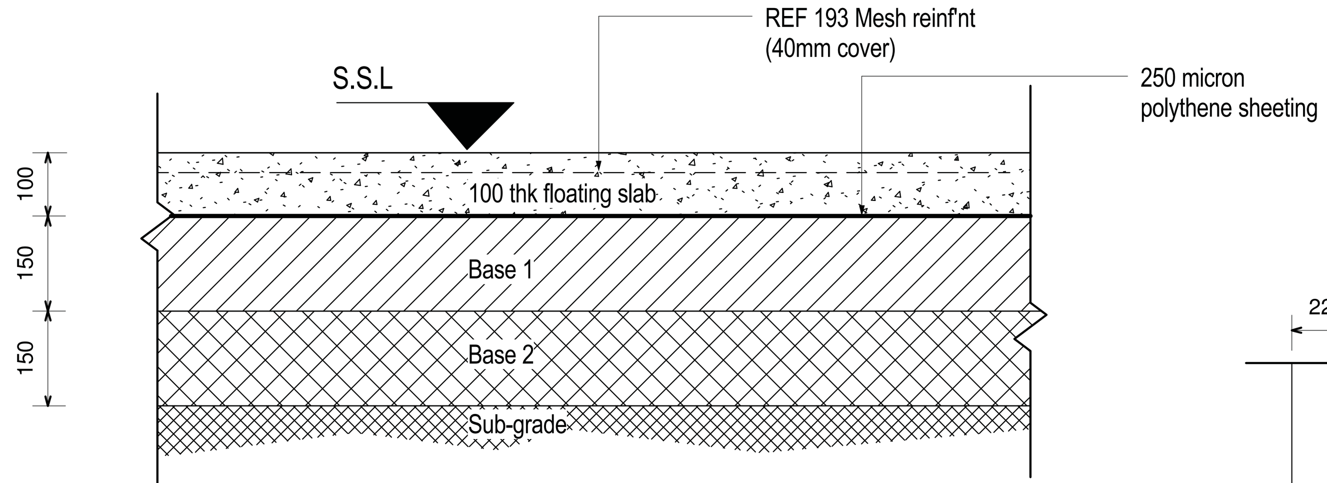
5 00 First Floor
1 : 15

NOTES:

1.Grade of concrete to be 25Mpa
2.Floor slab thickness is 75mm

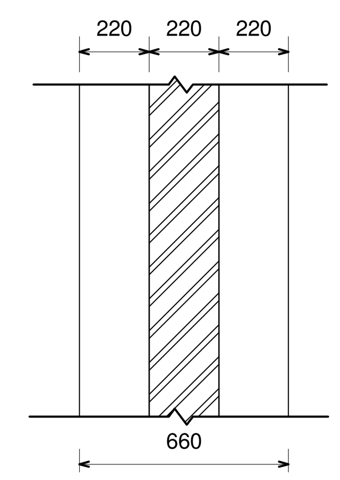


1 Typical cross section detail through external wall
1 : 20



TYPICAL FLOOR DETAIL UNDER FLOOR TREATMENT
1. Remove 150mm top soil to waste
2. Scarify top of in-situ material & compact to 89% mod asshto (subg-rade)
3 Import gravel of G8 material or better to achieve 150mm of well compacted fill to 91% mod aashto (Base 2)
4. Import gravel of G8 material or better to achieve 150mm of well compacted fill to 93% mod aashto (Base 1)

2 Floating slab detail
1 : 10



3 Strip footing/wall plan detail
1 : 20

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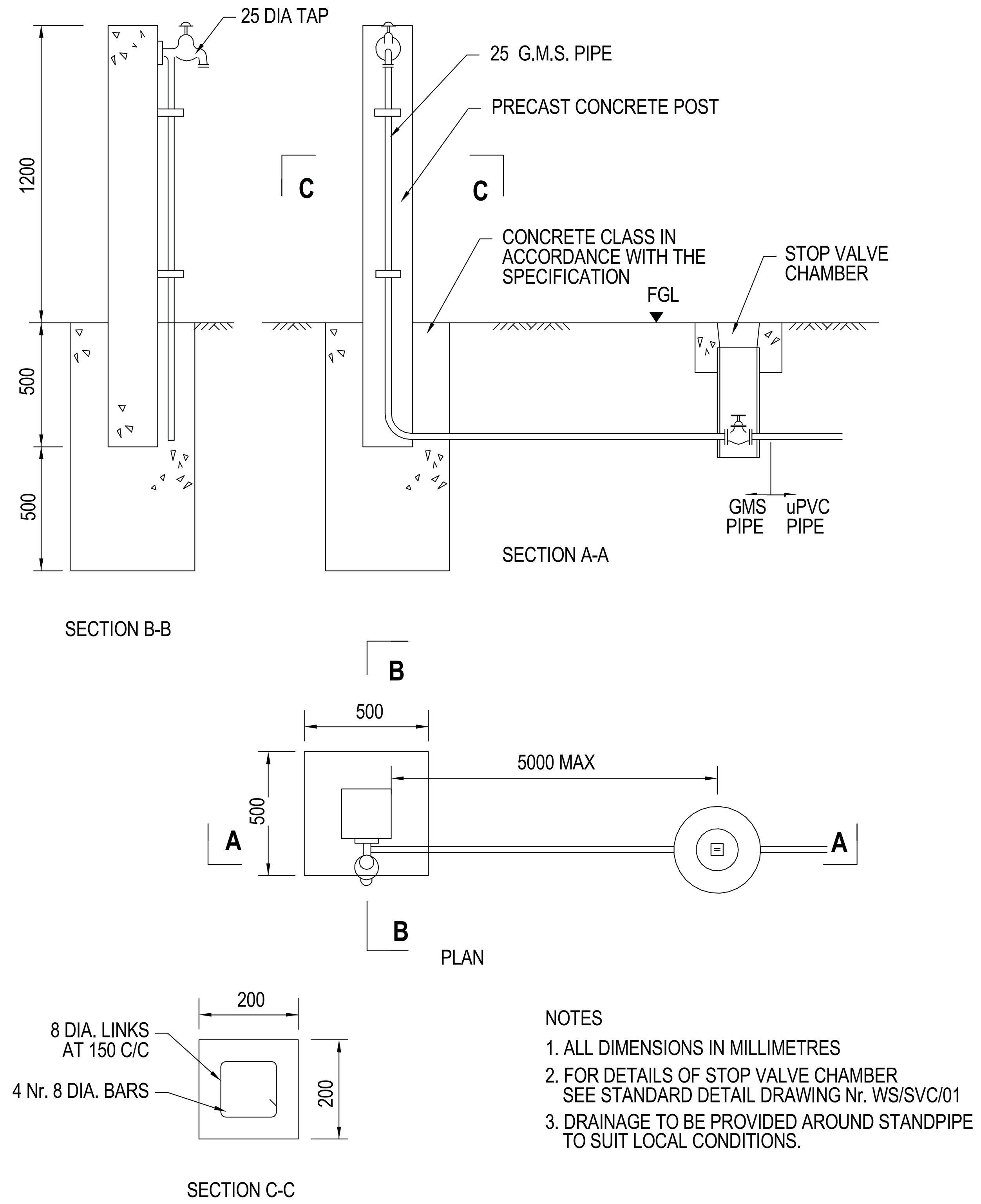
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
PUMP HOUSE FENCING

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C06
DATE	SCALE
JANUARY 2018	As indicated
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C06

K1/12607/1-C06



NOTES
1. ALL DIMENSIONS IN MILLIMETRES
2. FOR DETAILS OF STOP VALVE CHAMBER SEE STANDARD DETAIL DRAWING Nr. WS/SVC/01
3. DRAINAGE TO BE PROVIDED AROUND STANDPIPE TO SUIT LOCAL CONDITIONS.

1 STAND PIPE DETAIL
1 : 1

STAND PIPE - TPYE 1

STAND PIPE - TPYE 2

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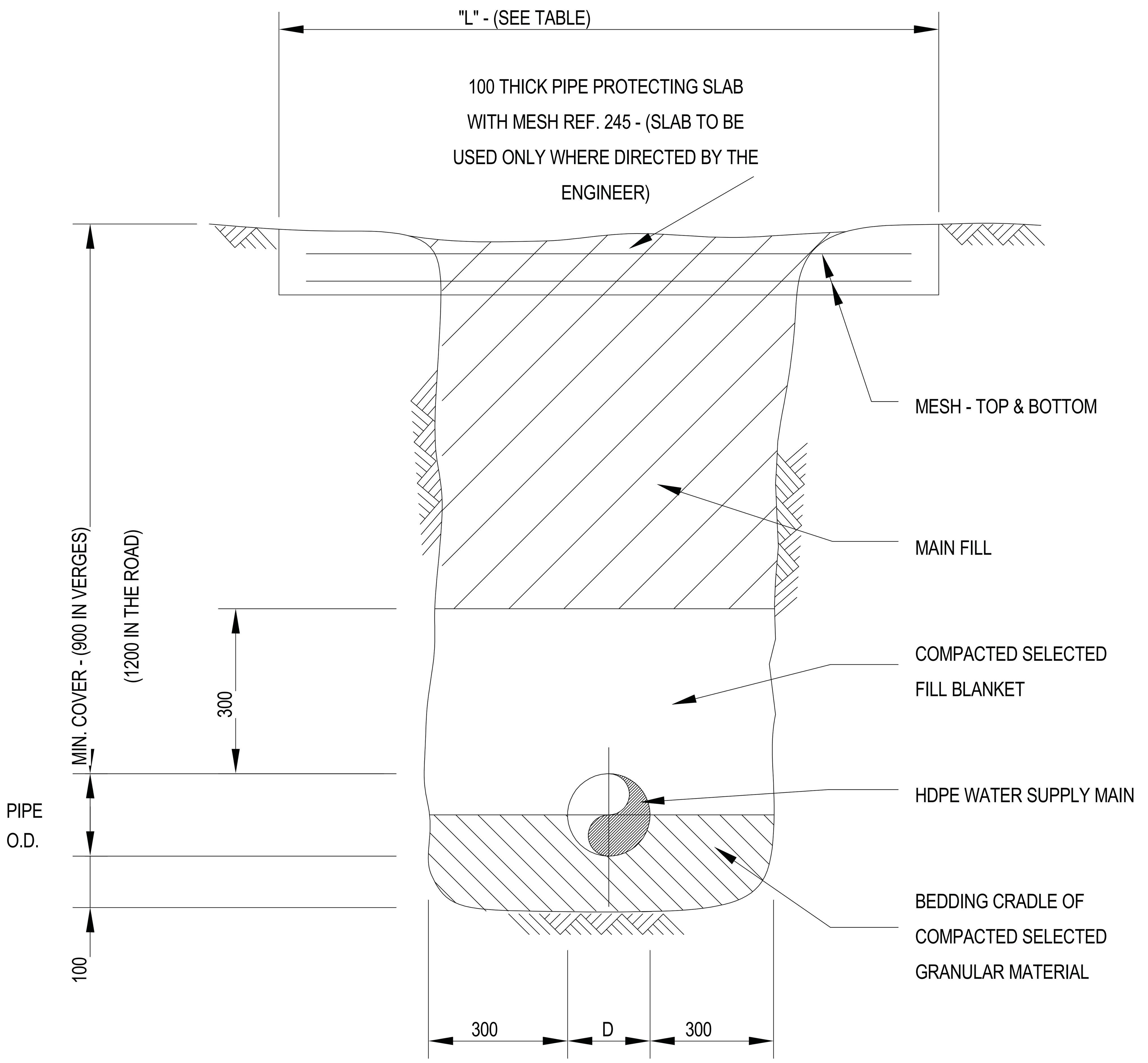
CLIENT	DATE
CONSULTING ENGINEER	DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
STAND PIPE DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/2607/1-C07
DATE JANUARY 2018	SCALE 1 : 1
PROJECT NUMBER K1/2607/1	DRAWING NUMBER K1/2607/1-C07

K1/2607/1-C07



TYPICAL PIPE BEDDING DETAIL

TABLE

PIPE NB	TYPE	CLASS	BASE WIDTH (SEE PSDB - 5.2)	'L'
90	HDPE	10	700	1600
110	HDPE	10	700	1650
160	HDPE	10	750	1700
200	HDPE	10	800	1750

2 PIPE BEDDING DETAILS
1 : 65

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CHECKED BY	M.K.Phasha

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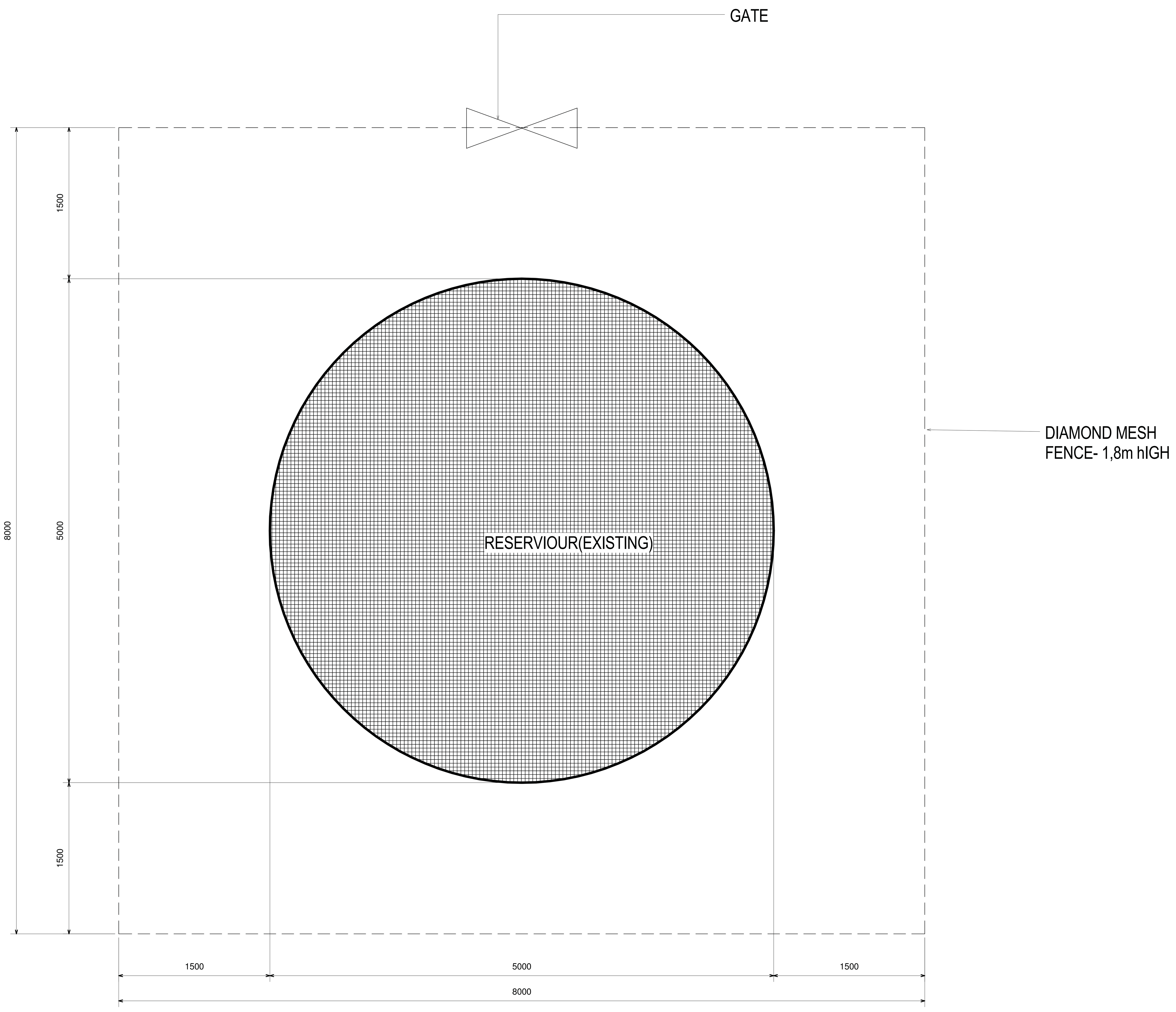
CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER SERVICES (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
PIPE LAYING DETAILS

PROJECT STATUS: CONSTRUCTION	SHEET: K1/2607/1-C08
DATE: JANUARY 2018	SCALE: 1 : 65
PROJECT NUMBER: K1/2607/1	DRAWING NUMBER: K1/2607/1-C08

K1/2607/1-C08



1 TANK FENCING
1 : 25

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WATER RESEARCH COMMISSION

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CLIENT DATE

CONSULTING ENGINEER DATE

PROJECT DESCRIPTION
MULTIPLE USE WATER (MUS) - TSHAKHUMA

DRAWING DESCRIPTION
WATER STORAGE FENCING DETAILS

PROJECT STATUS CONSTRUCTION	SHEET K1/12607/1-C09
DATE JANUARY 2018	SCALE 1 : 25
PROJECT NUMBER K1/12607/1	DRAWING NUMBER K1/12607/1-C09

K1/12607/1-C09