LIFE IMPACT TRAINING CENTER
MASTER PLAN

Project Report | Project ZA-0078 | Itezhi-Tezhi, Zambia
EMI South Africa
November 2023

Fishermen on Lake Itezhi Tezhi
(photo: Ben Shinabery - Itezhi Tezhi)

Engineering Ministries International
designing a world of hope

EMI's Vision:
People restored by God and the world restored through design.

EMI's Mission:
To develop people, design structures, and construct facilities which serve communities and the Church.

EMI is a non-profit international Christian design organization that mobilizes architects, engineers, land surveyors and construction managers as volunteers using their skills to serve the least reached peoples in the world. Our multidisciplinary teams collaborate with our local client ministries to design culturally-appropriate facilities that are sustainable, affordable and transformational. Our projects include hospitals, schools, orphanages, ministry centers, WASH projects and many other types that enable our Christian ministry partners to fulfill their calling and transform their communities.

Together, we are designing a world of hope.

SOUTH AFRICA
designing a world of hope

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01 | Introduction

0.1Body of Christ

The body of Christ is one even as each plays his and her part. The various stakeholders involved at Life Impact Training Center embodies the essence of this scripture (1 Cor 2:12-14) so well. It is truly a profoundly encouraging picture to see different people bring their skills and knowledge in whatever way they can to contribute as they seek to further the kingdom and see people restored to right relationship with God. The zealous dedication of the Impact Zambia team will no-doubt see their vision realized as they pioneer the way towards sustainable impact. As EMI it is a deep joy for us to join this partnership by bringing the skills and knowledge that we have to a table which is already so rich in faith, obedience, and courage to pursue their God-given vision.

This project has taken us on an incredible journey which started even before going to site as we, the EMI South Africa office, started the design process not with rulers and excel spreadsheets, but with prayer. Wanting to align our hearts with God's we sought his guidance and insight on the project and listened to what he had to say, writing, or drawing whatever we felt God saying to us regarding this project.

For our team, this design embodies so much more than planning, architecture, and engineering. It is a window into God's heart for the people of Itezhi Tezhi. As the journey unfolds and we take steps of faith, we trust that His way is higher than our own and that He will direct every step.

above: the EMI team "hands that make up the body" (photo: Lianti Muller)

> *"12 Just as a body, though one, has many parts, but all its many parts form one body, so it is with Christ. 13 For we were all baptized by one Spirit so as to form one body — whether Jews or Gentiles, slave or free — and we were all given the one Spirit to drink. 14 Even so the body is not made up of one part but of many."*
>
> *- 1 Corinthians 12:12-14 NIV*

02 | Ministry Overview

2.1 iTeams and Impact Zambia

The Life Impact Training Center is driven forward by a beautiful collaboration between a few partners. This brings a unique richness to the work. Richness of background, wisdom, cultures, and resources. The different partners each work diligently as part of the body of Christ to achieve the vision set before us by God, they include:

Iteams Canada

International Teams Canada is a ministry with a unique approach to international development, not seeking to sweep in and do work themselves coming from an external context. Rather, they seek to partner with established local leaders to add velocity to the work and vision that already exists to transform communities.

Their mission is to see vulnerable people move toward fullness of life characterized by dignity, justice, peace, and hope. ITeams believes that that transformation does not take place overnight therefore they seek to create long-term partnerships between churches, supporters in Canada, and established community leaders who work together on projects that will, over time, break the cycle of poverty. ITeams have "Impact Programs" around the world, where they partner with local leaders. Some locations include, Burkina Faso, Ecuador, Haiti, Kenya, Romania Uganda, Zambia and many more.

Impact Zambia

Impact Zambia is one of the Impact Programs, shaped by ITeams Canada partnership. With a mission to help rural churches and communities flourish by providing leadership and skill training. Located in Southwestern Zambia, its programs are primarily operated through New Life Tabernacle and Cell Ministries (founded in 1994 in Itezhi-tezhi, Zambia) and its 30+ churches. Impact Zambia was launched in 2012 and the first project was to build an office and preschool on the site of the Itezhi-tezhi church, and to build two new church buildings in the rural communities of Mumbwa and Namwala.

During this time, the Share Your Knowledge program was also established which provided sewing and other employable skills in partnership with Rotary International, Canadian, and South African churches. This program inspired the dream to embark on the journey of starting the Life Impact Training Center to improve the quantity and quality of training offered so that more churches and communities can flourish.

Life Impact Training Centre (LITC)

Program leaders Daniel and Florence Mayapi's dream for skills and leadership development in their rural district has been growing for more than a decade. To date, the district of Itezhi -Tezhi has no tertiary education facilities for the youth from this area. This results in most of the youth leaving the district or

above: client review (photo: Ed Luebben - LITC, Itezhi Tezhi, Zambia)

above: Daniel Mayapi showing EMI team around (photo: Ed Luebben, Life Impact Training Center- Itezhi Tezhi) those remaining being stuck in a cycle of unemployment. With the implementation of a skills training program, the heart is to equip the youth of the community with trade skills as well as entrepreneurial training which will encourage them to start their own businesses. Consequently, these businesses can employ other people, catalyzing the development of the communities and the district with an economy that grows from within the space.

Over the years, this God-inspired dream slowly started to take shape, with leadership trainings taking place regularly and short skills training courses like carpentry, brick laying, sewing, bread making, catering, counseling skills, etc happening as and when they have the volunteers to teach or can find and pay a local instructor. The team soon realized that they would like to formalize this training and put together their vision, values, and next step plans.

The vision and goals of the Life Impact Training Center is clear: Their vision is **to be a point of contact in the community for spiritual development alongside vocational and skills training**. Doing so by providing the following:

- Pre-employment training services
- In-service training services
- Entrepreneurship Training

At the training center, the team aims to serve with **Excellence** and **Integrity**, and to be a **Support** to their surrounding community with a holistic approach.

The next step toward this goal is formalizing the program offerings by registering the facilities with the TEVETA (Technical Education, Vocational and Entrepreneurship Training Authority) board. This will allow the training center to offer structured training and grow incrementally in the training that they offer to the point where they can be a full-fledged training center.

above: food preparation (photo: Lianti Muller, Life Impact Training Center- Itezhi Tezhi)

above: deovotions around the fire (photo: Edward Luebben, Life Impact Training Center- Itezhi Tezhi)

above: youth singing at New Life Tabernacle Church (photo: Lianti Muller - Itezhi Tezhi)

2.2 Engineering Ministries International

Engineering Ministries International (EMI) is a non-profit Christian development organization made up of architects, engineers, surveyors, and construction managers. We use our skills to serve the church and communities worldwide through the design of hospitals, schools, water systems, and many other facilities.

Our stories at EMI are as individual and unique as those of the Impact Zambia team, yet one thing ties us together and that is our HOPE of restoration in this world. Our vision is to see people restored by God and the world restored through design. Each life, each ministry, each building is an opportunity to restore God's relationship with humankind and draw individuals closer to Him. Our passion dovetails perfectly with Impact Zambia's vision for the training center and the empowering that will come as a result.

The built environment around us has such potential to create spaces that focus our attention, influence our emotions, and shape our mindset, inspiring a unique experience within each user. Hence, intentional prayer and consideration must apply to planning and design of the urban fabric to ensure the correct organization, hierarchy, and elements are included. This would lead to concepts such as dignity, hope and empowerment, which may not immediately connect with spatial design, being included in our long-term development plans.

Understanding this need, Impact Zambia engaged and hosted an EMI team in July 2023 to conduct a design charette process that included staff, volunteers, and Impact Zambia representatives. The design charrette took place 19-26 July 2023 with primarily design layouts and feedback provided at the end of the visit and continued development in the EMI South Africa office.

The team, pictured below was made up of 2 EMI staff, 5 volunteers and 4 nationalities represented (Zambia, South Africa, USA, and Canada) with 5 different design disciplines.

Staff:	Matthew Moeckel (Project Lead | Architect)
	Chamonix Stuart (Project Lead | Architect)
Volunteers:	Thomas Sarmiento (Canada | Civil Engineer)
	Edward Luebben (USA | Architect)
	Mutinta Kaula (Zambia | City Planner)
	Tim Brouillette (USA | Electrical Engineer)
	Ben Shinabery (USA | Surveyor)

Through the practice of designing and constructing, EMI seeks to develop people into better designers, constructors, and witnesses for the gospel – regardless of background, privilege, or status.

The following report, calculations and drawings are the result of those design efforts.

above: the EMI team, *left to right:* Thomas, Edward, Chamonix, Matthew, Mutinta, Tim, Ben (photo: Ben Shinabery, Life Impact Training Center- Itezhi Tezhi)

03 | Project Overview

3.1 Site Location

The life impact training center site is located 24km NE from the small town Itezhi Tezhi in Southern Zambia. It is accessed via a gravel road that was recently upgraded by the Zambian government.

The site is part of a resettlement initiative in the Itezhi Tezhi area, and while it is currently fairly isolated, future development in this community is both planned for and predicted. Pastor Daniel Mayapi purchased a sizable piece of farmland during this resettlement planning phase a few decades ago. In 2019 Daniel sectioned of a 10-hectare piece of his farmland to be used by Impact Zambia as the site for the dream of a training center. Pictured in the image to the right is the sequence in which the property was sectioned off. At first Daniel only gave the 1st section to the training center for ministry use, but then realized they might need more space and then sectioned off the second piece in addition. The majority of the Northern Boundary of the site borders Daniel's own farmland.

A land survey was done during our visit to the training center. The purpose of this land survey is to provide a scalable digital CAD base map of the existing topographic conditions of the Life Impact Training Centre. See full site survey report in Annexure A for more information.

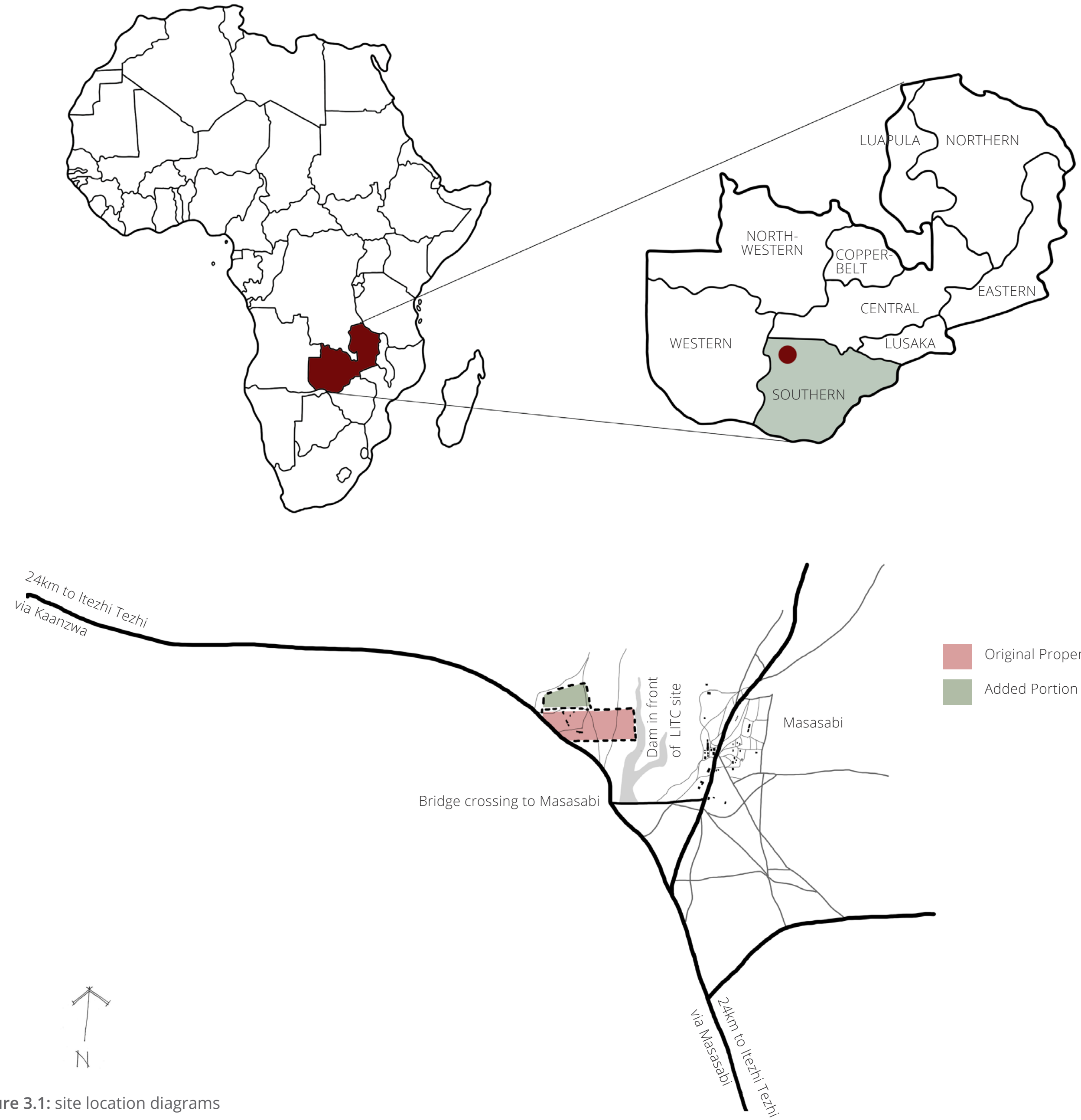


Figure 3.1: site location diagrams

3.2 Site Analysis

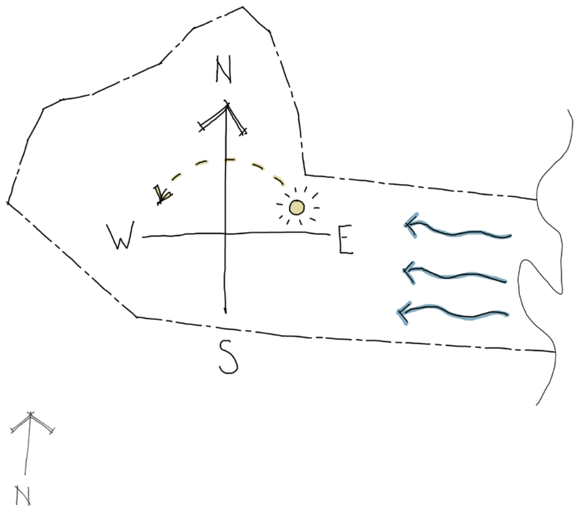


Figure 3.2: wind + sun diagram

Figure 3.3: vegetation + river diagram

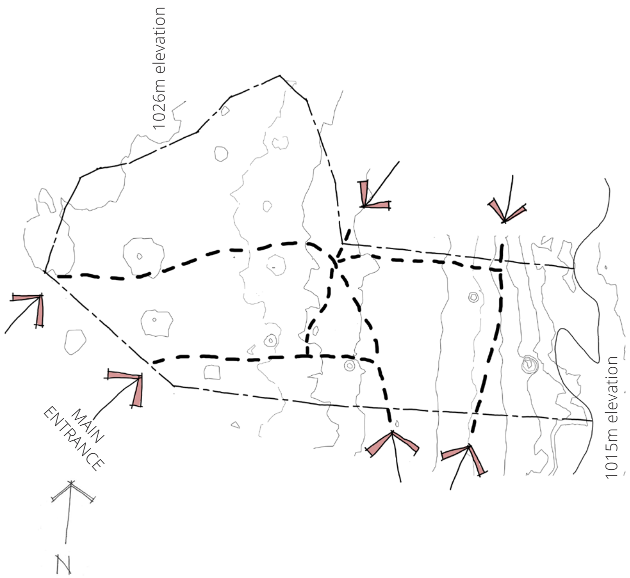


Figure 3.4: contours + paths diagram

Climatic Conditions

Zambia has a warm dry climate with heavy short bursts of rainfall during the rainy summer season from mid-November to April. Itezhi-Tezhi has an average annual rainfall of 881mm. Prevailing strong winds on the site come from the East over the dam. The average minimum temperature is 9.5°C and maximum temperature is 35°C.

Itezhi-Tezhi experienced 7.13 kha tree loss, 0.455 kha tree disturbance, 3.61 kha tree gain, whilst 39.3 kha of forests remained stable. This district experiences low risk pollutants such as PM10, NO2, SO2, and CO. The medium risk pollutant is PM2.5 and the high-risk pollutant is Ground Level Ozone.

Natural Elements

One of the best characteristics of this site is the beautiful natural elements that are in and around the space. Dense tree coverage that becomes comforting shelters from wind and sun is found in large pockets on the site.

The full extent of the eastern boundary of the site comprises of a beautiful waterbody. Home to colorful waterlilies and fish eagles in abundance.

Topography and Access

West to East, the site has a very gradual fall in elevation toward the dam on the eastern edge. The slope is gradual enough to feel like the site is flat, but enough of a slope to be able to comfortably drain any excess water toward the dam.

Currently the site is unfenced and to any visitor the boundary is unclear. Because of this, there are a few informal pedestrian routes that walk through the property and createvvvvv multiple access points to the site. The main entrance is currently found on the western boundary, coming off the recently repaired access road to Massabi.

Existing Site Features

A few buildings housing the beginning programs of the training center are scattered on the site. These are constructed in a variety of architectural styles and construction methods. As is, they do not meet the basic requirements for the training center to be registered with TEVETA, being either too small, not properly enclosed, or appropriately ventilated. Adjustments are being made to these structures in order to begin the bare minimum registration process for the training center.

1. Student Residential Block

For residential purposes, the campus has an existing row with 2 blocks of student resideces linked by a communal gathering space in the middle separating the male and female wings on either side. Each wing has three rooms and one bathroom. In total there are 6 rooms and 2 bathrooms in this block.

Figure 3.5: existing site showing building and road locations

The campus further has two completed and operational chalets to accommodate temporal staff that travel to the Campus to offer short term training courses.

2. Care-takers residential dwellings

Distributed around the above-mentioned buildings are the care-takers compounds were you can see the traditional spatial planning practices being appreciated were a compound is established of more than one traditional hut to accommodate a single family household.

3. Ablution Block

Additional to the bathrooms in the residential block, there is also a freestanding ablution block that caters for the rest of the existing campus. This block consist of a male wing with 2 showers and 1 toilet and female wing with 2 toilets and 1 shower.

4. Semi-open training center

For meeting and training purposes, the campus has an existing 1x2 building shelter that offers a semi-open dining area and a meeting area that is currently being used for any meetings and trainings taking place on the campus. The campus further has a kitchen attached to the dining area used to prepare meals.

5. Outdoor cooking area

Currently, the campus has also accommodated an optional outdoor cooking area where cooking can be done using the alternative traditional methods of using fire wood or charcoal for cooking.

6. Carpentry Workshop

As a begining step toward the idea of a skills training center, a workshop for carpentry was errected with a covered outdoor working area in front. This workshop also has 2 storerooms for the heavy duty machinery.

Other services existing on the campus is water supply from a borehole and electricity supply from the local electricity utility company. To the Northern edge of the site, members of the church have already started using the site for agriculture.

Opportunities + Constraints

The site analysis identified that the following elements must be considered in design:

- The existing buildings that are scattered around the site do not have an architectural relationship with one another and do not create desirable communal space between them.
- Scattered around the site are many beautiful and useful trees that create shelter and shade whilst at the same time making placement of buildings more of a challenge by dictating building footprints.
- As is the site is not fenced and there are a variety of people using the site as public trough way to the main site, making the space lack privacy for the function that it wishes to serve. As well as making it vulnerable to potential acts of crime.
- Due to the waterbody with only one bridge crossing on the eastern edge of the site, the location becomes a converging nodal point where various people come past to cross the water. That can become a significant space for the various surrounding communities.

Above: Ben surveying hut on site
Life Impact Training Center, (photo: Chamonix Stuart)

Above: temp staff housing at Life Impact Training Center, (photo: Edward Luebben)

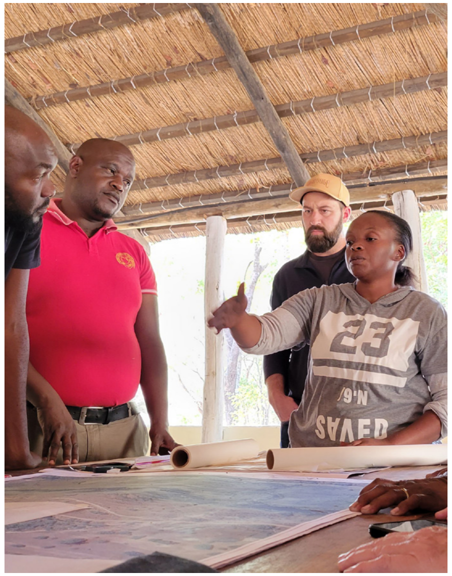
3.3 Design Brief

The Life Impact Training Center has a desire to use their site for the purpose of training people in employable skills whilst imparting in them leadership, life skills, and a spiritual foundation. To this end the site will host facilities aimed at both their practical training as well as focusing on and encouraging spiritual training. Full development of this property is planned over several years as the training offerings of the school expand.

- Student Residences
- Dining Space
- Staff Housing
- Caretakers Housing
- Chapel
- Administration Office
- Library
- Computer Room
- Classrooms
    - General
    - Sowing
    - Culinary training
- Workshops
    - Plumbing
    - Carpentry
    - Electrical
    - Brick Laying
    - Welding

Inspired by God's vision of restoration and tasked with these requirements for the site, our team of designers set off to create a master plan concept that would drive the layout of the site.

Above: EMI team working in training center, (photo:Lianti Muller, Life Impact Training Center - Zambia)



Above: Mutinta presenting process work
(photo: Ben Shinabery,
Life Impact Training Center - Zambia)

Above: walking the LITC site with training center board
(photo: Lianti Muller,
Life Impact Training Center - Zambia)

04 | Master Plan

4.1 Master Planning

Architectural master planning is the first step in a design process, especially developments looking 10-20 years into the future, such as the Life Impact Training Center. A master plan format can vary, but is essentially dynamic long-term planning that provides a framework for future growth according to an organisation/ community's vission. It creates a well thought through urban fabric; a scheme from which architecture can take shape. It is ultimately about considering and creating intentional connections between spaces and users.

The master plan is intended to guide a community's growth from a high-level perspective, focusing on:

- Identifying priorities
- Promoting future vision and desired change
- Preserving a locality's unique character
- Enhancing a community's livability
- Allowing for phased implementation
- Growing toward the God-given dream

A key aspect to the master planning process for a community is a collaborative approach. This allows for the broader community's desires and values to be taken into consideration. Our approach to utilise workshop style design encourages the reimagining of spaces through collective imagination. This brings the end user alongside the designer in brainstorming around the future.

Life is a series of experiences created by a variety of external and internal choices. Our goal in the master plan process is to consider the experiences encountered on site and make choices in layout and design that will yield the most fulfilling experience for the user. The journey of every good master plan begins with a concept that guides the design. Through time spent with the training board, listening to their stories and dreaming with them, the following 5 principles became the driving conceptual ideas for the master plan.

4.2 Design Concept

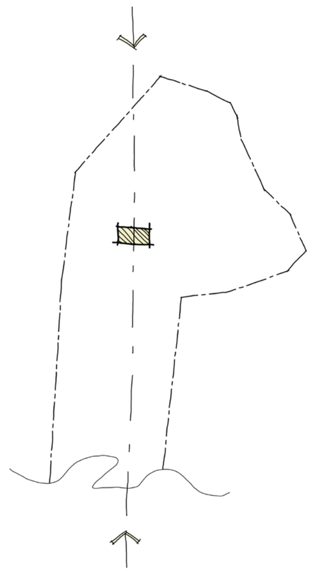


Figure 4.1: Underpinned by Faith

The driving motivation for Impact Zambia is the deep roots in the truth of the Christian faith and the manner in which it calls us to a hope found in Jesus Christ. True to this, a master plan for this training center needs to communicate the importance of Christ as the motivator and center of the training center. Placing the Chapel, the space of worship, at the center of the campus and creating axis from the starting point communicates the foundational importance of faith in all that we do in life, including our vocations, everything flows from Him.

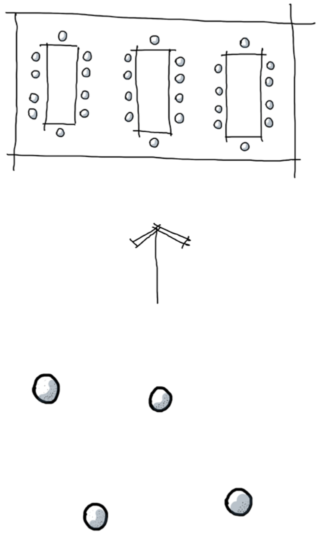


Figure 4.2: Sense of Family

As part of instilling a sense of dignity and value in each student that comes to learn at the training center, the Life Impact team has a heart to create a sense of family on the site.

During discussion with the EMI team and the Life Impact team consensus was made that one of the ways in which this value drives architectural placemaking is through communal dining spaces as opposed to self-catering kitchens. Although self-catering kitchens might be more common in Zambia, they hold a risk of creating separation between students coming from different socio-economic backgrounds. One might find individuals that can provide and cook for themselves, and those who might not have the financial ability to provide themselves with 3 meals a day. Creating communal dining facilities mitigates the formation of separation and emphasizes a sense of family.

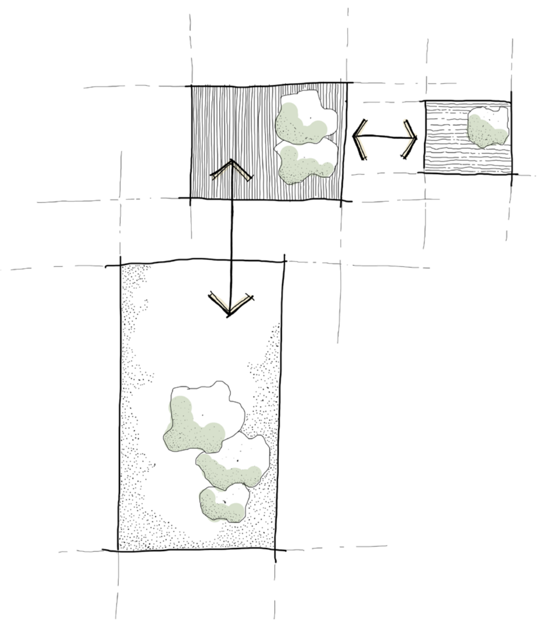


Figure 4.3: Connection to Nature

The abundance of tree canopies, along with a scenic river, and majestic fish eagles found on and around the site, speak so gently of God as a divine creator. Appreciation of this nature and its innate ability to bring a sense of calm and awe drives a desire to create spaces that have a natural flow and connection between inside and outside spaces. Using interleading green spaces of ranging sizes allow for a variety of natural spaces that can host from big groups to individual studying. Ultimately, making spaces where the natural elements become part of the architectural design.

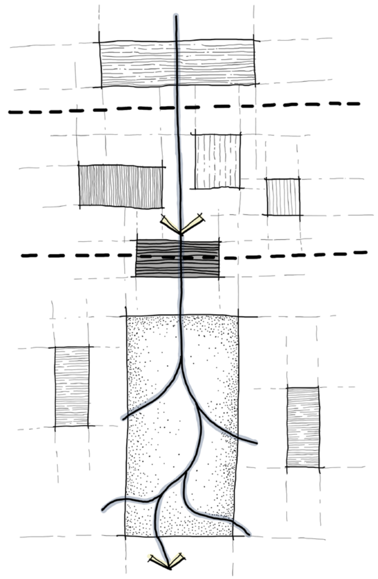


Figure 4.4: Journey Through Site

In order to create a space that is both open for public engagement as well as being safe, comfortable, and private for those who live on the site, a journey through the variety of spaces needs to be carefully crafted. It is important to create layers as you move through the site.

There are a few ways in which layers are created. Firstly, placing most public facilities, like the sport fields and school buildings closer to the entrance, and the more private buildings like residences deeper into the site. Added onto that, is the layer of strategically laid out movement routes. Firstly, in the public spaces, the paths are clear and defined with open views to the end destinations. As you move deeper into the site, the paths are less clear, and meander more, necessitating a knowledge of the space and the user's desired end destination. This also allows for more of a contemplative journey towards the river at the end of the site.

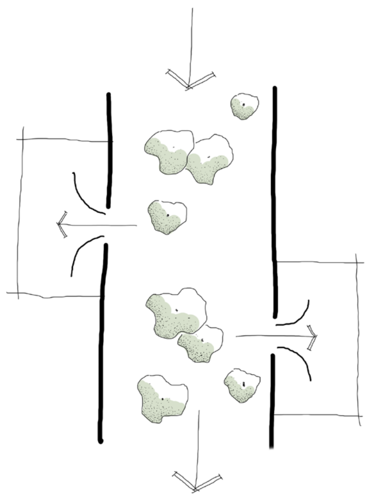


Figure 4.5: Special Moments

Creating a variety of special moments throughout the site adds to layering and aids in making it possible for the user to read which spaces they are meant to access or not. These moments include framing special entrances to certain spaces, communicating that all is welcome, or in other instances hiding spaces away to deliberately create a private moment.

Some special moments are replicated across the site to unify the architectural language. This also serves to elevate the overall aesthetic of the architecture in an affordable manner by having mostly affordable building methods across this site, with these small punctures of unique materiality scattered around.

4.3 Master Plan

- Sport Fields
- Academic
- Residential
- Green Lung
- Agriculture
- Camping

The proposed conceptual site zoning was developed in close collaboration and discussions with Life Impact training center management and board members to specifically assist them to meet both their short term and long term growth plans. Close attention to detail was priotized to the training center's needs and any other requirements highlighted to Life Impact training center management by the Zambian higher education regulatory body.

Overall, from the discussions held with the client a conceptual master plan split into six planning zones was created. These were positioned in a way that movement through the site would gradually grow from public, to semi-public, to private at the eastern side of the site. This allows the site to be regulated with regards to who can move through the site at different points. Figure 4.6 shows a breakdown of the zones.

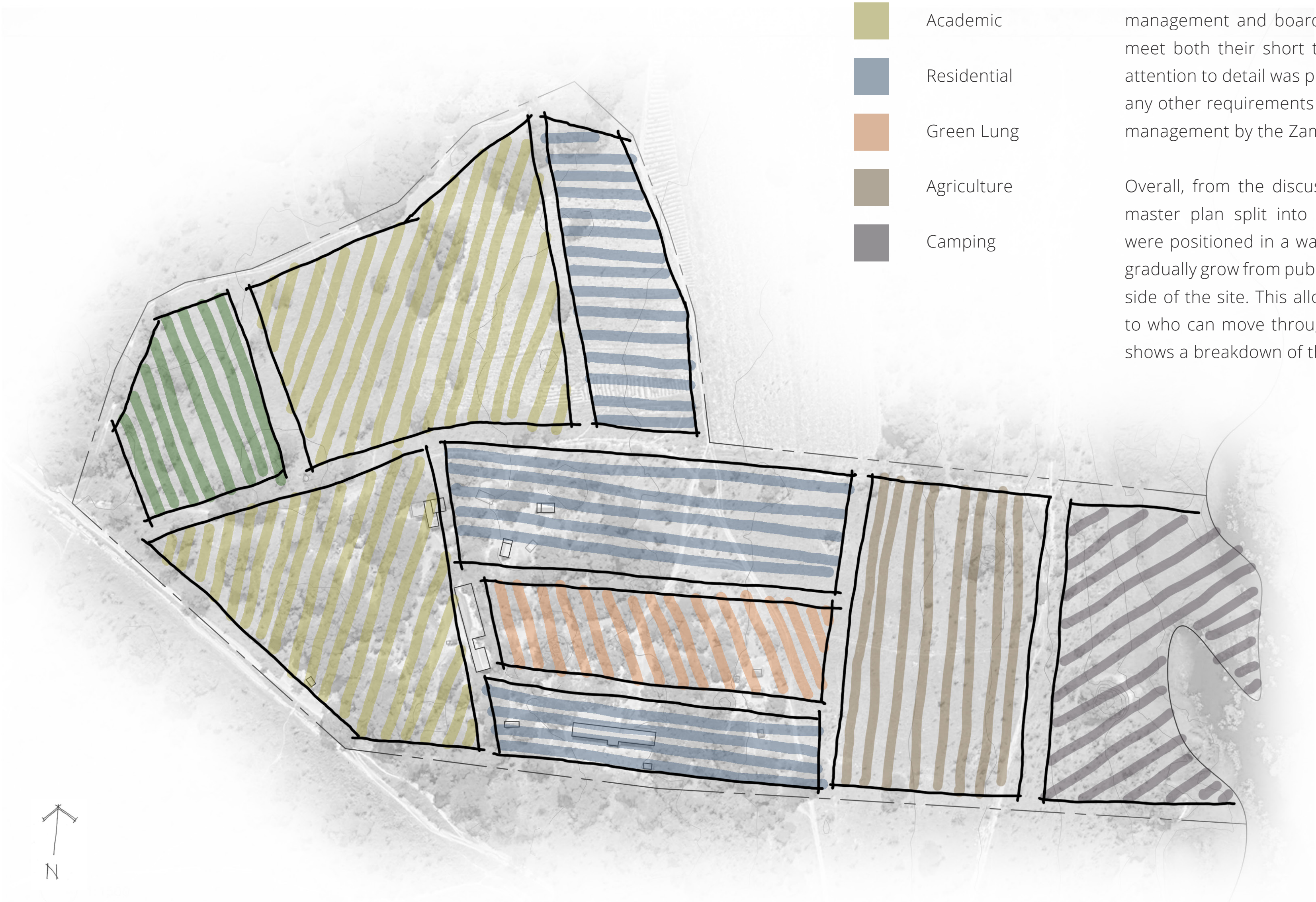


Figure 4.6: allocated zones for different functions on site

Figure 4.7: proposed LITC master plan

1	- Administration	8	- Male Dorm
2	- Classrooms	9	- Staff Housing
3	- Library & Computor Room	10	- Caretakers Housing
4	- Workshops	11	- Temporary Staff Housing
5	- Chapel	12	- Camping
6	- Dining Hall	A	- Sport Fields
7	- Female Dorm	B	- Agriculture Fields

Figure 4.8: proposed LITC master plan sketchup model

4.3.1 Academic

Visible under the beautiful canopy of trees is the academic zone, the welcoming entrance and public interface of the campus. With the administration building opening toward the public road, it welcomes the user of the space in and then they are directed from that point on where to go. The different buildings in the academic zone are strategically arranged to create very defined courtyards as outdoor gathering spaces. These courtyards remain beautiful natural spaces allowing the buildings surrounding them to have a connection with the natural spaces. Once you move through the Administration building you are in the most public courtyard facing the beautiful chapel building that becomes the feature of this public gathering space. The chapel holds the space while the other buildings remains a blank canvas. The existing 1x2 semi open training classrooms has been proposed to be converted into a chapel for the campus. The chapel will be the central point of the campus with its architectural design communicating the foundation of the campus being wholly based on Christian values. In doing so, the location of the Chapel will also act as the bridge between the Academic Zone and the Residential Zone.

The academic space is split into 2 wings by the Library and Computer rooms. These communal facilities located in the middle serve both the domestic skills training, like culinary, sewing and childcare on the southern side, and all the workshop and classrooms that serve those workshops to the Northern side. This split allows the workshops noise to be contained at a distance from the classrooms as well as easy access along the ring road for deliveries.

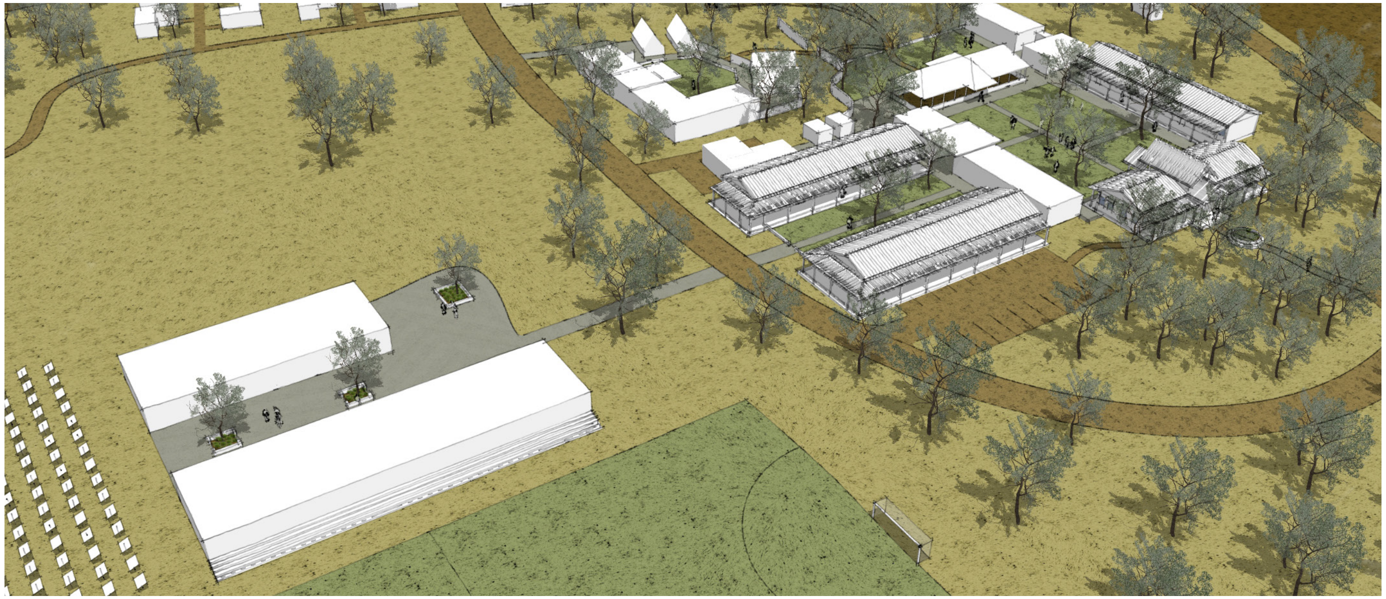


Figure 4.9: overview of proposed academic zone

Figure 4.10: close-up view of academic cluster

4.3.2 Recreational

Next to the academic zone, at the public face of the site you find the playfields for recreational activities, especially sports. These are an important requirement for a learning center as this helps students use their physical strength to interact on a larger scale with other students and most important promotes a healthy community. The proposed master plan allows for the inclusion of recreation facilities such as a soccer pitch, netball ball pitch and a basketball court for the students. Locating these on the public side allows for the surrounding community to watch and engage with any of the sporting activities that take place on these fields. In so doing it creates another avenue of connecting with the community and making an impact.

4.3.3 Residential

The Residential dwellings within the campus are broken down into two distinctive categories which are:

Student residential

Once you move through or around the chapel in the academic area, you enter the more semi-private student residential space. The chapel, once again from the residential side, becomes the iconic building that is a beacon at the head of the space. Next to the chapel in the communal area you find the dining hall where the students can enjoy a communal meal together. In front of the chapel and the dining hall you find another formal courtyard space where outdoor gatherings can take place. However, once you move beyond this courtyard, you enter a contemplative, restful frame of mind.

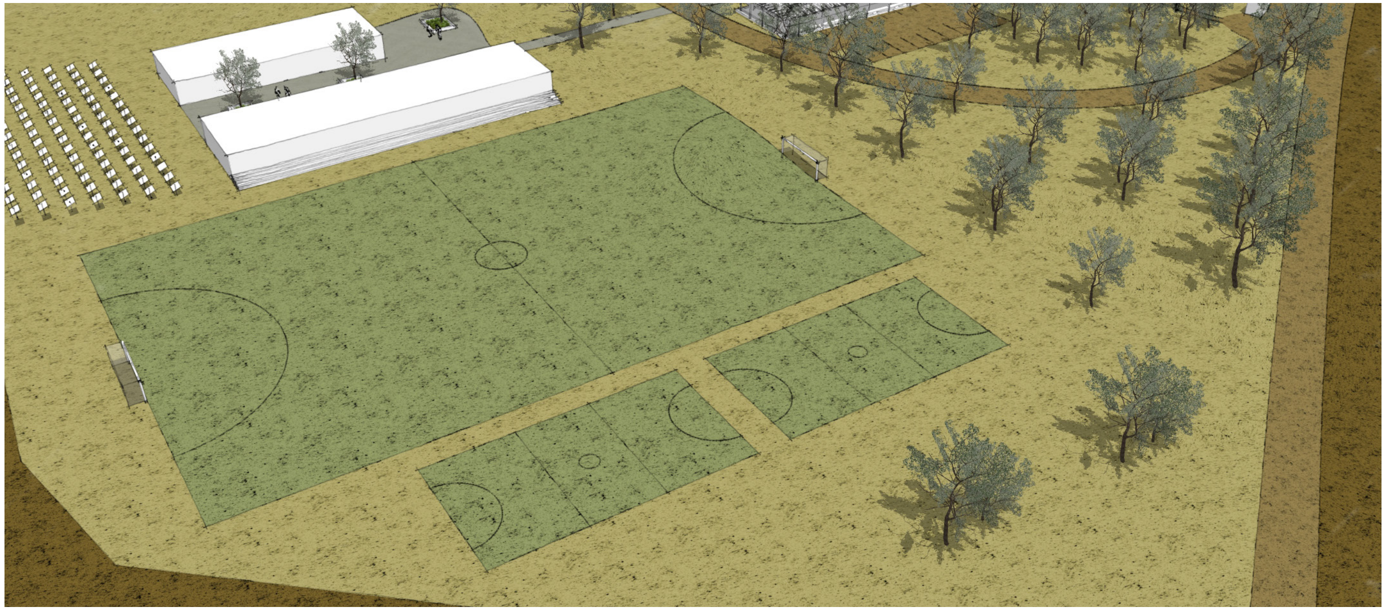


Figure 4.11: playfields at public front of site

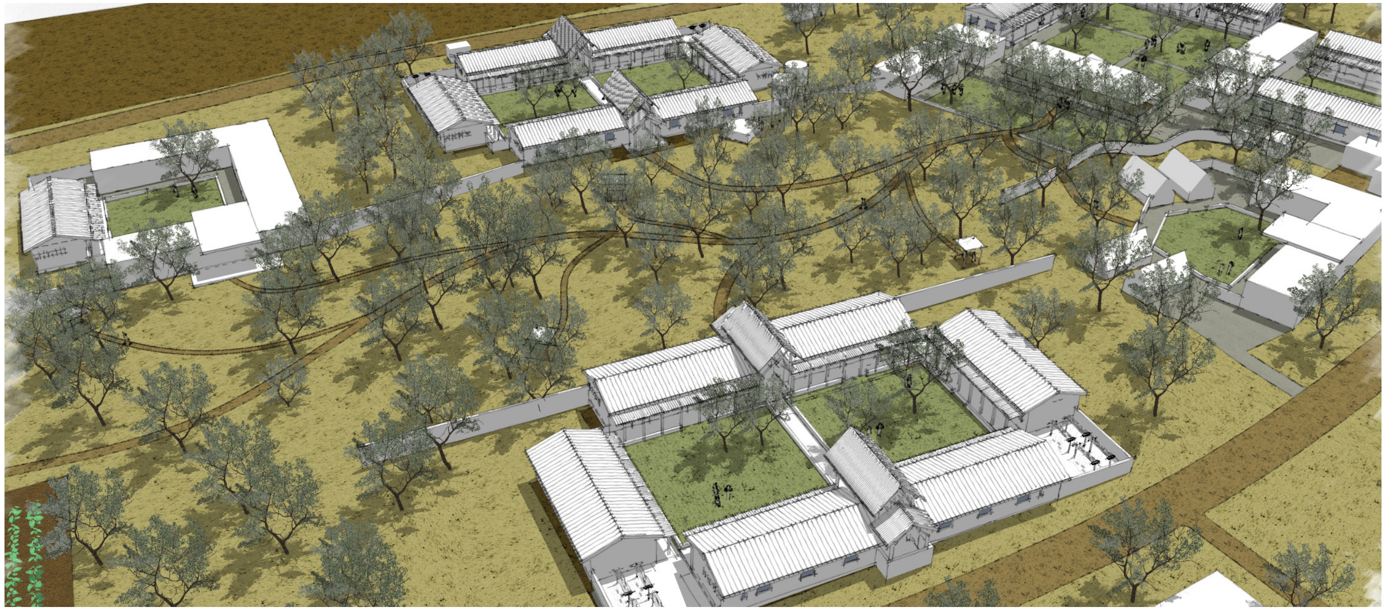


Figure 4.12: overview of student residential zone

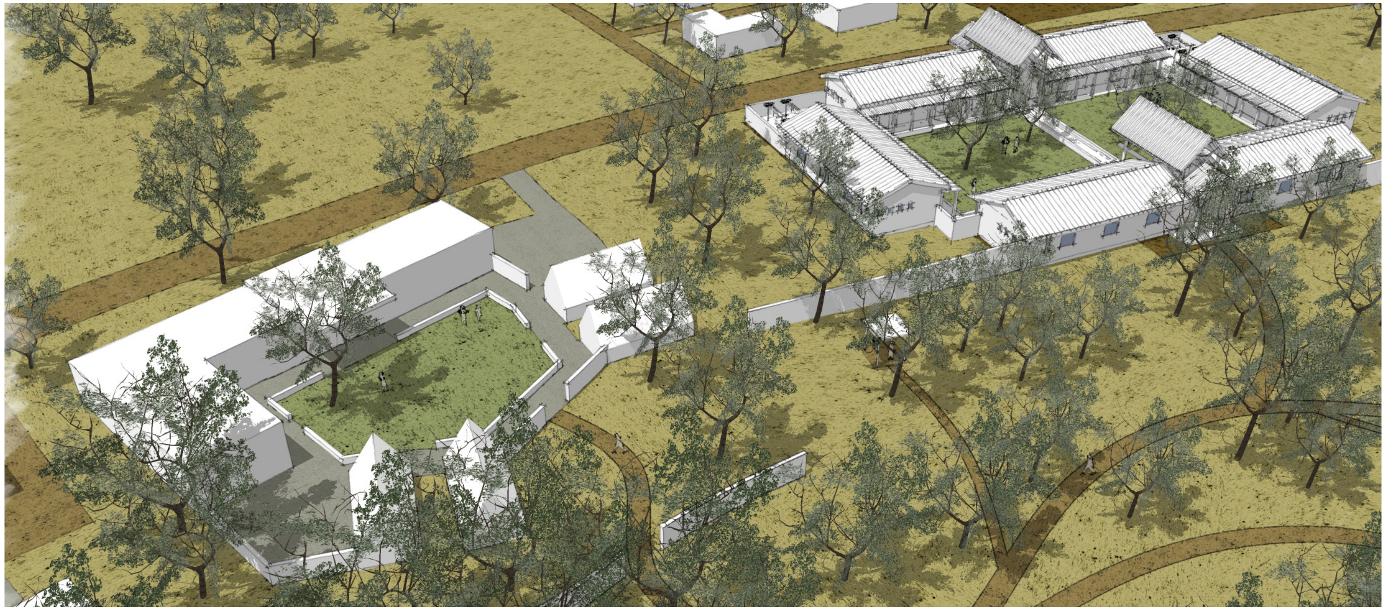


Figure 4.13: female student residences

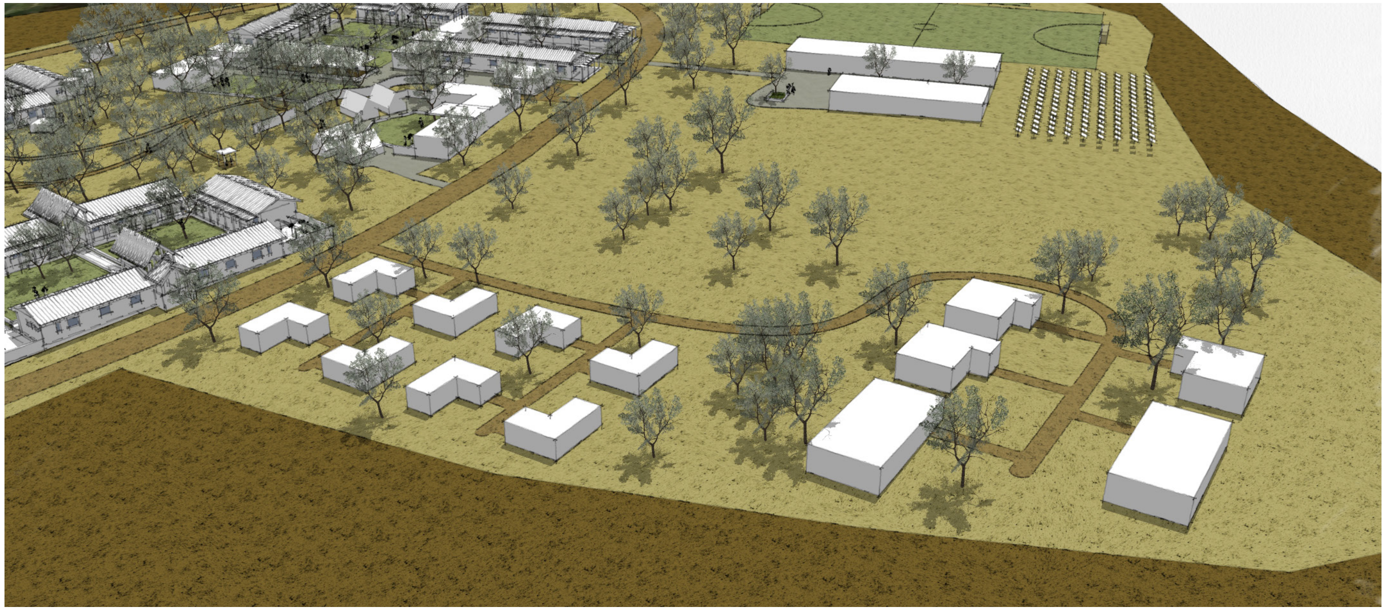


Figure 4.14: staff housing clusters

Here, the green space changes from being a tidy, manicured, courtyard to being the natural trees and uncleared ground with walking paths meandering through the unrefined forest. Scattered around the paths are shaded coverings where students can sit in nature and study whether in groups or as individuals. On either end of this green lung of natural tree growth, you are met by a long-extended brick screen wall. In fact, these walls are the extension of the student residences walls beyond the building frames and functions to hold the big green lung in the middle of the campus. These "walls", made of natural sympathetic materials (see fig4.15 & fig4.16) that pick up the gentleness of the surrounds, are pierced at the moments where you enter the residence cluster. When you slip through the pierced moment, like a mysterious entrance in a whimsical forest, you enter the residence space that has a beautiful green courtyard in the middle. The residences become an introspective sanctuary in the forest known only to those who live in them.

Staff & Caretaker Residential

Located on the Northern side of the campus is the staff residential area, with the ring road creating a level of separation from the student residences. Closest to the campus area is the cluster of small houses creating a form of community for the caretakers. This, for them to have easy access to the student residences for general oversight.

Slightly further removed from the campus zone is the housing for the full-time staff for the training center. Currently there are 5 homes indicated, with room for westward expansion if need be. These homes are removed from the academic and student areas in order for the staff to have their own spaces of retreat.

Each home has room for making the space their own, by having a room to create a garden and personalize the living area.

Materiality Precedent
What: Student Hostels
Where: Nagpur, India
Architects: Studioboxx
When: 2020

Figure 4.15: Precendent example materiality of "wall' surrounding green space

Figure 4.16: Precedent showing wall sympathetic to surrounds

Source: https://www.archdaily.com/998136/students-hostel-studioboxx?ad_source=search&ad_medium=projects_tab

4.3.4 Green Spaces

Zambia, and the LITC site, has some of the most pristine natural environments. This is one of the biggest strengths of this space. Creating pockets of varying types of green space between the different programs encourages a connection with these natural spaces. Green spaces are strategically integrated into the master plan, with manicured green spaces around the buildings and the big strip of unmanicured green lung that sits in the middle of the site. These will allow for a variety of outdoor gatherings and recreation and promote an aesthetic value of greenery to the entire campus.

4.3.5 Camping/ Visitors Space

Located at the far end of the campus, this area will be meant to establish a camping site on campus that will provide a serine and private environment where the temporal visiting lecturers or any other delegates will have an opportunity to set up a camp site or check into some beautiful chalets while enjoying a clear view of the water dam at the eastern boundary of the campus while staying at the learning center.

4.3.6 Agriculture

Small scale agriculture will help the training center to promote self-reliance in the production of vegetables and other crops that can be supplied to the kitchen for student meals. This will also be an opportunity for any students that will be interested in taking up a part time job while on campus to engage in the growing and maintenance of vegetables and crop gardens. The Agriculture Zone has been proposed to be strategically located close to the existing water dam so that the learning center can have easy access to the available water source throughout the year for irrigation purposes.

4.4 Circulation

Planning access routes within the campus of the learning institute is vitally important. Consideration needs to be given particularly to accessibility for delivery vehicles to various locations on site. It is also important to keep the vehicular routes separate from the pedestrian routes. Doing so ensures that the pedestrian spaces feel safe, and on a human scale, prioritizing the importance of the usability of the space for the student.

To achieve this a main ring road and feeder roads providing access to the various zones on the campus have been proposed in the master plan. This allows for deliveries to take place, as well as any maintenance vehicles to access the buildings.

The majority of the pedestrian routes are held within the middle of the ring road. Keeping vehicles mainly on the outskirts of the site allows for prioritizing of quality outdoor gathering spaces and in doing so enhancing the nature of these spaces visually by treating them like outdoor "rooms".

4.5 Conclusion

Overall, the Master plan developed is a conceptual plan aimed to guide a systematic and orderly pattern of infrastructure growth at the learning center. The plan aims at minimizing the demolition of the existing infrastructure and establishing a community where people will have a sense of togetherness and accessibility to various resources within the campus with ease.

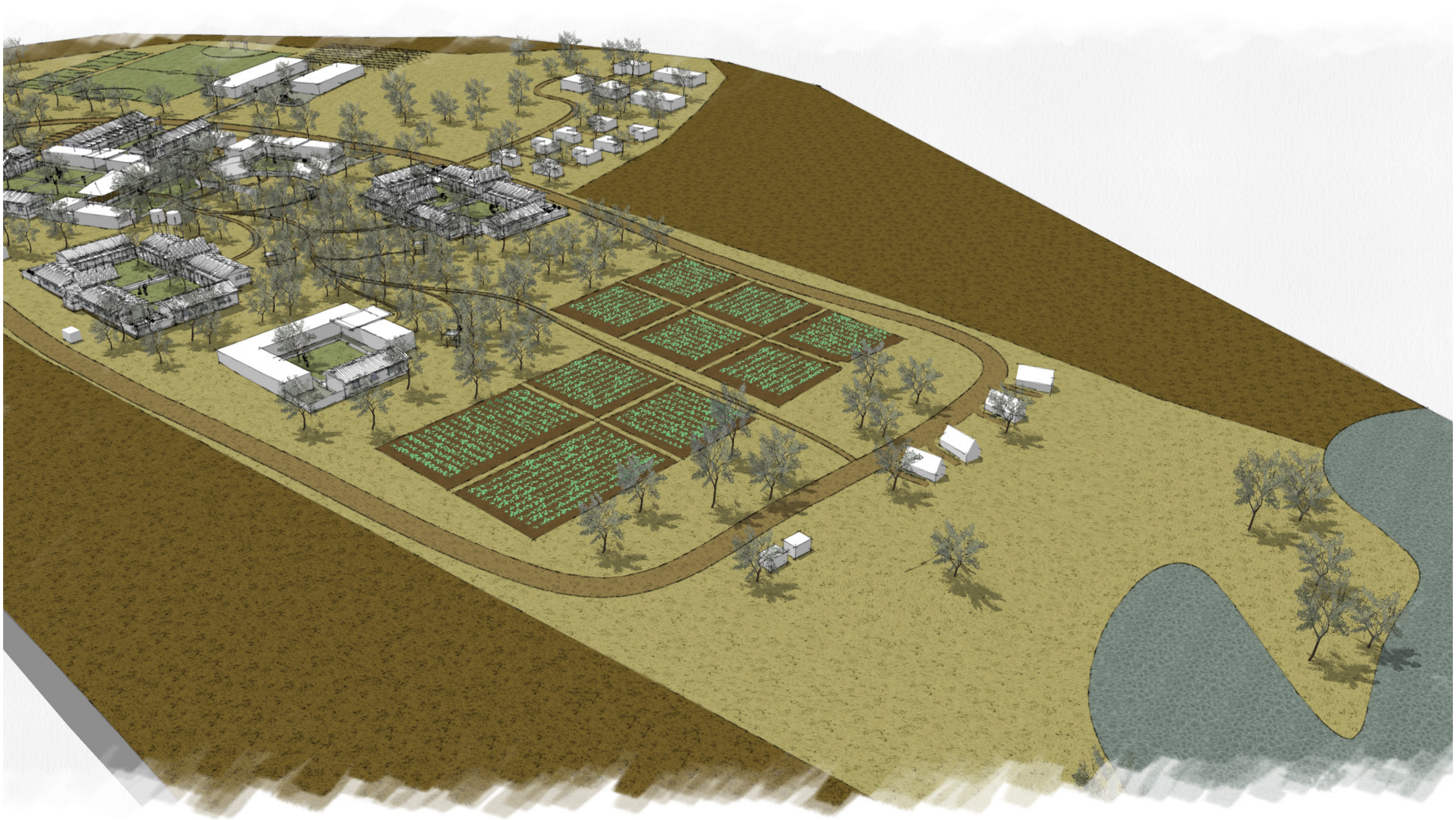


Figure 4.17: site overview from river

Team site walk
(photo: Lianti Muller - LITC, Itezhi Tezhi, Zambia)

05 | Architectural Design

5.1 Administration Building

Upon arrival at the LITC, you arrive at the Administration Building, the grand entrance, the access point to all that lies beyond. You are welcomed by a tall entry archway connecting the two wings of the Administration Building and ultimately leading into the central campus courtyard: the heart of the campus. This entry archway indicates a significant moment on the campus and will be constructed from a special material indicating a welcome to the user at various entry points on the site. Under the entry archway you can access the two wings of the Administrative Building. When entering the south wing you will be received by the administrative assistant and a small waiting area. The principal is located adjacent to the administrative assistant; and across the hall is the boardroom, with a small kitchenette. Other spaces in the south wing include the accounting and procurement office, a strong room, a secure room for storing standardized tests, and an ablution.

The north wing will house the vice principal, six department heads, plus an open staff/training room for temporary use by all campus staff. Each building wing has an ablution, located off the main entryway. The overall Administration building complex is 219.1m2. The south wing is 99.6m2, the north wing is 83m2, the covered campus entryway connecting the two wings is 36.5m2.

Throughout the campus architecture, strategies to soften the spaces internally and externally. Along with the special entry ways constructed from more sympathetic materials, there are also planter boxes with seating proposed in some of the walkways through buildings. Allowing for plants in space softens what could be perceived as dead walls or space that you pass through. This is a simple solution to add life, vibrancy and allowing for a continuation of the beautiful external natural qualities in the internal spaces.

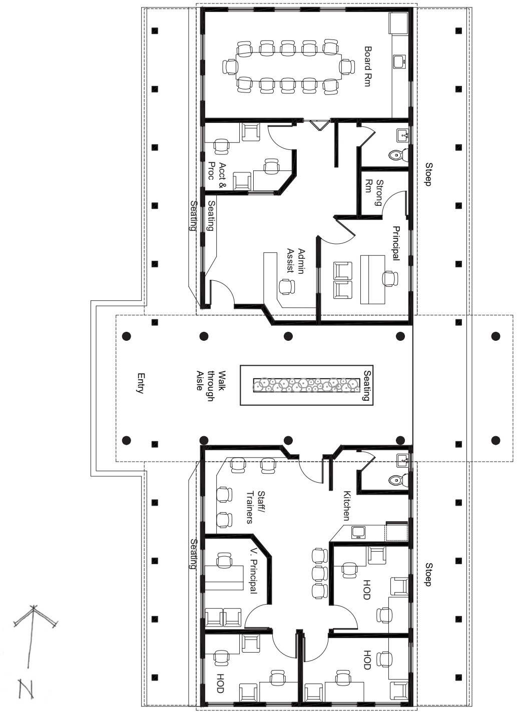


Figure 5.1: administration floor plan

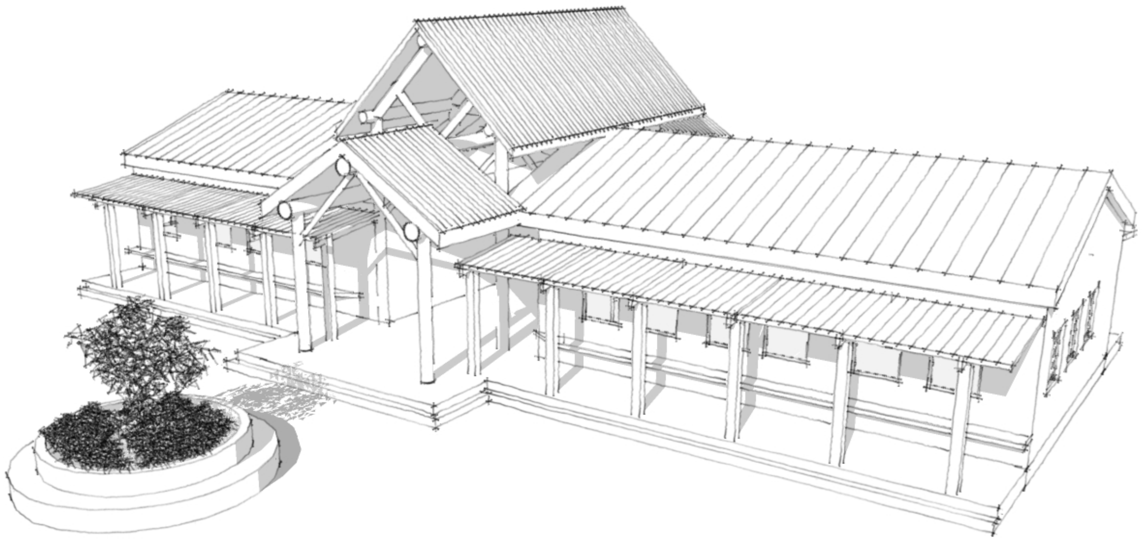


Figure 5.2: conceptual 3D drawing administration

5.2 Classrooms

The classrooms are divided into three, 3-classroom buildings. The 3-classroom building planned to be constructed forms the south side of the central campus courtyard. Future classroom buildings will form a second academic courtyard north of the central courtyard, accessed between a future library and computer center which will be along the north side of the main courtyard.

The first classroom building consists of three rooms, each sized to seat up to 40 students, and each with storage rooms. LITC anticipates that as the campus grows and additional classroom buildings are constructed that the western most classroom will eventually be used as the catering classroom which will require approximately 10 cooking stations; but initially this will be used similarly to the two other classrooms and have seating for up to 40 students. The southern, future catering classroom is conveniently located near the existing campus kitchen, and the future campus dining hall.

The classroom buildings will have a covered verandah along the fronts for rain protection. The future catering classroom may also include a wrap-around verandah to provide protected access to the existing campus kitchen. Each classroom seating area is approximately 64m2, exceeding the 50m2 government requirement for a 40-student classroom. The overall 3-classroom building is 221.5m2.

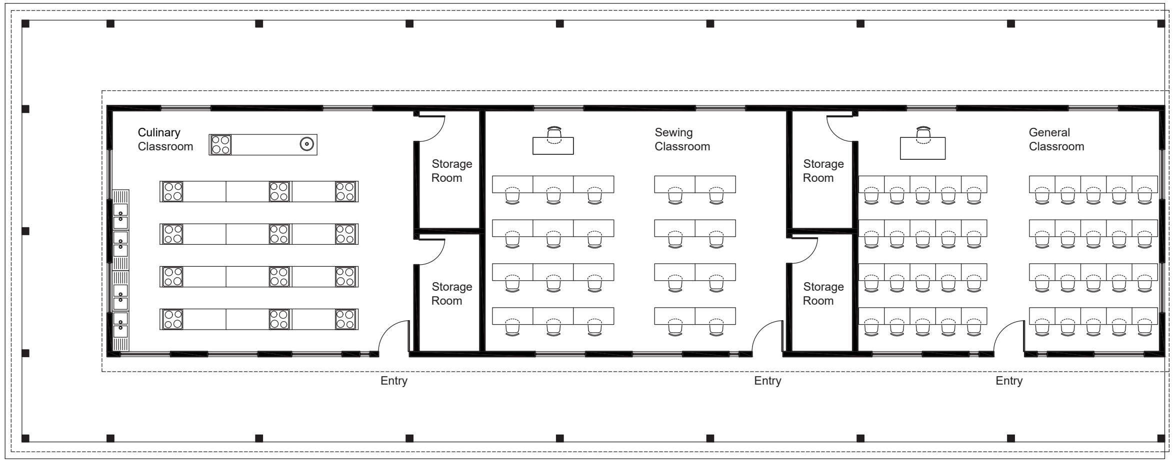
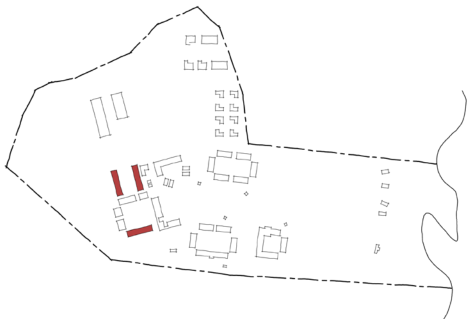


Figure 5.3: classroom floor plan



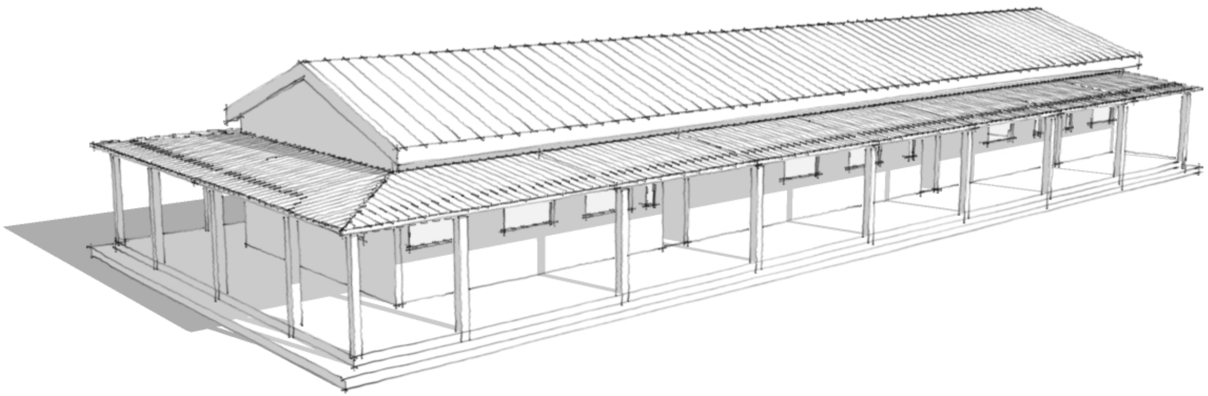


Figure 5.4: conceptual 3D drawing classroom

5.3 Student Residences

The male and female student residences are located on the interior of the campus, east of the central campus courtyard, and the future courtyard formed by the future classrooms and workshops. The primary female and male student residence complexes consist of six buildings, each forming their own internal courtyard and separated from each other by a large campus green space. The male and female student residence complexes are located along opposite sides of a campus greenway that connects the campus to the agricultural area and the river. Future, smaller student residence clusters are also shown on the master plan to accommodate the desired future student population of approximately 280 students.

Each student residence building consists of three sleeping rooms. Each sleeping room will have three bunkbeds accommodating 6 students. A typical residence building will house up to 18 students. A cluster of six residence buildings will house up to 108 students sharing a common courtyard, as well as two covered gathering spaces between residence buildings. These gathering spaces become the social spaces within each of the residence clusters allowing for lounging space or secondary studying spaces. The internal courtyards are a key part of this cluster, once again containing manicured green space with trees where students can enjoy being outside. The cluster of buildings is secured with only one access point at the entrance, and a secondary exit way in the social gathering space in case of emergency. The plans shown in this report show two typical residence buildings with a covered gathering space.

Each sleeping room is 28.3m2, exceeding the 28m2 criteria set by the country. Each residence building will contain an ablution with two toilets, two showers, and three sinks, meeting the criteria of 1 ablution per 11 students. The ablutions are positioned along the ends of the building on the outside edges of the residence courtyards. Buildings will be positioned to create a laundry along the ablution sides of the residence buildings. The residence buildings will have a covered verandah along the entry sides for weather protection. A typical residence building with three sleeping rooms and one ablution room is 112.3m2.

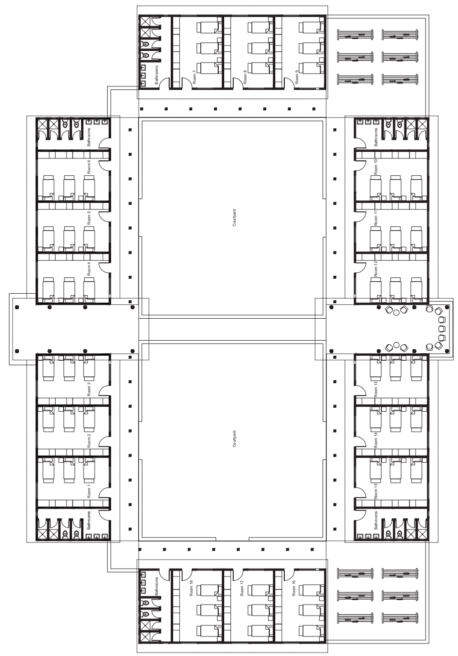


Figure 5.5: student residence cluster floorplan

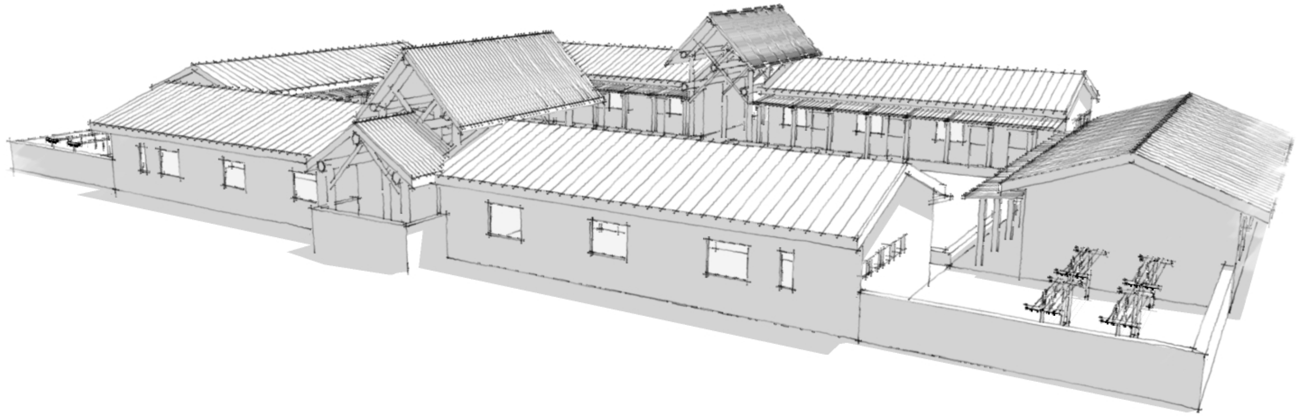


Figure 5.6: 3D conceptual drawing student residence cluster

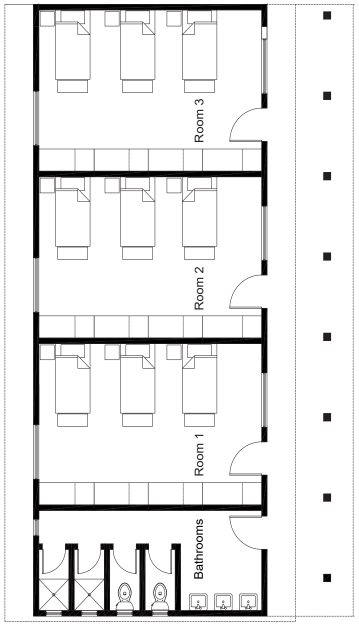


Figure 5.7: student residence floorplan

Figure 5.8: conceptual drawing student residence entrance

5.4 Additional Campus Buildings

Several additional buildings are planned for the LITC campus which are shown on the master plan. Following is a list of campus buildings not included within the architectural design scope:

CHAPEL: the existing multi-purpose building located adjacent to the kitchen will be modified to become the chapel. This building truly is the heart of the LITC project; where sewing classes have been provided; where pastor training conferences are held, and where large, covered dining take place. The chapel forms the east end of the central courtyard, and the planned new entry to the chapel will center on the covered entryway through the two administration buildings which form the west side of the central courtyard. The chapel will divide the academic and housing sides of the campus.

LIBRARY and COMPUTER BUILDINGS: these two buildings will form the north side of the central courtyard and divide the central courtyard from a north end courtyard which will include future classrooms and workshop buildings.

WORKSHOPS: five workshop buildings are anticipated; each being approximately 170m2. These will be located north of the future classrooms; slightly removed from the rest of the campus to assist with noise problems. The western edge of the workshops facing the soccer field can also become a tiered seating space for spectators to what the games.

EXISTING RESIDENCE: an existing residence building, located along the south side of a future greenway, will be modified to form two male residence buildings. The current dining dividing this building will be demolished and will become a covered gathering area between what will now be two residence buildings. Each existing sleeping room is sized to allow for 5 students each. The two buildings will be able to house up to 30 students. The existing ablutions will need to be modified to include one additional shower and one additional toilet in each. This existing residence building will form the south side of the male six-building residence complex.

HOUSING: a housing wing is formed along the northeast edge of the campus. Staff housing for the principal, vice principal, potentially the administrative assistant and future staff is located at the north end of this residential corridor. Caretaker housing is located closer to the campus to the southern core of this housing corridor.

CHALETS: two existing two/person chalets are located east of an existing workshop, which is adjacent to one of the future classroom buildings. The master plan anticipates two future chalets adjacent to the existing, and adding another L-shaped building forming ne cluster for the future female residence complex.

Furthermore, 4 replicas of these chalets will be developed along the river edge. Slightly removed from the campus, this is a tranquil space will be for temporary visiting staff to stay. It allows them to have moments where they can retrieve and enjoy the natural beauty of the space.

CAMPING: a future camping area is planned along the river; with an ablution also planned for this area.

Progress meeting with training board (photo: Ben Shinabery - Itezhi Tezhi, Zambia)

06 | Civil Design

6.1 Basis of Design

Design Capacity

The Life Impact Training Centre is expected to be a staged build with a ramp up in students and staffing up to a maximum capacity of approximately 400 people. This is a substantial increase from the current population between 20-30 (estimated from the number of families living onsite and year round volunteers). As such, planning to expand current civil infrastructures must be considered. Phasing is expected to begin in 2024 with yearly phases until full buildout in 2030. However, as phasing will include the concurrent construction of dorms, apartments, and auxiliary facilities, it is more practical to build the full civil infrastructure within 1-2 phases.

Water Source

Other significant parameters to consider are the quality of water and soil onsite. The current site has an existing borehole which has comfortably provided their water facilities at current capacities. The current setup is only uses between 10-15m depth of the 50m borehole. The bore pump has been installed by a drilling contractor at 15m below the top of the borehole and has currently been able to comfortably provide water throughout the current peak periods. While this observation shows promise, EMI recommends that a drilling contractor come to site to validate current bore capacity for confirmation.

A water dam was constructed and provides a reservoir about 300m east of the main facility (about 50-100m) east of the proposed campground. This has been a water source mostly for animals, as well as an onsite source for construction water.

An assessment of water quality was completed by taking water samples were taken at the following locations described in Figure 6.1:

1. Borehole
2. Perimeter Limits for water taps
3. Water Storage Dam

Soil Test Locations

Water Test Locations

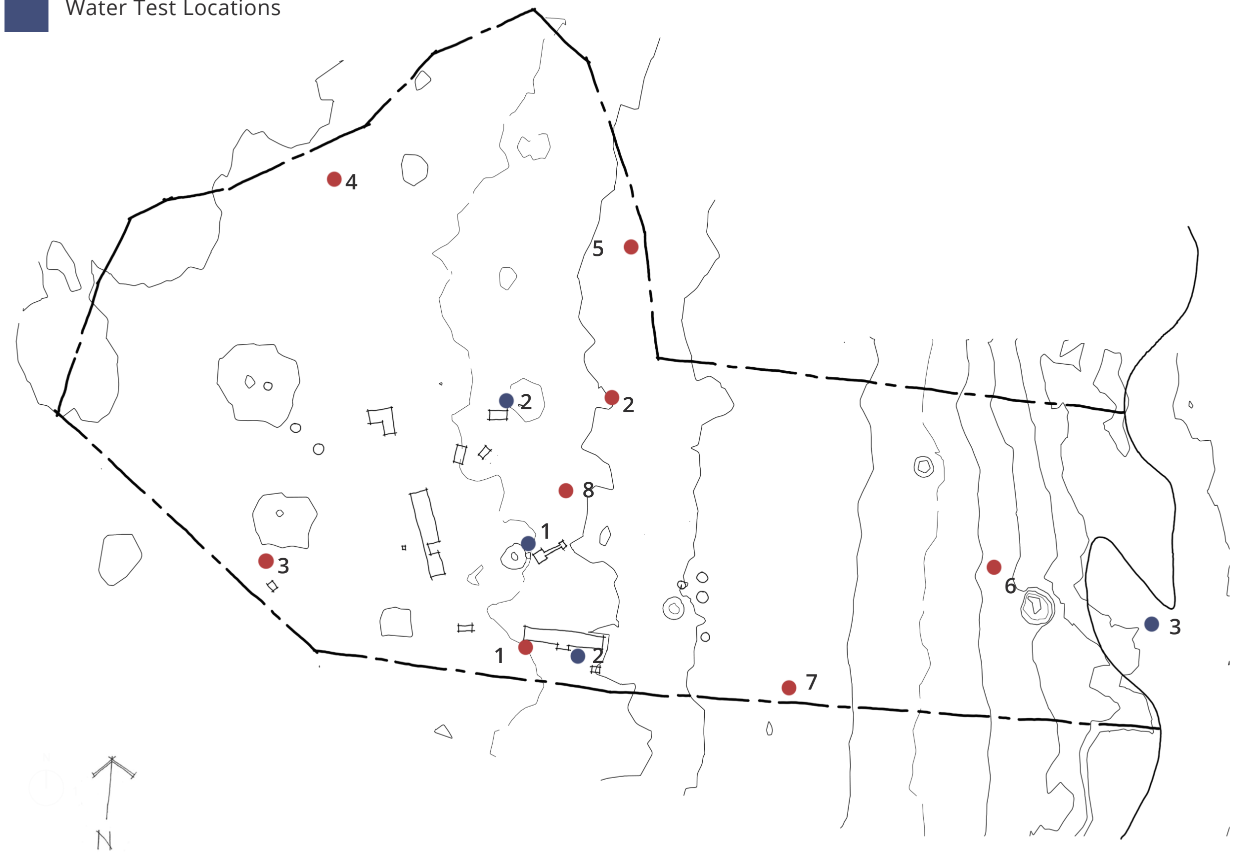


Figure 6.1: water and soil sample locations

Water Quality Results

Bore water sampling results are provided below. Table 6.1 provides the range at the bore hole itself, and the furthest locational water taps. Appendix D.1 provides individual results at each sample point. Values are mostly within the WHO guidelines, but chlorination is recommended at a sample point prior to building distribution.

Water storage dam results are provided in Table 6.2 and show detections of coliform and E.Coli.

Soil Quality

Soil samples, percolation, and soil classification tests were conducted at eight separate locations throughout site as indicated in Figure 6.1.

Table 6.3 show percolation test results. All areas were classified as either fine sand//loamy sand or sandy loam with the exception of test pit area #2 where the soil was clay and unsuitable for location of an infiltration field/trench.

Detailed percolation tests can be found in Appendix D.2 of the report.

Parameter	Result	WHO Guidelines
pH	6.8-7.8	6-8
Free Chlorine (mg/L)	0	5mg/L (0.2-1 mg/L is normal)
Total Chlorine (mg/L)	0	5mg/L (0.2-1 mg/L is normal)
Hardness (mg/L)	120-250	Taste Threshold is 100-300mg/L
Alkalinity (mg/L)	120-280	None
Iron (mg/L)	0	Taste Threshold <0.3mg/L
E-Coli (CFM/100ml)	0	None Detectable per 100ml

Table 6.1: bore water results (range of values)

Parameter	Result	WHO Guidelines
pH	6.8	6-8
Free Chlorine (mg/L)	0	5mg/L (0.2-1 mg/L is normal)
Total Chlorine (mg/L)	0	5mg/L (0.2-1 mg/L is normal)
Hardness (mg/L)	50-120	Taste Threshold is 100-300mg/L
Alkalinity (mg/L)	80-120	None
Iron (mg/L)	0.15	Taste Threshold <0.3mg/L
E-Coli (CFM/100ml)	TMTC	None Detectable per 100ml

Table 6.2: water storage dam - water quality results

Parameter	Result	Comments
Percolation Tests	8.3-25 mins/25mm resulting in an application rate between 25-33 Lpd/m2	Sandy Loam in most places. Areas near water (Test Pit 6 and 7) were more rocky.

Table 6.3: percolation test results

6.2 Water Supply and Infrastructure

Current System

Onsite water supply is provided through the local borehole which utilizes a bore pump to pump to a water tower 5m away and 5.3m above the top of the borehole. The system has the option to divert water from the water tower to a local storage tank. Water is then delivered by gravity to site facilities providing a driving pressure between 5-8 psi depending on the height of the tank. The system is entirely manual and works on the following methodology:

- The bore pump is an ON/OFF pump and is controlled by a nearby switch in one of the accommodation rooms about 50m away from the borehole.
- When the site water pressure drops or loses completely, the operator is prompted to turn on the bore pump.
- The operator waits until water rises to the overflow level at which the operator turns off the pump.
- The valves standard positions are aligned to direct flow to the water tower.
- The process takes approximately 1 hr to complete starting from an empty tank. The current water tower has a capacity of 3900L.

The existing watermain is currently not set up as a looped system, and as such there is no redundancy if there is a blockage to one of the main lines. Figure 6.2 shows a flow diagram of the existing water supply system currently implemented onsite.

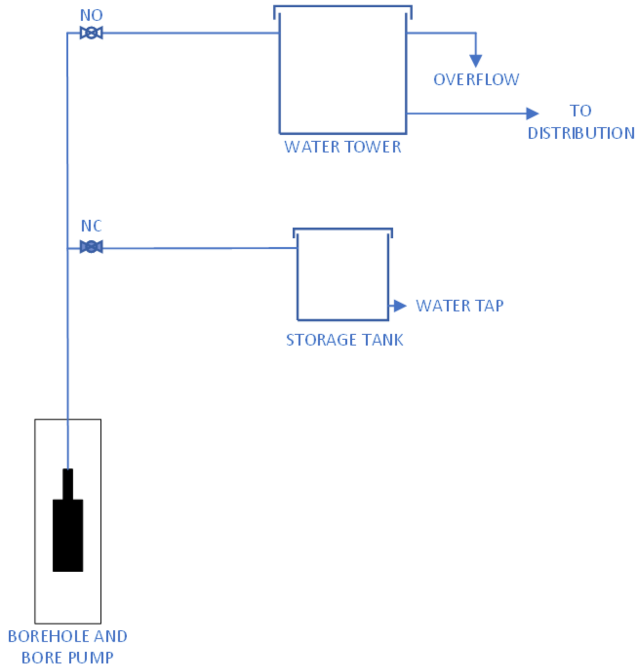


Figure 6.2: flow diagram of current water supply system

above: thomas testing soil condition on site
(photo: Ben Shinabery- Itezhi Tezhi, Zambia)

Proposed Design

Water quality results at the bore and at the perimeter limits of the water supply watermain show that most parameters are compliant within the WHO standards with the exception of chlorine concentrations.

While the system is sufficient for the sites daily activities, it is recommended that a disinfection process be added prior to water distribution . This can be done through chlorine dosing (tablet or bleach) or a UV system reducing the risk of e-coli formation when water remains stagnant for larger periods of time. While many critical QA/QC parameters were analyzed onsite, it is recommended for samples to test for BOD, TSS, COD, Metals, and Turbidity to ensure compliance within WHO standards. Results of these tests could potentially result in investigating the need for a Microfiltration or Ion Exchange system to reduce solids and metals to WHO standards.

Based on the latest demand requirements, it is expected that the system water demand will increase from its current demand of 2000-3000 L/day to 50,000 L/day . Appendix D.3 provides a detailed breakdown of these calculations. To ensure availability of water supply during maintenance events, a 2-day storage capacity is recommended. A water tower has the capability to keep up with this storage demand, but availability of large tanks may be a challenge for either fabrication on onsite delivery. One alternative solution is to hydraulically connect a series of smaller tanks to provide a similar volume. One benefit of this approach is the ability to phase storage demand alongside the projected capacity on a yearly or bi-yearly basis. One drawback may be the need for increased maintenance on multiple tanks, as more fittings will be required, but this is offset by the ability to have water available even when tanks require maintenance. Finally, a float switch or float valve with a pressure control is highly recommended which will turn the pump ON/OFF automatically based on the height of the hydraulically connected tanks. Figure 6.3 & figure 6.4 provides diagrams of the proposed water supply system.

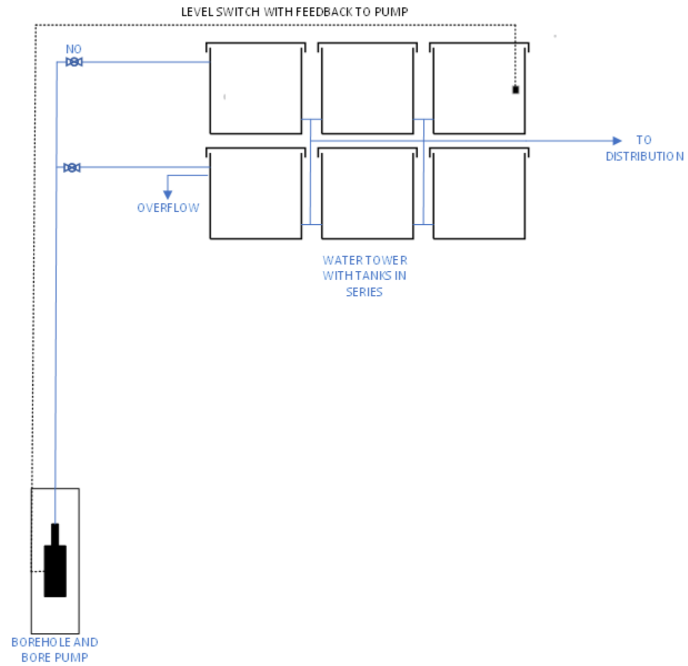


Figure 6.3: flow diagram of proposed water supply system

Given the current demand of 50,000 L/d, two days of storage or (100,000 L)is recommended. This would result in a set of 5 tanks each 20,000L. The benefit of this design is that the tanks can be phased based on site demand. In order to provide suitable pressure to all buildings, a water tower between 7-10m is recommended as this will provide sufficient pressure (1 bar or 14.7 psi) to the distribution lines. If significantly more pressure is desired – a circulation pump maintaining pressure throughout the lines would be recommended but will require additional maintenance.

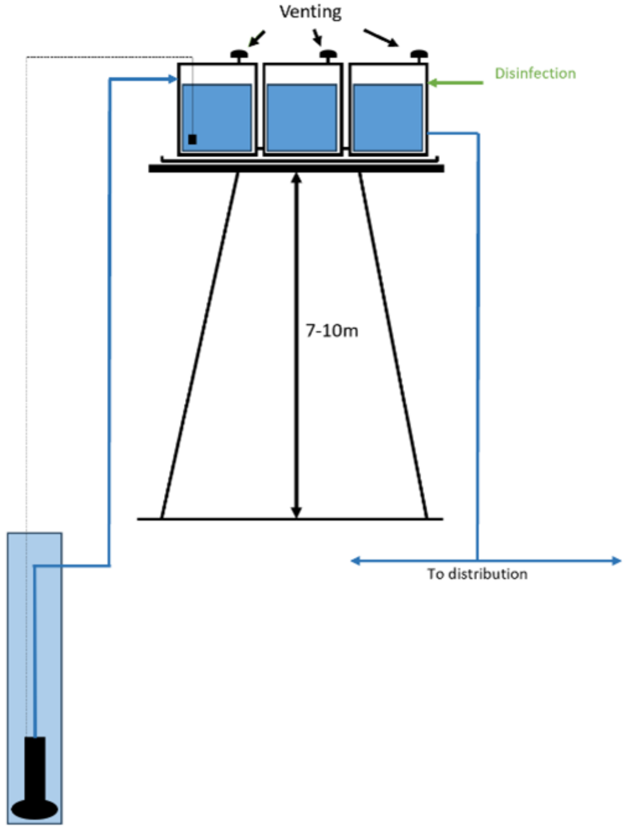


Figure 6.4: side view - hydraulic profile of proposed water supply system

The proposed water supply system shall also have a fully connected watermain (looped system) providing increased reliability to all areas onsite. Two conceptual water line layouts are provided in Figure 6.5 and 6.6 to the right.

As part of the phasing process, running the watermain can be delayed until the campground construction in 2028. An alternative design as shown in Figure 6.6 can be considered which provides a loop system to the higher density areas while reducing pipe/ trenching requirements to the campground.

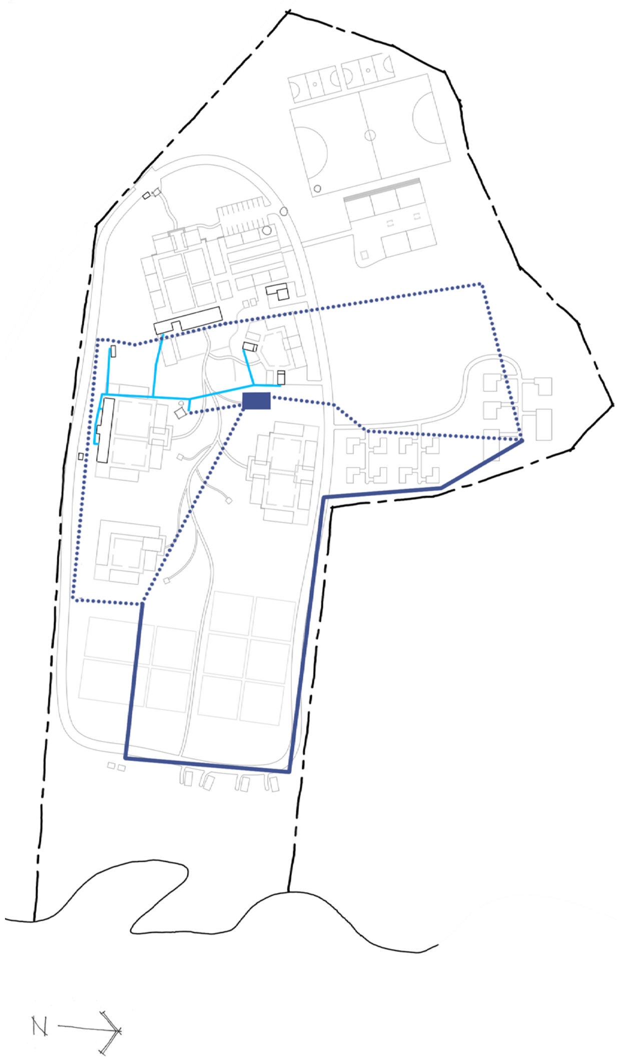


Figure 6.5: proposed connected watermain - full loop

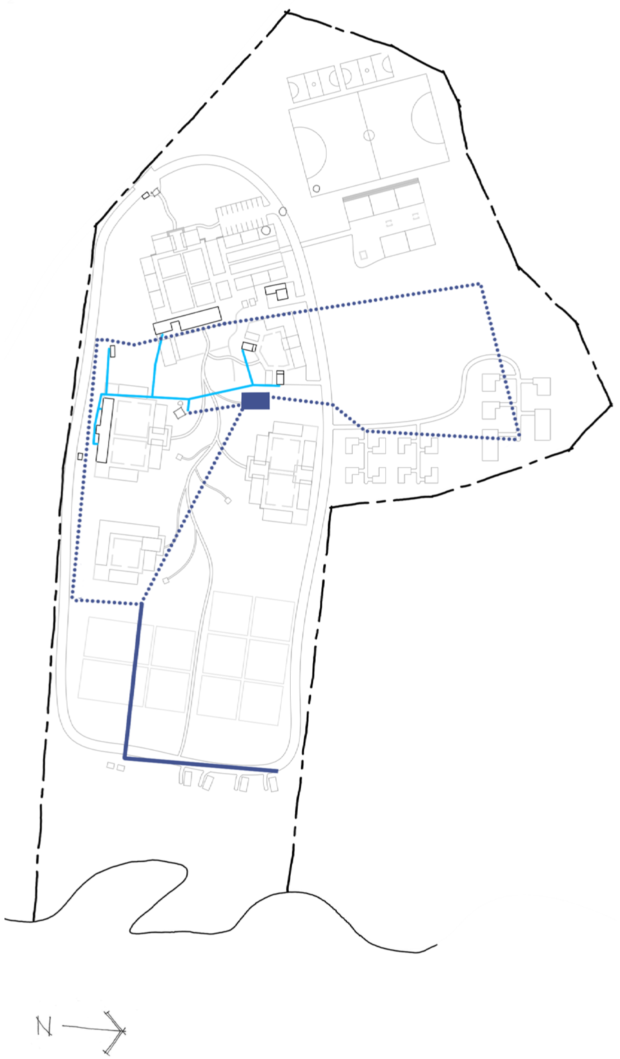


Figure 6.6: proposed connected watermain - partial loop

6.3 Sewage Infrastructure

Current System

The site currently has individual sewage facilities per dedicated ablution . The shower and toilets currently drain into a common splitter box which is directed into a septic tank. As the septic tank was sealed shut, final dimensions were unable to be confirmed. The effluent from the septic tank is directed into a soak away system which introduces the effluent back into the soil which provides final filtration prior to being re-introduced into the groundwater system. Figure 6.7 shows an example of the current sewage facilities within the existing dormitories. The soak away system is created using fabricated bricks onsite. The bricks are placed in a 1.2m circle with small gaps in between and are built to a 3m depth. Small rocks are placed around the bricks which allow for seepage into the soil. Similar systems can also be found at the two site chalets as well as the common ablution block. However, as the facility expands, implementing a common sewage system could be a viable option as it will be difficult to maintain multiple smaller systems as the site capacity increases.

Figure 6.7: current sewage facility

Proposed Design

Sewage demand is expected to be between 40-45,000 L/day . Appendix C.3 provides these calculations in detail for additional context. Two scenarios are considered in the sizing of the wastewater system; a full buildout in one area, and two smaller systems located in within the higher volume areas onsite . Due to the simplicity of design and compatibility of soils, a septic system with infiltration trenches/fields are recommended for this application. Table 6.4 shows preliminary sizing of a common sewage treatment facility for the Life Training Centre.

Figure 6.8 & 6.9 below shows the proposed sewage treatment areas for each option.

	Option 1	Option 2	
	Full Buildout	Septic Zone A	Septic Zone B
Description	For entire facility	Dormitories	Staffing and Auxiliary
Required Retention Time (d)	2	2	2
Total Volume (m3)	80,000	60,000	30,400
Number of Tanks	4	3	2
Volume per Tank (L)	20,000	20,000	15,200

Table 6.4: conceptual sewage design options

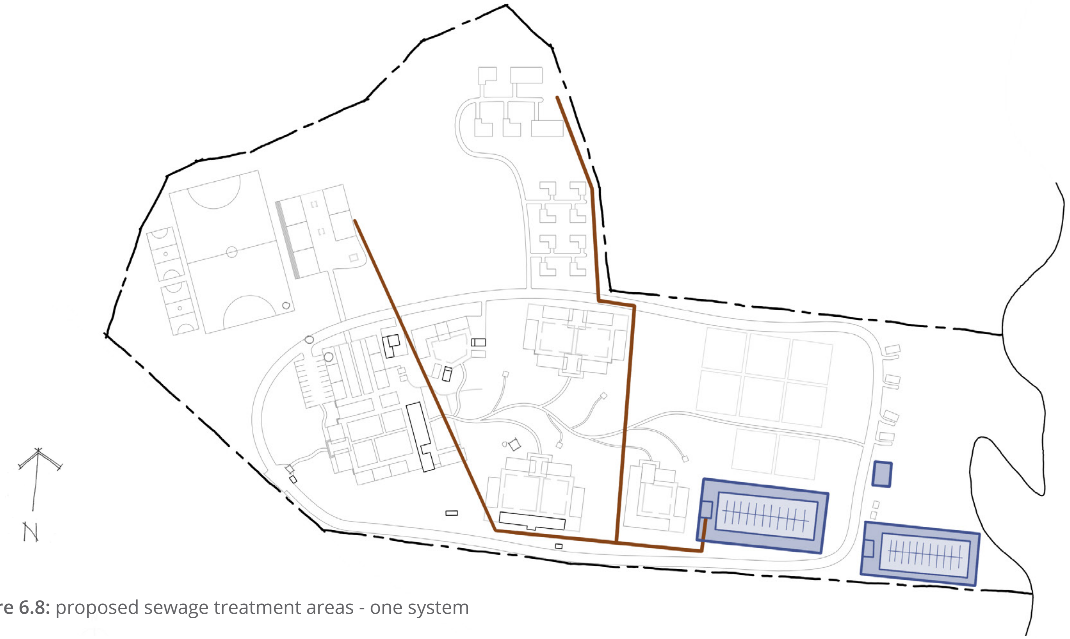


Figure 6.8: proposed sewage treatment areas - one system

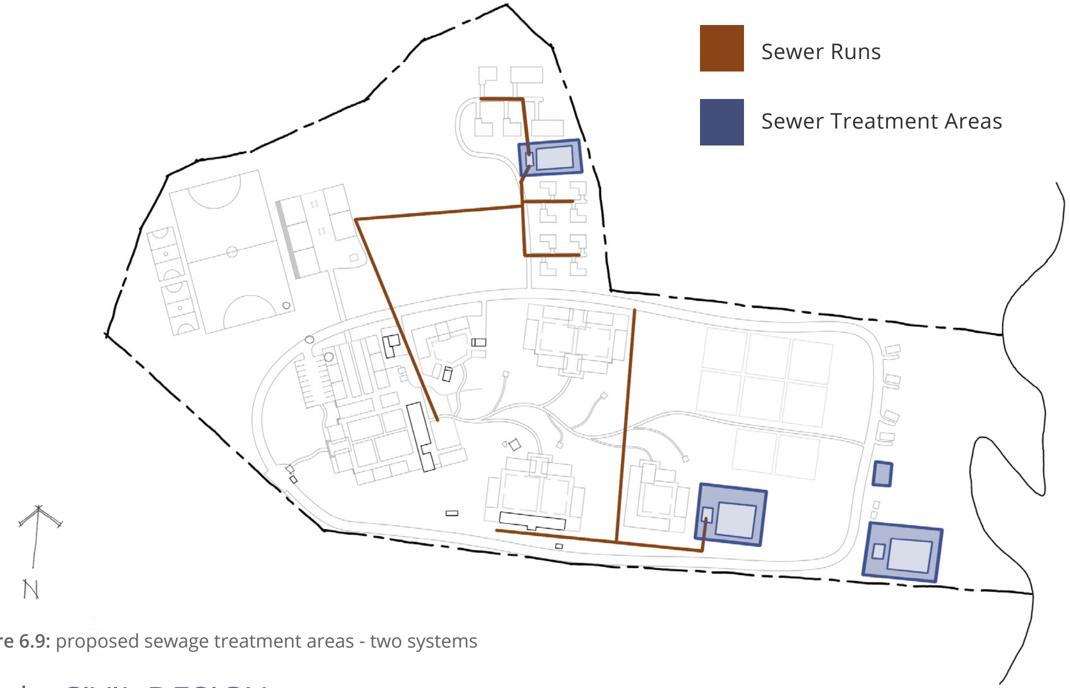


Figure 6.9: proposed sewage treatment areas - two systems

6.4 Stormwater Design

Existing Conditions

Current site conditions show a 5-metre elevation drop moving east of the property towards the water storage dam. With no current stormwater infrastructure in place, the water simply flows along grade and into the water storage dam during the wet seasons which occur between November and March. Figure 6.10 shows the drop in elevation and direction of stormwater flow during the wet season.

Proposed Design

As activity increases in the area, it is prudent to implement a drainage system to divert water along trenches which can be constructed in parallel to the main access roads to the facility. This can be accomplished be establishing a small grade on the facility running towards each of the access roads. This prevents rainwater ponding in higher traffic areas after a rainfall event.

10-25mm aggregate was identified onsite as a potential source of erosion protection for trenches, and walkways onsite. Figure 6.10 show the proposed gradient of the stormwater and the aggregate which can be used for erosion protection.

Above: onsite aggregate

6.5 Additional Areas of Investigation

Water Storage Dam

The water storage dam is a source of water for local farming as well as construction water onsite. Samples were taken from the water storage dam and were checked for, alkalinity, and e-coli. Results can be found in section 6.1 of this report. Further investigation of the water source may lead to provide a water source for agriculture as well as dust suppression and road maintenance during the wet season.

Digester

The site currently has a biogas digester which is currently not in operation. The digester was designed for chicken manure as feedstock which was then used for heating purposes.

Further investigation is required to determine the viability of the current digester to take in other feedstock (i.e. – other animal manure or diversion of some wastewater from the septic system).

Rainwater

As the site may receive an average of 150-300mm per month of rain during the wet season , further investigation can be done to collect rainwater for ablutions or fire suppression.

Figure 6.10: current and proposed stormwater flow

Above: water storage dam

Above: onsite biogas digester

Sunrise over hut on Life Impact Training Center site (photo: Matthew Moeckel - Itezhi Tezhi, Zambia)

07 | Electrical Design

7.1 Existing Electrical

7.1.1 Buildings and Loads

There are currently 6 buildings located at the training center which use power. None of the buildings contain any large appliances or equipment and currently only utilize power for lighting and power outlets. The site is also equipped with a water pump which supplies the water tower. The table below lists the existing buildings and the electrical loads associated with each.

Building/Load	Load Types
Dormitory 1	Lights, Outlets
Dormitory 2	Lights, Outlets
Ablution	Lights, Outlets
Kitchen	Lights, Outlets
Future Chapel	Lights, Outlets
Chalet 1	Lights, Outlets
Chalet 2	Lights, Outlets
Water Tower	Water Pump

Table 7.1: existing buildings and loads

During a 24-hour evaluation period, the total power usage was 6kW-h. Figure 7.1 shows the real-time power usage throughout the 24-hour period.

This data was collected while the engineering team was on site along with other visitors, so it is above average but likely similar to the usage required when the site is operating as a training center at this scale.

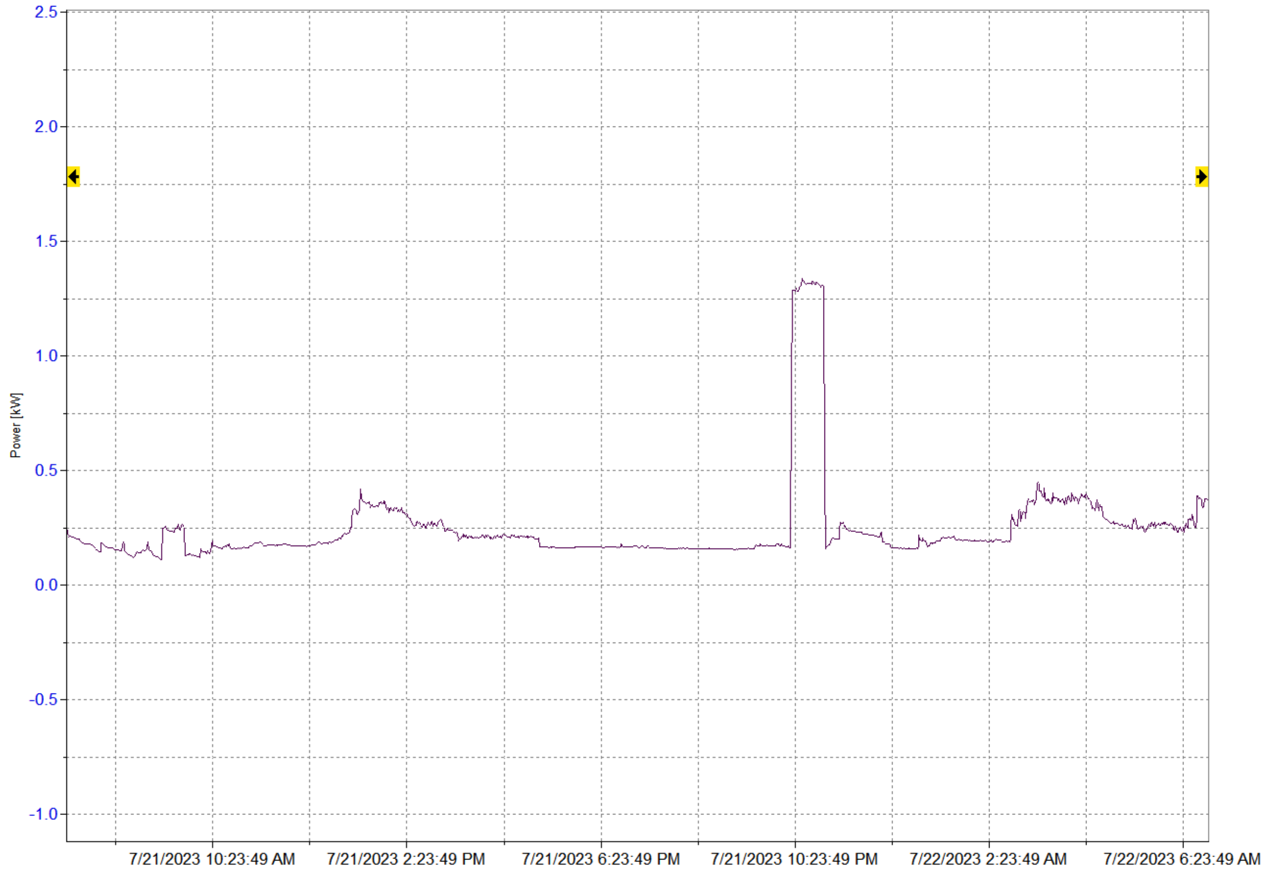


Figure 7.1: Power usage recorded over a 24-hour period

The 'Existing Site Electrical Plan' diagram shows the current power distribution to the buildings. The 3-phase power at the electrical building is split up with a single-phase connection going to the dormitories and ablution, and a separate single-phase connection going to the kitchen, future chapel, and chalets.

The current wiring that is in place between the buildings is satisfactory for the loads that exist today. However, because most of the wiring is small and only single-phase, some of the existing wiring will need to be upgraded to support future plans.

7.1.2 Power Sources

The local electrical utility company is currently supplying electricity to the training center site as 230VAC at 50Hz. This power enters the site from an underground, 3-phase cable on the south end of the property and is connected to the meter and main breakers located in the electrical building. The 100kVA transformer for the site is located in the nearby village and is shared between the training center and the nearby houses. To get from the transformer to the on-site electrical building the power is transmitted via above-ground cables for approximately 1.1km before going to the 83m long underground cables that enters the site.

There is a single earthing location at the training center located directly behind the electrical building. Earthing resistance testing was conducted and the resistance was measured to be 11 ohms. This value was measured at the electrical building and is well within the acceptable range of values for this application and means that the soil has good resistivity. As the site grows however, it would be necessary to create additional earthing sites to ensure that the resistance to earth remains within acceptable values.

During the site evaluation the supplied utility power experienced multiple power outages lasting up to 4 hours. There was also a great deal of variability in the voltage supplied from the utility power. In some cases the voltage dropped by nearly 30%, down to 164V. In addition, the observed power factor from the electrical utility was poor at times reaching values as low as 52. Although it was not observed while on-site, the client also mentioned that they had experienced significant power surges in the past that had damaged equipment. While the site analysis was taking place, the nearby power plant was being repaired due to a recent failure and this was likely a major contributing factor to the observed power outages and potentially the voltage variability and low power factor. Although these issues were not detrimental to how the electricity is currently being used at the site, as the site grows these will need to be addressed.

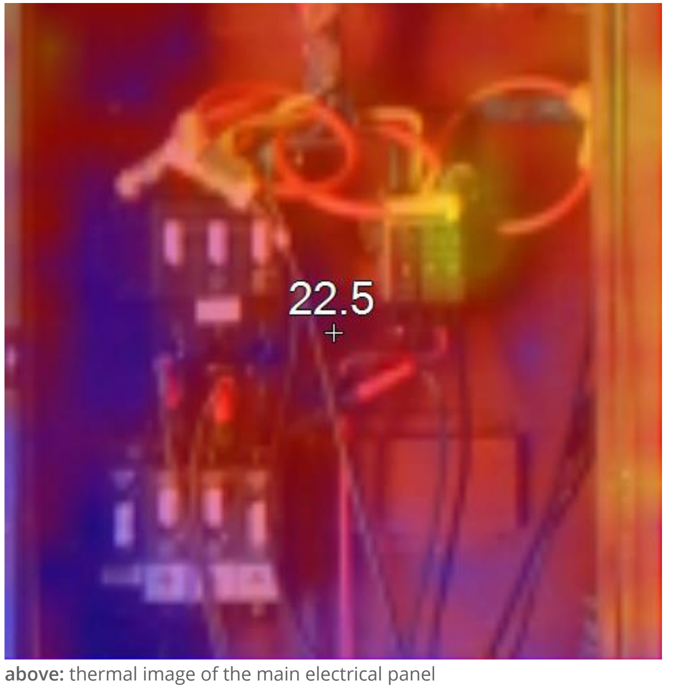
7.1.3 Safety

As part of the site evaluation, all of the existing electrical panels and wiring was inspected for signs of overheating using thermal imaging. The figure below shows a thermal image of the main electrical panel for the site.

In this image the picture is overlade with thermal data. The red and yellow colors indicate warmer temperatures, and the blue indicates cooler temperatures. It can be seen that the panel is running fairly cool (around 22°C) which does not present any safety concerns.

The existing electrical configuration had proper placement of breakers in the electrical panels, but some of those breakers were oversized for the application. In an optimal configuration the beakers are sized so that they will be tripped before any damage to people, equipment, or wiring occurs. In the case of the existing system some of the breakers were sized to allow more current than the wiring could carry safely. This means that if the wiring were to short, the wiring is likely to melt and potentially start a fire or cause injury before the breakers trip. It is recommended that these breakers be replaced as soon as possible to ensure safe operation.

Another safety concern is the with the electrical panels in the Kitchen and Chapel buildings. These panels are currently missing the panel convers that protect from accidental shock. Although this might not be a concern for the current use of the facilities, it is something that should be addressed before operating as a training center.



above: thermal image of the main electrical panel

7.2 Proposed Electrical System

7.2.1 Building and Loads

The proposed master plan consists of an additional 46 buildings that will be added to the site and will require power. The table below lists out these new buildings and the electrical equipment that is expected to exist in each of these buildings.

Most of the electrical power required for these future phases of development will be consumed by the Welders, Stoves/Ovens, and Carpentry tools. All of this equipment will be in use around the same time while classes are in progress during the day. This increases the total power that is required at one time and results in the need for a larger transformer and larger wiring.

Since there are plans to expand the classes offered and the number of classes, two of the classrooms will be designed with enough power to support ovens for catering classes and two classes will be designed for sewing machines. In addition, three of the 5 workshops will be designed to support the use of welders and all of the workshops will be capable of running other power tools for carpentry, plumbing, etc.

Building	QTY	Electrical Loads
Campsite, Male Ablutions	1	Lighting, Outlets
Campsite, Female Ablutions	1	Lighting, Outlets
Ablution	3	Lighting, Outlets
Admin	1	Computors, Printers, Small refrigerator, Lights, Outlets, Microvawes, Air conditioning, Fans
Tailoring Classroom	1	Outlets, Lights, Projectors, Computers, 10+ sewing machines
Catering Classroom	1	Outlets, Lights, Projectors, Computers, Ventilation Fans, ~10 Stoves/Ovens, 2 Large Refrigerators, ~10 Hand Mixers
General Classrooms	7	Outlets, Lights, Projectors, Computers
Computor Room	1	Lights, Outlets, 20+ computers, Air Conditioning
Library	1	Air Conditioning, Lights, Outlets, ~5 Computers
Chapel	1	Fans, Sound System, Projector
Welding Workshop	1	Ventilation Fans, 4 Welders, Metal Cutters, Metal Saws, Grinders, Bending Machines, Electric Rollers, Lights, Outlets
Carpentry Workshop	2	Ventilation Fans, Circular Saws, Planes, Drills, Lights, Outlets
Painting, Plumbing, Brick Laying Workshops	2	Ventilation Fans, Compressors Electric Brick Maker, Small Electric Tools, Lights, Outlets
Dining	1	Lights, Outlets, Fans, Projector (for small meetings)
Male Residence	8	Irons, Hand Dryers, Fans, Lights, Outlets
Female Residence	8	Irons, Hand Dryers, Fans, Lights, Outlets
Caretakers	8	Fridge, Stove/Oven, TV, Lights, Outlets
3 Bed House	2	Fridge, Stove/Oven, Air Conditioning, Lights, Outlets
2 Bed House	4	Fridge, Stove/Oven, Lights, Outlets
Part-time Staff	4	Fridge, Stove/Oven, Lights, Outlets
Kitchen	1	Stoves/Ovens, Ventilation Fans, Lights, Outlets
Water Towers	1	Water Pump

Table 7.2: future buildings and loads

7.2.2 Power Sources

Like any electrical utility, it will not be 100% dependable and as a training center it is recommended that there be at least one backup power source. Figure 7.2 gives a cost comparison for various power sources.

The 'Utility Only' option represents the costs associated with upgrading the incoming power lines and transformer from the utility site and the continued costs of purchasing electricity from the utility company to run the training center.

The 'Utility + Generator' option shows the cost of purchasing, maintaining, and occasionally running a backup generator at the site.

The '55% Solar (No Battery) + Utility' option represents the cost of purchasing enough solar panels to provide 55% of the site's electrical needs. This value gives the optimal electrical solar production so that most of the training center's power usage during the daytime is from solar and the utility company provides the required power at night.

The '100% Solar (with 32% Battery)' option represents the cost of purchasing enough solar panels to generate all of the power used by the training center as well as the batteries required to store the excess electricity generated during the daytime for use at night.

For this project we are recommending installing solar panels to supply 55% of the required power in addition to the utility power. This is the least expensive option for getting the required electrical power and will provide a backup source of energy during the primary training hours in the daytime at the training center.

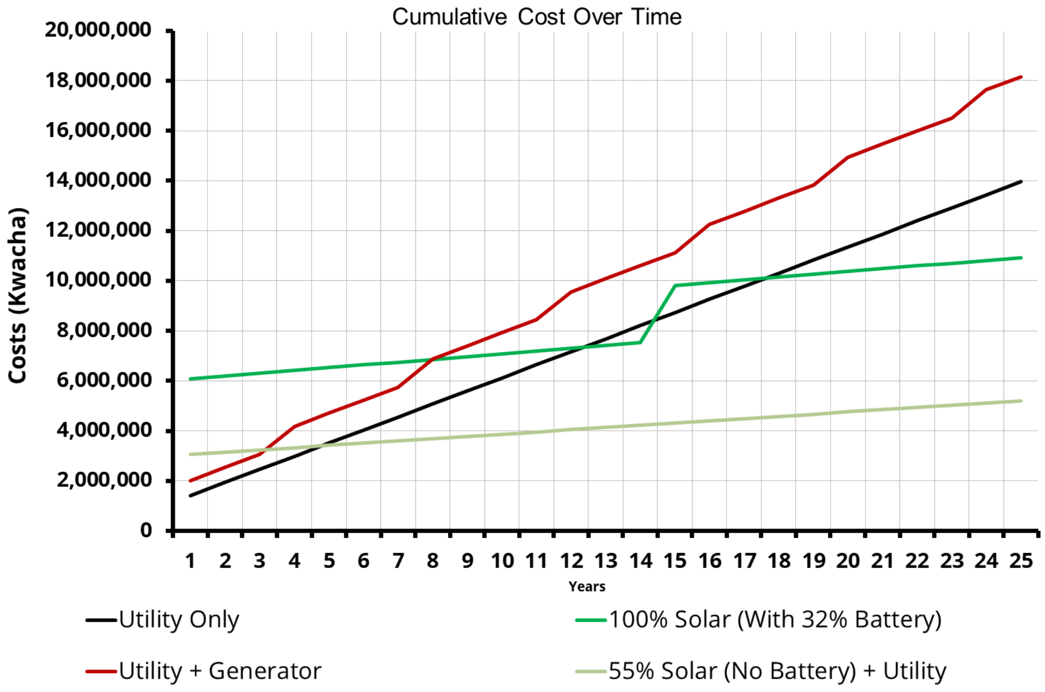


Figure 7.2: cost comparison between several power sources

Utility Power

The primary complexity with using the existing utility power is the long distance (over 1 km) between the transformer and the training center. If the entire site was powered from these utility power lines, 66% of the power would be lost just in transporting the electricity over this distance. There are a few changes that need to be made for the utility to be used for power.

1. Higher Voltage Power Lines need to be brought closer to the training center so that power is not being transmitted over such a long distance after the transformer converts it.
2. A new transformer must be purchased and placed at the training center. This will reduce the power loss from transmitting power from the existing transformer and will allow the utility to support the full capacity that is needed.
3. The electrical building for the site will need to be moved to a more central location, closer to the heaver loads (the workshops and classrooms). The recommended location is the old workshop next to the chapel, which is intended to become a maintenance shed.

There are also a few optional upgrades that we recommend waiting to implement until after the above changes are made. The first few fixes may end up fixing some of these issues so that they do not have to be addressed directly. A new analysis of the power supply should be conducted after the new transformer and power lines are installed to determine if these further steps are still necessary.

1. Install a Voltage regulator. Based on the variability observed in the voltage at the site, there could be significant degradation and variability in the performance of heavy equipment like ovens or welders. A voltage regulator would fix this issue and make sure that there is uniform power for the facility.
2. Install a Power Factor Corrector. This modification is important to minimize the infrastructure required to supply power to the training center. When the power factor is poor it requires the electrical system to be built with larger wires so fixing this in the beginning would save on building the rest of the infrastructure.
3. Install Surge Protection device. This will be very important when there is more sensitive equipment (like computers) which are being powered. Failing to protect against this may result in equipment being damaged in the future.

Solar Power

Solar Panels provide a low-cost source of power that gives a backup power source during core training hours in the daytime. Use of solar does not negate the need to do the utility upgrades previously discussed because the existing utility supply is not capable of supplying the additional 45% of the power needed at the site.

We are recommending a solar system that will provide 55% of the total energy needed by the training center. This equates to a 166kW solar array that will be placed on the norther end of the training center site.

Battery Power (Optional)

Batteries are a good addition to a solar system that allows the system to store some of the power collected during daylight hours to be used at night or during cloudy days.

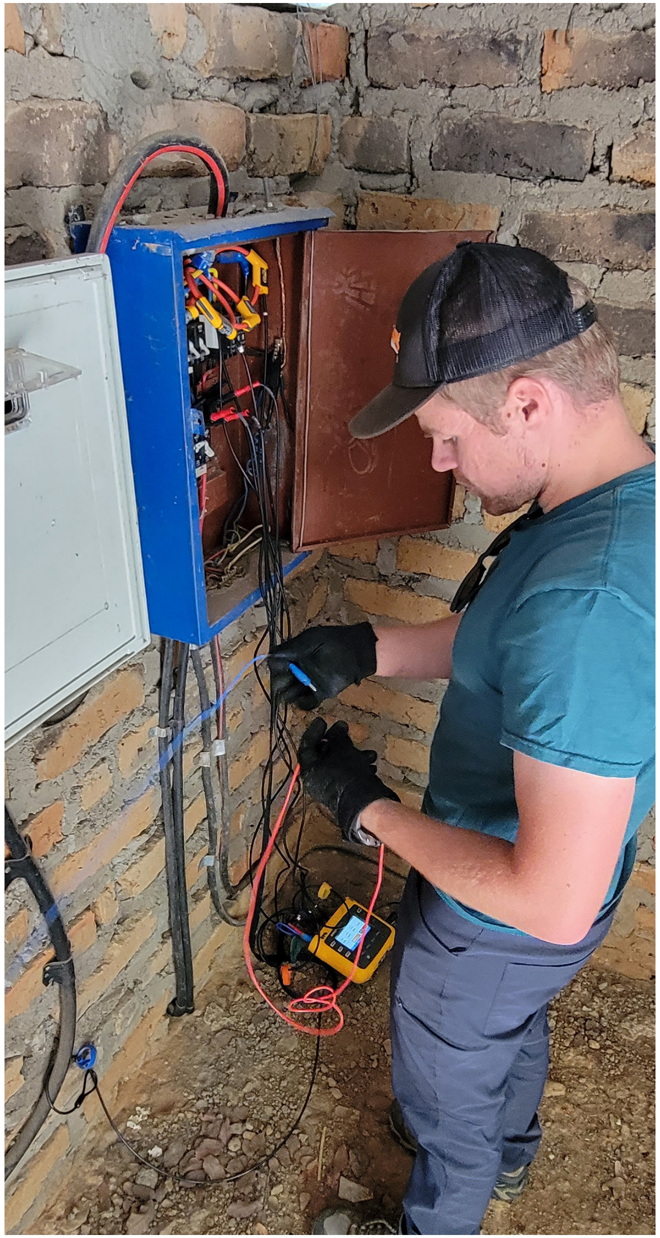
The downside is that batteries are expensive and usually have to be replaced every 15 years.

If a good backup power source is desired, a battery system is our recommendation to do this. This would require expanding the solar power generation so that during daylight hours enough power can be generated to charge the batteries. The batteries would then be able to supply the necessary power for the facility overnight. Because most of the power usage at the training center occurs during the daytime, the batteries would only need to store 32% of the site's total power usage. The other 68% of the power will be used as it is generated so there is no need to store it.

Generator Power (Optional)

Using a generator as a backup power supply is a good option if having a low initial cost is important. The negative side is that generators are very expensive to run and require a source of diesel fuel which can be hard to get in remote areas. Generators are generally a better option if they are purely used as a backup option and are not run on a regular basis.

We recommend adding a generator only if battery power is not a good option or if a second backup power source is desired.



above: Tim testing existing electrical conditions on site
(photo: Ben Shinabery - Itezhi Tezhi, Zambia)

7.2.3 Design

Site Plan

See the Site Plan CAD drawing for the proposed electrical distribution, electrical building location, and solar field placement.

Single Line Diagram

See the Singe Line Diagram which shows the proposed wiring layouts, wire lengths, wire sizes, etc. that are necessary to implement the system. Keep in mind that this is purely a conceptual design and would need further validation before being implemented.

Earthing

The earthing design for the training center is not included as part of the conceptual design except for some conceptual recommendations on the implementation. Because this is a large site there will need to be multiple grounding locations in place. The number and location of these sites will be determined later during the detailed design. The included 'Grounding Diagrams' file includes different methods for implementing earthing at building panels. We recommend using the TN-C-S method for most applications. In addition, the 'Panel Grounding & Bonding Diagram' file gives a more detailed drawing of how to configure grounding wiring for most systems. These again will become more defined during the detailed design for this site.

Phasing Recommendations

Although most of the training center buildings are being built in phases, the core infrastructure for the electrical power system must be put in place in the beginning. Because of the higher demand for power from the classrooms and administration building being built in phase one, the existing electrical infrastructure will not be sufficient. Therefore, the new electrical building location, new transformer, and new power lines will need to be in place for phase one. From there, some of the existing electrical wiring will need to be replaced based on higher power needs for the existing buildings and routing from the new electrical building.

The solar arrays may be installed in phases as electrical demand of the site increases. Because the utility infrastructure will be capable of supplying all of the required power, parts of the electrical solar system may be installed throughout the different phases without concern for not having enough power.

above: Tim testing existing electrical conditions on site (photo: Ben Shinabery - Itezhi Tezhi, Zambia)


Thatched roof training building on site
(photo: Lianti Muller - Itezhi Tezhi, Zambia)

08 | Phasing

8.1 Phasing

Figure 8.1: phase 1 buildings

8.1.1 Phase 1 - 2024

During the first phase many existing spaces will be used as interim solutions to accommodate certain workshops or classes. The chapel will be modified and used as 2 classrooms. Bathrooms of the existing student residence, as well as the detached ablution block will be renovated. The administration building will be erected in the 3rd semester of the year. Followed by 5 homes for management and 4 for caretakers of the site. And lastly 1 workshop that will be utilised for carpentry.

Phase		Phase 1		
Year		2024		
Semester		S1	S2	S3
Student numbers		50	50	50
Total Staff		**12**	**12**	**12**
On site Management housin	**on site - mgt**	**5**	**5**	**5**
On site Worker housing	**on site - mgt**	**4**	**4**	**4**
Hostels Females		18	18	18
Hostels Males				
Stay in community		32	32	32
classroom needs		**3**	**3**	**3**
Library	Starts in Hostel	1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing	start in Chapel	1	1	1
Carpentry				
Tailoring	start in Chapel	1	1	1
Catering				
Electrical				
Childcare				
Hospitality				
Welding				

Table 8.1: phase 1 proposed school expansion

Phase		Phase 2		
Year		2025		
Semester		S1	S2	S3
Student numbers		66	96	110
Total Staff		**13**	**17**	**20**
On site Management housin	**on site - mgt**	**5**	**5**	**5**
On site Worker housing	**on site - mgt**	**4**	**4**	**4**
Hostels Females		44	44	44
Hostels Males		36	72	72
Stay in community		-14	-20	-6
classroom needs		3	3	5
Library	Starts in Hostel	1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing	start in Chapel	1	1	1
Carpentry		1	1	1
Tailoring	start in Chapel	1	1	1
Catering				1
Electrical				
Childcare				
Hospitality				
Welding				

Table 8.2: phase 2 proposed school expansion

Figure 8.2: phase 2 buildings

8.1.2 Phase 2 - 2025

Phase 2 kicks off by focusing on the existing temporary staff housing and setting that zone up to become a new female residence cluster. This, by adding 2 chalets to have four in total and then adding 2 student residence blocks. Allowing for a total of 44 beds for female students. Along with this, 2 more student residence block will be added to the existing male block, which also totals the male residence capacity to 72 students. The first row of classrooms will also be built during this phase. Lastly the student dining hall that attaches to the existing kitchen will be built in this phase.

Figure 8.3: phase 3 buildings

8.1.3 Phase 3 - 2026

During phase 3 the largest focus will rest on expanding student housing capacity for a grater intake. The second clusters of both female and male student residences will start with two residence blocks each, allowing for 36 more male and female students respectively. At the end of this phase one more workshop earmarked for electrical training will be built.

Phase		Phase 3		
Year		2026		
Semester		S1	S2	S3
Student numbers		142	154	146
Total Staff		21	22	23
On site Management housin	on site - mgt	5	5	5
On site Worker housing	on site - mgt	4	4	4
Hostels Females		44	44	80
Hostels Males		108	108	144
Stay in community		-10	2	-78
classroom needs		5	5	5
Library		1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing		1	1	1
Carpentry		1	1	1
Tailoring		1	1	1
Catering		1	1	1
Electrical				
Childcare				
Hospitality				
Welding				

Table 8.3: phase 3 proposed school expansion

Phase		Phase 4		
Year		2027		
Semester		S1	S2	S3
Student numbers		196	220	238
Total Staff		30	33	35
On site Management housin	on site - mgt	5	5	5
On site Worker housing	on site - mgt	8	8	8
Hostels Females		80	80	80
Hostels Males		144	144	180
Stay in community		-28	-4	-22
classroom needs		5	5	5
Library		1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing		1	1	1
Carpentry		1	1	1
Tailoring		1	1	1
Catering		1	1	1
Electrical		1	1	1
Childcare		1	1	1
Hospitality				
Welding				

Table 8.4: phase 4 proposed school expansion

Figure 8.4: phase 4 buildings

8.1.3 Phase 4 - 2027

In phase 4, 2 wings of student residences will complete the smaller male cluster. Allowing for a total of 180 male students on the campus. After this the last three workshops will be built.

During this phase the staff housing continues to expand by adding 4 more units for caretakers, along with 2 small chalets close to the river for temporary staff.

Figure 8.5: phase 5 buildings

8.1.3 Phase 5 - 2028

Phase five sees all the housing aspects of the site completed by adding 4 wings to the larger female residence cluster. This totals the full capacity on-site for female students to 152. And then completing the staff housing by adding 2 more chalets by the river for temporary staff.

Lastly for this phase the academic zone will expand by completing 2 more rows of classrooms.

Phase		Phase 5		
Year		2028		
Semester		S1	S2	S3
Student numbers		288	308	316
Total Staff		**37**	**40**	**42**
On site Management housin	**on site - mgt**	**5**	**5**	**5**
On site Worker housing	**on site - mgt**	**8**	**8**	**8**
Hostels Females		116	152	152
Hostels Males		180	180	180
Stay in community		-8	-24	-16
classroom needs		9	9	9
Library		1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing		1	1	1
Carpentry		1	1	1
Tailoring		1	1	1
Catering		1	1	1
Electrical		1	1	1
Childcare		1	1	1
Hospitality		1	1	1
Welding		1	1	1

Table 8.5: phase 5 proposed school expansion

Phase		Phase 6		
Year		2029		
Semester		S1	S2	S3
Student numbers		318	318	318
Total Staff		**42**	**42**	**42**
On site Management housin	**on site - mgt**	**5**	**5**	**5**
On site Worker housing	**on site - mgt**	**8**	**8**	**8**
Hostels Females		152	152	152
Hostels Males		180	180	180
Stay in community		-14	-14	-14
classroom needs				
Library		1	1	1
Computer		1	1	1
Bricklayer		1	1	1
Plumbing		1	1	1
Carpentry		1	1	1
Tailoring		1	1	1
Catering		1	1	1
Electrical		1	1	1
Childcare		1	1	1
Hospitality		1	1	1
Welding		1	1	1

Table 8.6: phase 6 proposed school expansion

Figure 8.6: phase 6 buildings

8.1.3 Phase 6 - 2029

In the final phase the master plan is completed with the library and computer room that is located in the heart of the academic zone, pulling it all together.

09 | Conclusion

9.1 Conclusion

Now faith is confidence in what we hope for and assurance about what we do not see.

- Hebrews 11:1 NIV

The dream for the Life Impact Training Center was carried by a series of people who had faith in what they could not yet see but knew that God had a plan. As we move forward, we start seeing glimpses of what will become. It was a privilege for EMI to com alongside Impact Zambia and iTeams Canada to take a step of faith toward the dream that God put in their hearts many years ago.

Together, we closed our visit to the LITC site with a time of prayer in the location where the administration building for the campus will be located, in hope for what is to come. Thank you for inviting us along on this journey and we look forward to seeing the Lord fulfill the dream.

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above: Impact Zabia, iTeams, and EMI team praying at future Administration building (photo: Ben Shinabery - Itezhi Tezhi, Zambia)

10 | Annexures

Fishing boats at Itezhi Tezhi dam
photo: Lianti Muller - Monrovia, Liberia

A | Survey Annexure

LAND SURVEY REPORT

SURVEY DATES

July 19, 2023 –

July 25, 2023

SURVEY EQUIPMENT

Trimble R10-2 Base

Trimble R12i Rover

Trimble TDC600 DC

Parrot Anafi – UAS

AutoCAD Civil 3D

Pix4D

Bentley MicroStation

Photoshop

SURVEY CREW

Ben Shinabery

Chamonix Stuart

Matthew Moeckel

Mutinta Kaula

Purpose:

The purpose of this land survey is to provide a scalable digital CAD basemap of the existing topographic conditions of the Life Impact Training Centre located near Itezhi Tezhi, Zambia for EMI Master Plan of the campus.

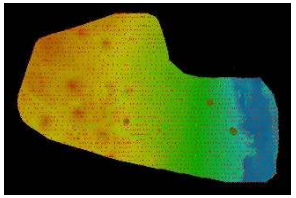
Methods Narrative:

Preliminary mapping files were compiled to draft a PDF site map for planning purposes from global online resources including: Google Earth, NGS, Pictometry, Geospatial.com and others. The preliminary map was printed onto large format A0 paper copies and smaller ledger size for team members to use for site notes and visual reference tools. Fortunately, Google Earth had recent imagery for the site from May 2023.

Wednesday July 19, during the team vision walking tour of the property, Pastor Daniel Mayapi indicated that the property limits aligned along the southern cleared area of the campus near the electrical meter building and ran through a triple trunk tree on the east side then projected to the limits of the lake on the far eastern edge of the campus. The existing deed calls for an area measured 400m by 200m. Pastor Daniel explained that the property would need to be expanded to the north to accommodate the proposed master plan. At the main entrance of the property, Pastor Daniel mentioned that the neighbor to the south had questioned the location of the property line and that the local surveyor was called to reestablish the position of the line. At that time no permanent survey points were placed in the ground because neither Life Impact Training Centre nor the neighbor wanted to pay the surveyor to finalize the survey. One other point of note during the site tour,

Pastor Daniel said there was no burial grounds or cemetery located on the property.

Thursday July 20, Ben Shinabery started the field survey by establishing a GNSS GPS base on CP 1 which is a 25cm survey nail with pink flagging near the center of the property. UTM 35S world coordinates were established on an autonomous position and held for the site reference coordinate frame. All survey points established are horizontally and vertically relative to CP 1. Six ground control panel targets were placed around the perimeter of the property and immediate context of the site including the berm dam and outlet spillway of the lake. GCPs were referenced to CP 1 by GNSS base and Rover methods with redundant observations stored and averaged at an expected precision of less than 2cm. With GCPs established, Ben conducted a UAS drone mapping session of 391 individual overlapping images collected at an altitude of 100m and an image resolution of 4.3cm per pixel (see pix4D mapping report). The flights took a total of 35 mins and processed more than 24 million data points across 64 hectares. Ben surveyed critical survey data points using GNSS Base and Rover methods including: building corners, septic tanks, bore hole, walls, sidewalk, utilities and the main entrance driveway into the campus. These points serve as the feature linework for the survey basemap.



Friday July 21

With the site survey complete, the survey points as breaklines were combined with extracted elevations from the drone pointcloud to create a ground surface model in Microstation. The color orthomosaic images were processed, filtered and added to the basemap in AutoCAD Civil 3D. Buildings and other features were annotated to the CAD for one 3D compiled topographic survey and ground surface .DWG file.

Saturday July 22

Additional request for critical tree locations were surveyed for the architectural planning. The trees located were of significant size in hopes of aligning the entrance administration buildings to the site and keeping as much existing tree coverage as possible.

Monday July 24

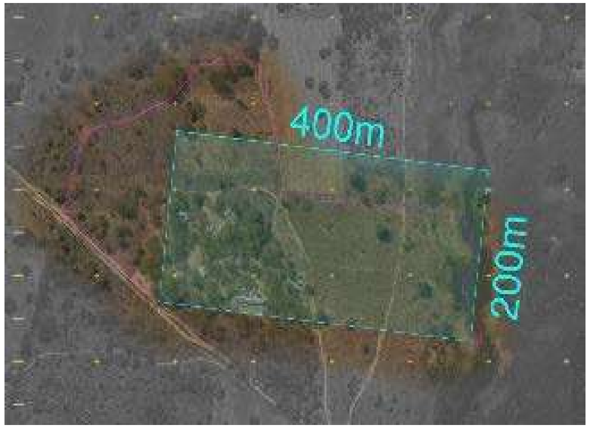
Finished CAD work by cleaning up layers, fading the base image in Photoshop and resizing the sheet to A1 1:1000 scale. Matthew and Ben located the underground utility network of water lines. Ben measured as-built dimensions of the existing buildings and surveyed the locations of the soil samples for potential septic.

Tuesday July 25

Finalized the CAD drawing for the presentation. Mutinta and Ben staked out the location of the proposed Administration Buildings at the western side of the property.

Recommendations for further legal boundary survey:

Although we located the limits of the topographic features of the site, the legal property boundary line should be determined and marked by a local licensed surveyor. These lines were measured in accordance with local regulations but were not marked on the ground with permanent stakes or references to natural monuments for future reference. The current legal description does call for a boundary of 400m by 200m but should be refined by an actual measured perimeter with bearing and distance calls which calculate to a geometric closure. Because Pastor Daniel expects to expand the property boundary to the north, this additional land transaction provides an opportunity to legally survey the overall boundary and place permanent monument markers such as metal stakes or posts, stones, or fence posts as reference to the property boundary. The consolidated boundary should be described accurately with precise bearing and distances and recorded in a registry of lands.



LAND SURVEY FILE TYPES

.DWG

The DWG file is an AutoCAD Civil 3D file with survey points, color orthographic mosaic, topographic feature lines, 3D ground surface and 3D pointcloud compiled together: **Life Impact Training Centre - Zambia.dwg**

.TXT

The TXT file has the existing topographic survey points in a ASCII format in P,N,E,Z,D (Point#, Northing, Easting, Elevation, Description) in meters adjusted to CP 1 observed as an autonomous GPS static session based on UTM coordinates Zone 35S: **LIFE IMPACT FIELD SURVEY.TXT**

.LAS / .FBX

The .LAS file is an indexed colorized pointcloud file that works with CAD platform software like AutoCAD. The pointcloud can be rendered with different visualization styles and views. It is a 3D digital twin of the site conditions: **LIFE IMPACT MAPPING_group1_densified_point_cloud.LAS**

The .FBX file is an indexed colorized mesh file that works with AutoDesk software like AutoCAD. The mesh needs to be linked with the files within associative folder FBM. It is another 3D digital twin of the site conditions: **LIFE IMPACT MAPPING_simplified_3d_mesh.FBX**

.PDF

The PDF is an overall topographic survey of the Life Impact Training Centre property with updated contour lines for visual reference and existing conditions as rendered from the DWG. This PDF has layers similar to AutoCAD or Sketchup that can be toggled to visible or toggled off to isolate information such as the background image. Layer toggles should be on the tabs section of the PDF viewer. **Life Impact Training Centre - Zambia - A1 - Site.pdf**

.JPG / .TIF

The background color imagery compiled from hundreds of drone images and tiled together as one complete color orthomosaic. These files have been coordinately adjusted to site survey coordinates. The overall orthomosaic image has been filtered and clipped to fade into black and white contextual image for the final survey PDF. These images will need to be linked in the xref dialog box within AutoCAD: **LIFE IMPACT MAPPING_FADE.JPG**

Other tiled images have been saved to be used within Google Earth as a modern overlay but may only be rendered in Google Earth software (see google tiles folder)

.MP4

The MP4 files are a video rendering of the digital colorized point cloud for site overview. These were rendered through a digital animation trajectory in Pix4D: **LIFE_IMPACT_ZAMBIA_MAPPING.mp4 LIFE_IMPACT_ZAMBIA_FLY.mp4 LIFE_IMPACT_ZAMBIA_FLY_ELEV.mp4**

B | Master Plan


BUIILDING KEY
A ADMINISTRATION
C CLASSROOMS
CH CHAPEL
CO COMPUTER ROOM
L LIBRARY
S SPORTFIELDS
D DINING HALL
W WORKSHOPS
H HOSTELS
CA CARETAKERS RES
R STAFF RESIDENTIAL
CL CHALETS
AG AGRICULTURE
LEGEND
GREEN SPACES
HARD SURFACE
INTERNAL ROADS
PROPOSED BUILDINGS
EXISTING BUILDINGS
SITE BOUNDARY
R
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MASTER PLAN
1:1500 @ A3
0 10 20 40 80M
1:1500
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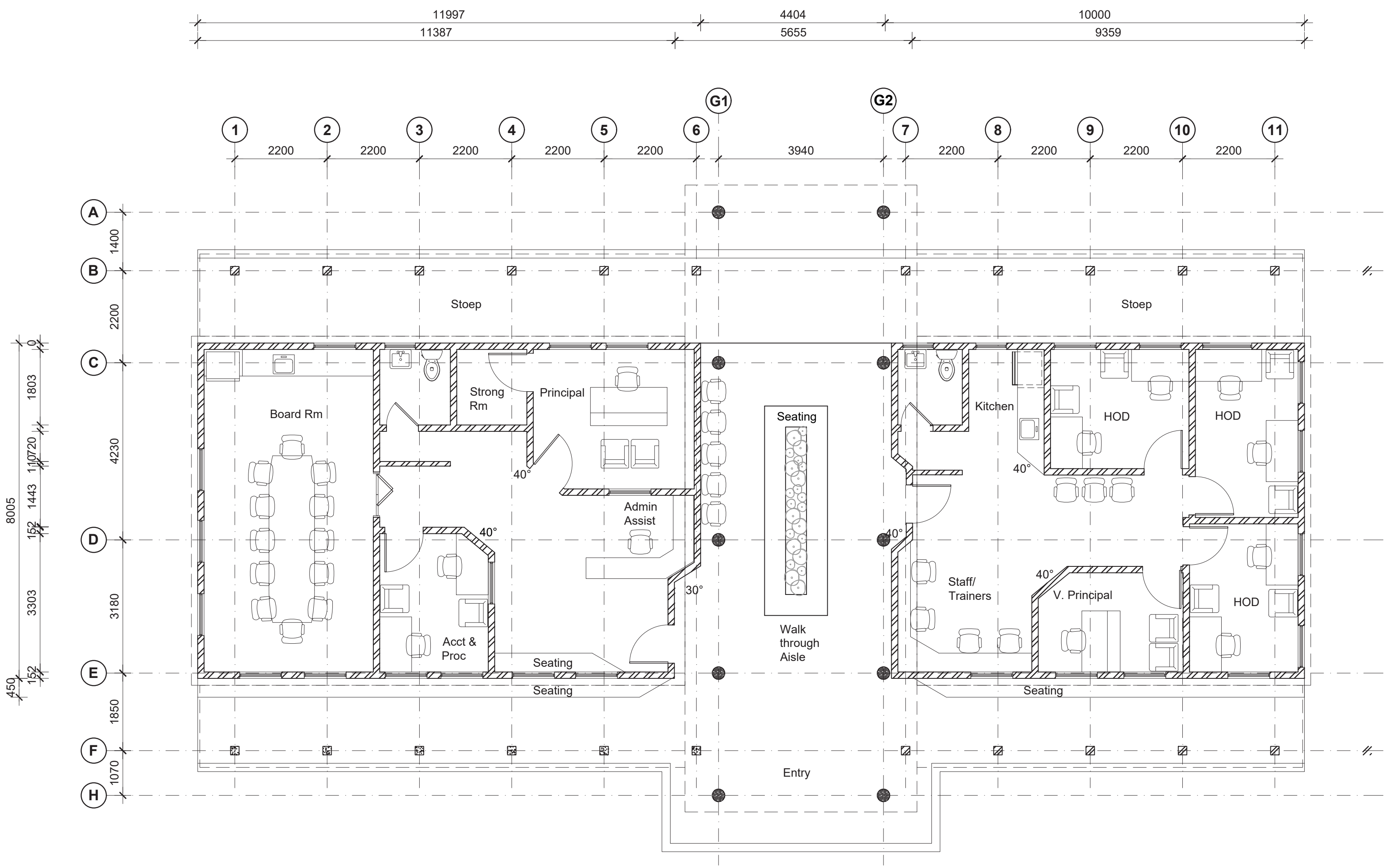
Life Impact Training Center
MASTER PLAN
CONCEPTUAL DRAWINGS NOT FOR CONSTRUCTION
LOCAL REGULATIONS MAY REQUIRE DRAWINGS TO BE FINALIZED BY AN ARCHITECT/ENGINEER LICENSED TO PRACTICE IN COUNTRY
PROJECT:
ZA-0078
DATE ISSUED:
OCT 2023
REVISIONS:
SHEET NUMBER
M1.0

C | Architecture Annexure



1 TECHNICAL FLOOR PLAN OF ADMIN
1:100

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ADMIN FLOOR PLAN
SCALE 1:100 @ A3

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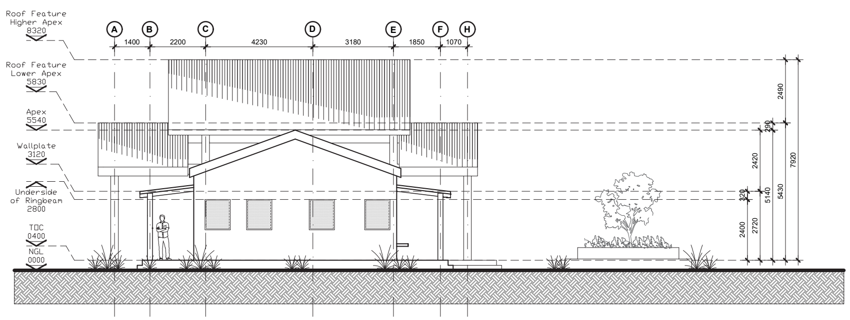
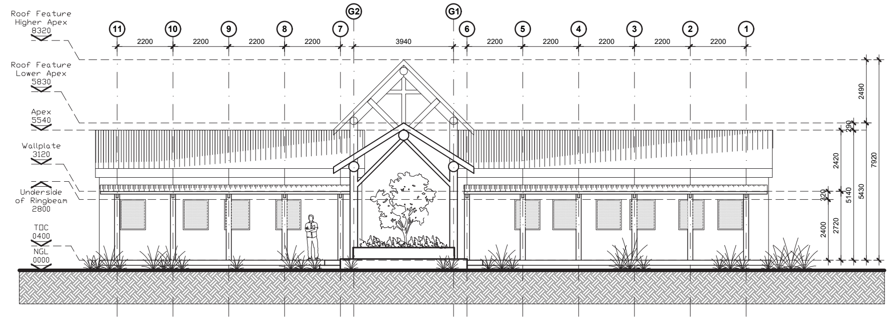
DATE ISSUED: OCT 2023

REVISIONS:

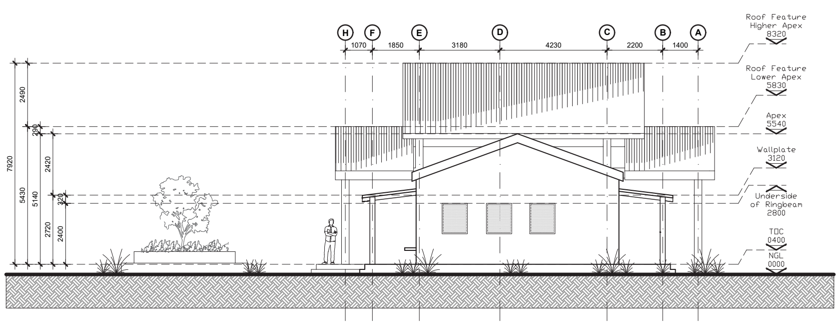
SHEET NUMBER
A 1.1



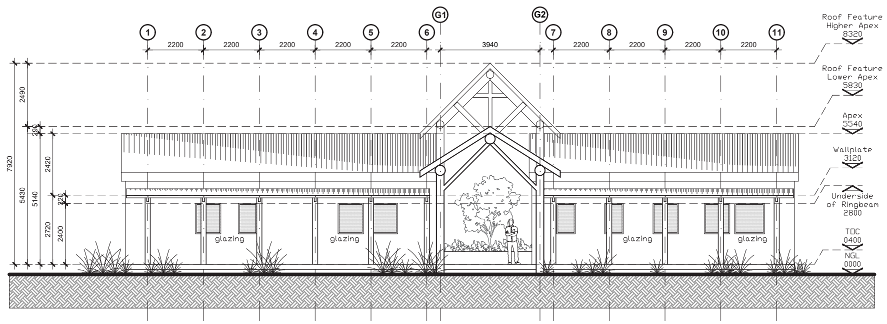
1 NORTH ELEVATION OF ADMIN
1:200



2 WEST ELEVATION OF ADMIN
1:200



3 SOUTH ELEVATION OF ADMIN
1:200



4 EAST ELEVATION OF ADMIN
1:200

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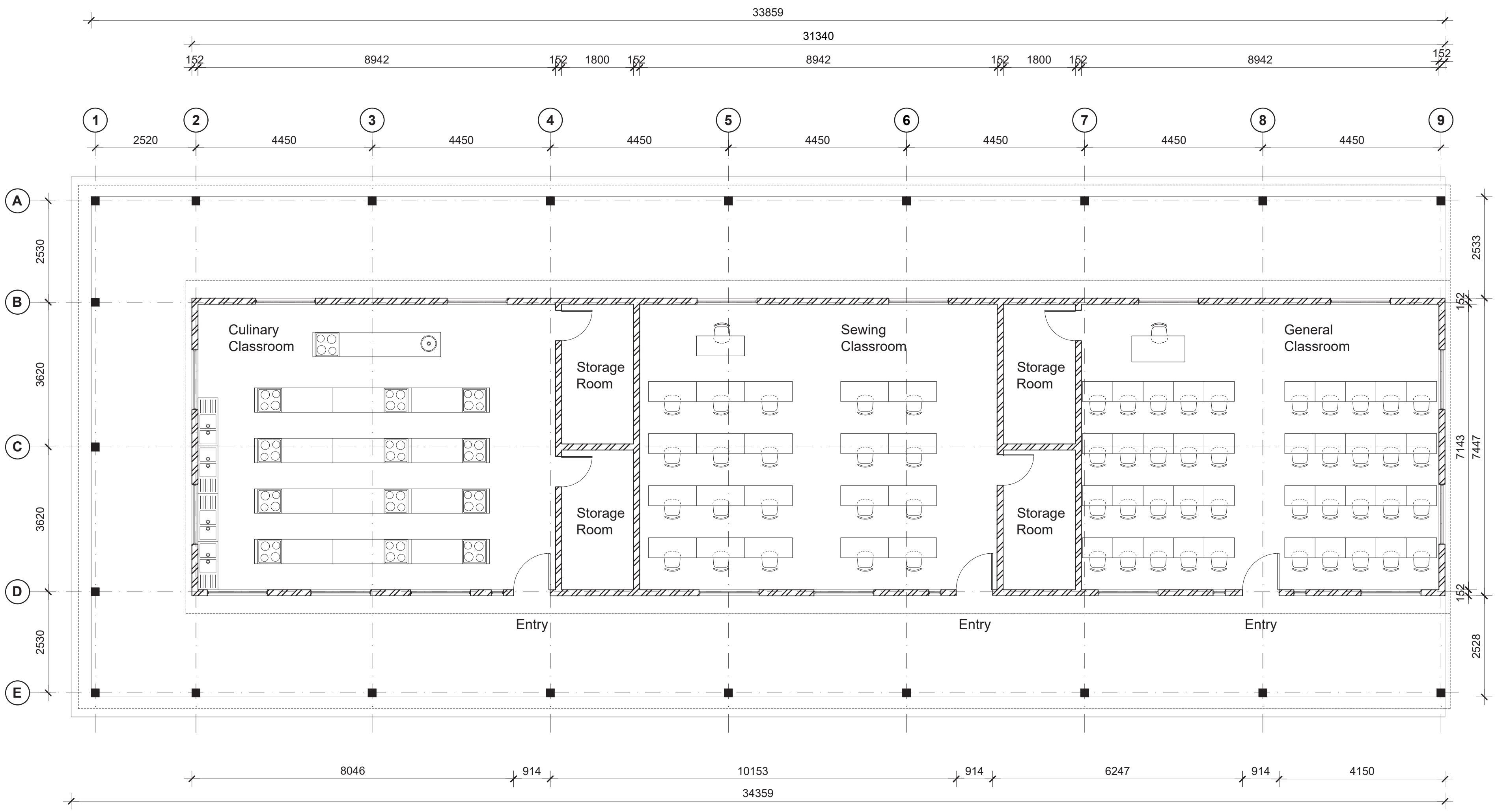
A 1.2



1 **TECHNICAL FLOOR PLAN OF CLASSROOM**
1:100

N

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CLASSROOM FLOOR PLAN
SCALE 1:100 @ A3

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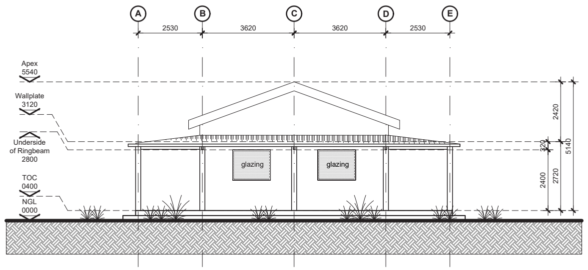
A 2.1



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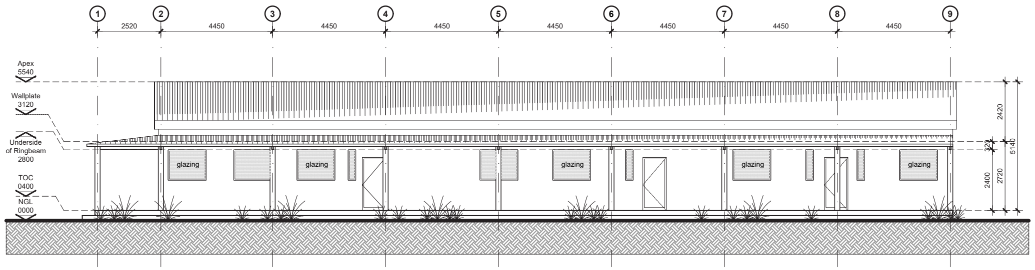
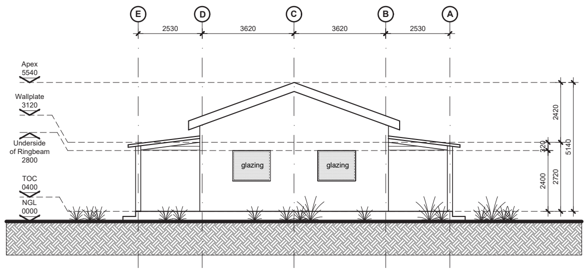
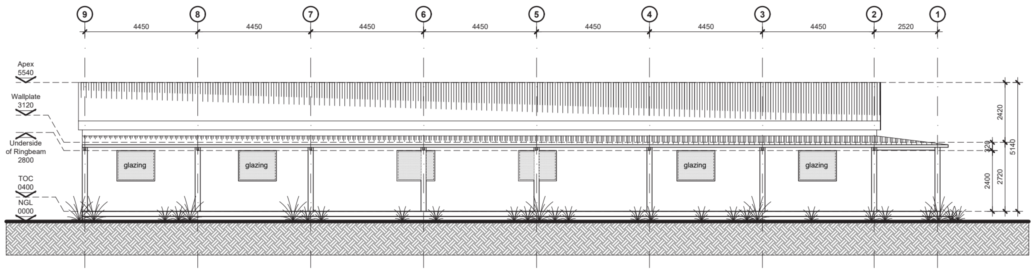
1:200



2 **WEST ELEVATION OF CLASSROOM**
1:200



3 **SOUTH ELEVATION OF CLASSROOM**
1:200



4 **EAST ELEVATION OF CLASSROOM**
1:200

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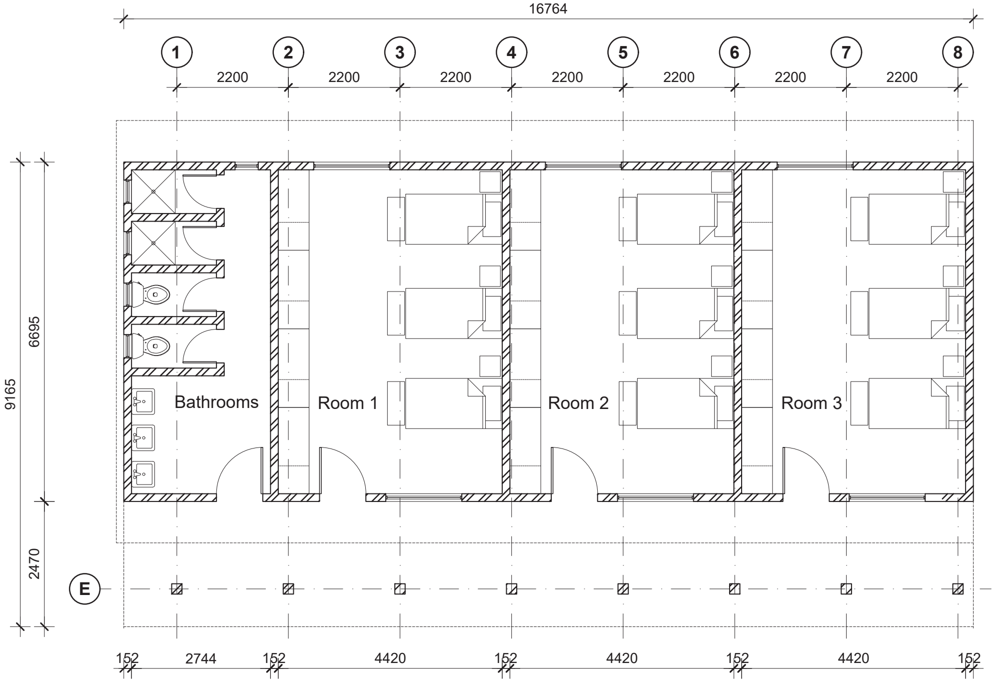
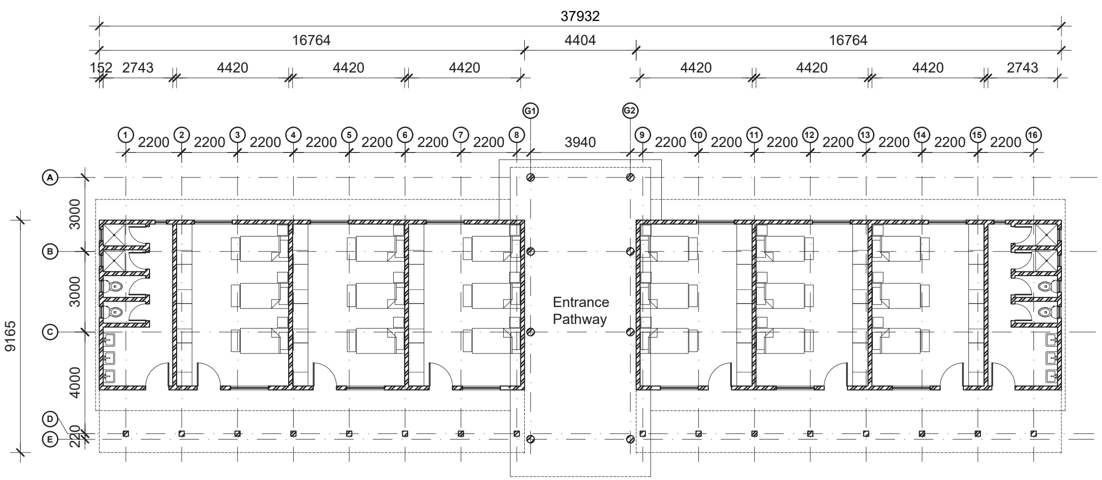
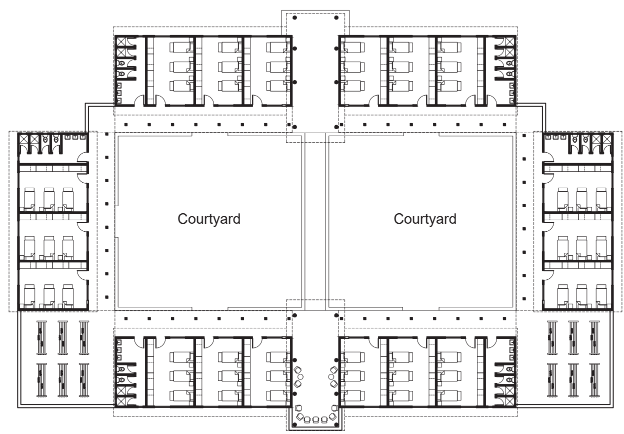
A 2.2



1 **TECHNICAL FLOOR PLAN OF SINGLE DORM IN HOSTEL**
1:100



2 **TECHNICAL FLOOR PLAN OF 2 CONNECTED DORMS IN HOSTEL**
1:200



3 **DESIGN FLOOR PLAN OF HOSTEL CLUSTER**
NO SCALE

N

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HOSTEL FLOOR PLAN
SCALE 1:100 @ A3

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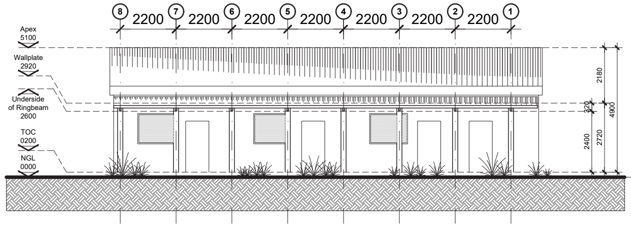
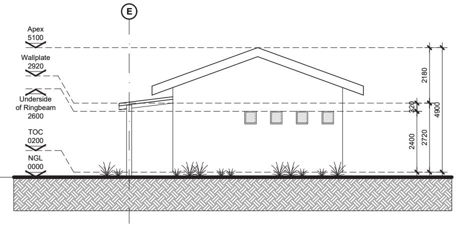
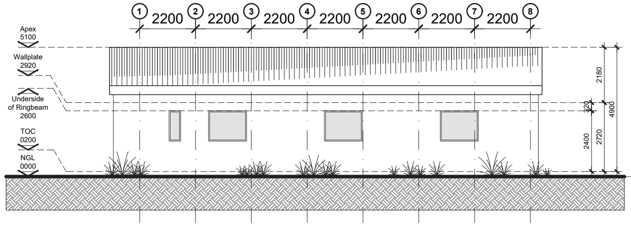
A 3.1



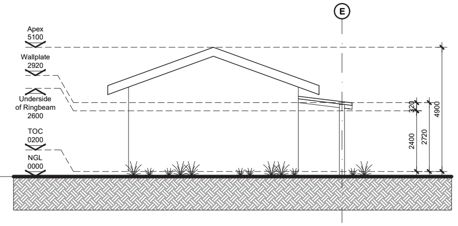
1 **NORTH ELEVATION OF SINGLE DORM IN HOSTEL**
1:200



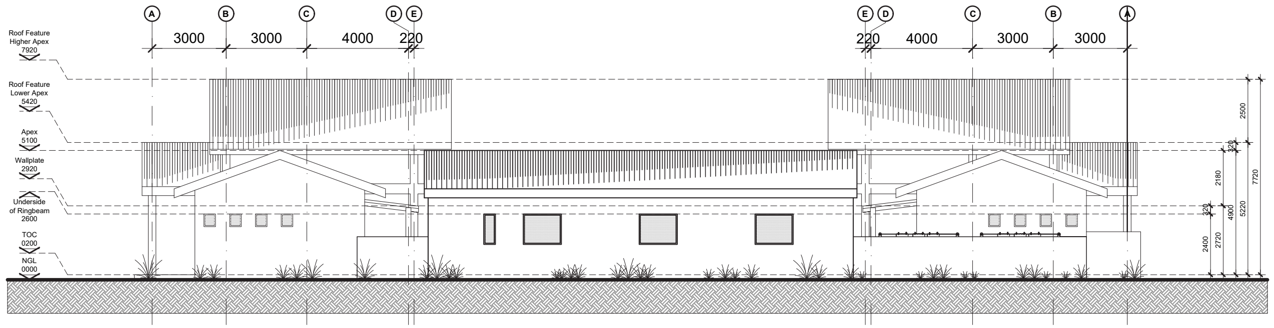
2 **WEST ELEVATION OF SINGLE DORM IN HOSTEL**
1:200



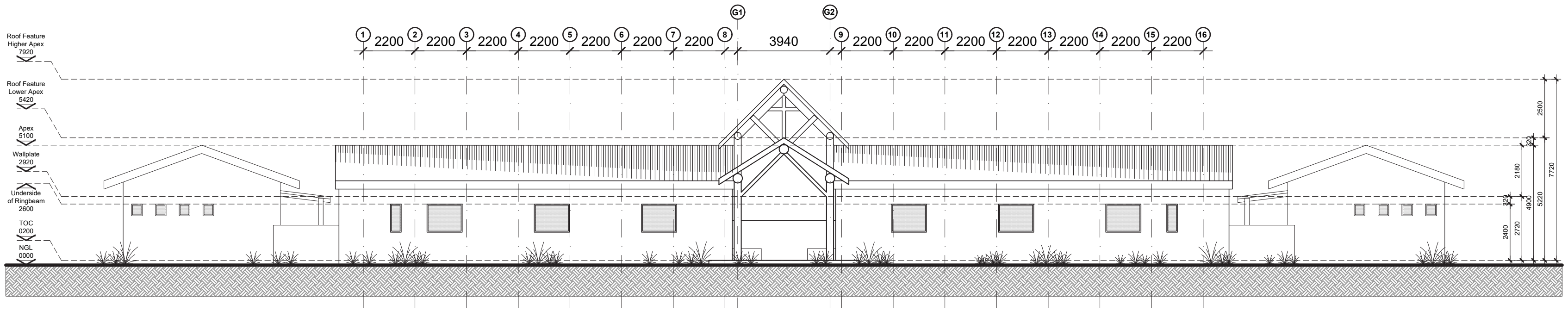
3 **SOUTH ELEVATION OF SINGLE DORM IN HOSTEL**
1:200



4 **EAST ELEVATION OF SINGLE DORM IN HOSTEL**
1:200



5 **WEST ELEVATION OF HOSTEL CLUSTER**
1:200



6 **NORTH ELEVATION OF HOSTEL CLUSTER**
1:200

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A 3.2

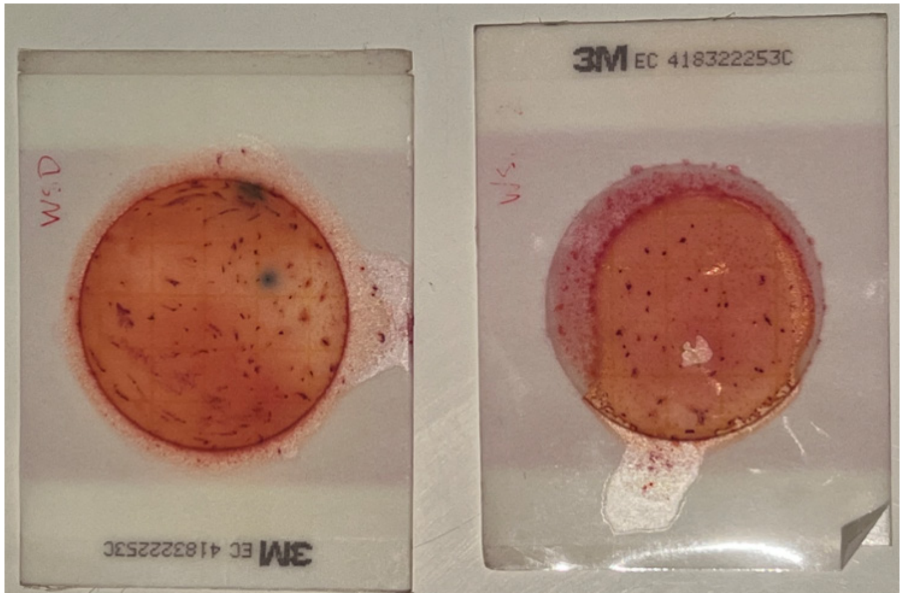
Temporary Staff Housing
(photo: Ed Luebben -
LITC Itezhi Tezhi, Zambia)

D | Civil Annexure

C.1 Detailed Water Quality Results

Parameter	At Bore	SP1-Chalet	SP2 - Accomodation	WSD	WHO Guides
pH	6.8-7.8	6.8-7.8	6.8-7.8	6.8	6-8
Free Chlorine (mg/L)	0	0	0	0	5 mg/L (0.2-1 mg/L is normal)
Total Chlorine (mg/L)	0	0	0	0	5 mg/L (0.2-1 mg/L is normal)
Hardness (mg/L)	120-150	250	250	50-120	Taste Threshold is 100-300 mg/L
Alkalinity (mg/L)	120-180	180	180	80-120	None
Iron (mg/L)	0	0	0	0.15	Taste Threshold < 0.3 mg/L
E-Coli (CFM/100ml)	0 (Tested at Bore Only)			TMTC	None Detectable per 100 ml

Table C.1.1: detailed water quality results



above: E-Coli Test (Left: Bore , Right: WSD)

C.2 Detailed Soil Quality Results

C2.1 Percolation Tests

Test Pit #1

Date:	July 21, 2023
Time:	5:00 pm
Test Hole Location:	Accomodation Zone #1
Data Collectors:	TS

Time	Depth to Water		Δ Depth	Perc Rate		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	85,00	850,0	--	--	--	--
5,00	87,00	870,0	20,0	4,0	0,3	6,3
10,00	87,50	875,0	5,0	1,0	1,0	25,0
15,00	88,00	880,0	5,0	1,0	1,0	25,0
20,00	88,50	885,0	5,0	1,0	1,0	25,0

Result: 25,0 **(min/25mm)**

Application Rate (lpd / m^2)
25

Test Pit #3

Date:	July 21, 2023
Time:	5:00 pm
Test Hole Location:	Site Entrance - Zone #3
Data Collectors:	TS

Time	Depth to Water		Δ Depth	Perc Rate		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	59,50	595,0	--	--	--	--
5,00	61,50	615,0	20,0	4,0	0,3	6,3
10,00	63,50	635,0	20,0	4,0	0,3	6,3
15,00	65,30	653,0	18,0	3,6	0,3	6,9
20,00	66,30	663,0	10,0	2,0	0,5	12,5
25,00	68,00	680,0	17,0	3,4	0,3	7,4
30,00	69,60	696,0	16,0	3,2	0,3	7,8

Result: 6,9

Application Rate (lpd / m^2)
33

Test Pit #2

Date:	July 21, 2023
Time:	5:00 pm
Test Hole Location:	Residential Area - Zone #2
Data Collectors:	TS

Time	Depth to Water		Δ Depth	Perc Rate		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	49,00	490,0	--	--	--	--
360,00	50,00	500,0	10,0	0,0	36,0	900,0
840,00	51,00	510,0	10,0	0,0	48,0	1 200,0
1 140,00	52,00	520,0	10,0	0,0	30,0	750,0
1 440,00	53,00	530,0	10,0	0,0	30,0	750,0

Result: 750,0 **(min/25mm)**

Application Rate (lpd / m^2)
Not Suitable

Test Pit #4

Date:	July 22,2023
Time:	5:00 pm
Test Hole Location:	Proposed Resident Area - Zone #4
Data Collectors:	TS

Time	Depth to Water		Δ Depth	Perc Rate		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	81,00	810,0	--	--	--	--
5,00	82,50	825,0	15,0	3,0	0,3	8,3
10,00	83,50	835,0	10,0	2,0	0,5	12,5
15,00	84,50	845,0	10,0	2,0	0,5	12,5
20,00	85,50	855,0	10,0	2,0	0,5	12,5
25,00	86,50	865,0	10,0	2,0	0,5	12,5

Result: 12,5 **(min/25mm)**

Application Rate (lpd / m^2)
33

Test Pit #5

Date:	July 21, 2023					
Time:	5:00 pm					
Test Hole Location:	Proposed Resident Area - Zone #5					
Data Collectors:	TS					
Time	**Depth to Water**		**Δ Depth**	**Perc Rate**		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	69,00	690,0	--	--	--	--
5,00	70,50	705,0	15,0	3,0	0,3	8,3
10,00	72,00	720,0	15,0	3,0	0,3	8,3
15,00	73,50	735,0	15,0	3,0	0,3	8,3
20,00	74,50	745,0	10,0	2,0	0,5	12,5

Result: **8,3**
(min/25mm)

Application Rate (lpd / m²)
33

Test Pit #7

Date:	July 21, 2023					
Time:	5:00 pm					
Test Hole Location:	East of Dormitory/Agriculture Area - Zone #7					
Data Collectors:	TS					
Time	**Depth to Water**		**Δ Depth**	**Perc Rate**		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	56,00	560,0	--	--	--	--
10,00	58,00	580,0	20,0	2,0	0,5	12,5
15,00	58,50	585,0	5,0	1,0	1,0	25,0
20,00	59,00	590,0	5,0	1,0	1,0	25,0
25,00	59,50	595,0	5,0	1,0	1,0	25,0
30,00	60,00	600,0	5,0	1,0	1,0	25,0

Result: **21,9**

Application Rate (lpd / m²)
25

Test Pit #6

Date:	July 21, 2023					
Time:	5:00 pm					
Test Hole Location:	Campground - Zone #6					
Data Collectors:	TS					
Time	**Depth to Water**		**Δ Depth**	**Perc Rate**		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	73,00	730,0	--	--	--	--
5,00	77,00	770,0	40,0	8,0	0,1	3,1
10,00	78,50	785,0	15,0	3,0	0,3	8,3
15,00	79,00	790,0	5,0	1,0	1,0	25,0
20,00	79,50	795,0	5,0	1,0	1,0	25,0
25,00	80,00	800,0	5,0	1,0	1,0	25,0

Result: **15,4**

Application Rate (lpd / m²)
33

Test Pit #8

Date:	July 21, 2023					
Time:	5:00 pm					
Test Hole Location:	Dormitory Area - Zone #8					
Data Collectors:	TS					
Time	**Depth to Water**		**Δ Depth**	**Perc Rate**		
(min)	(cm)	(mm)	(mm)	(mm/min)	(min/mm)	(min/25 mm)
0,00	62,50	625,0	--	--	--	--
5,00	64,50	645,0	20,0	4,0	0,3	6,3
10,00	65,50	655,0	10,0	2,0	0,5	12,5
15,00	66,50	665,0	10,0	2,0	0,5	12,5
20,00	67,50	675,0	10,0	2,0	0,5	12,5
25,00	68,50	685,0	10,0	2,0	0,5	12,5

Result: **10,9**

Application Rate (lpd / m²)
33

C.3 Water Consupmtion and Sewage Calculations

C3.1 Estimate for Average Daily Water Demand - Full Bluildout

Calculated by:	TS	07/20/2023
Reviewed by:	TG	10/06/2023

Liters per Capita Per Day

Area of Campus	No. of Buildings	User Type	No. of Users/Bldg.	Total No. of Users per Bldg. Type	Per capita usage rates used in calculations								Total per Capita Use by User (Lpcd)	Demand per Day by User Type (Lpd)
					Drinking	Cooking	Dish Washing	Building Cleaning	Laundry	Bathing	Flush Toilets	Other unit rate		
					5	5	10	1	10	55	30	1	117	
Academic Campus - Admin Building	1	Staff	20	20	-	-	-	2,3	-	-	0,3	-	10	197
Academic Campus - Male Ablution Block	1	Students	6	6	-	-	-	1,1	-	-	0,5	-	16	96
Academic Campus - Female Ablution Block	1	Students	6	6	-	-	-	1,1	-	-	0,5	-	16	96
Academic Campus - Classrooms	10	Students	40	400	-	-	-	0,52	-	-	0,2	-	7	2 607
Academic Campus - Computer Room	1	Students	20	20	-	-	-	0,53	-	-	-	-	1	11
Academic Campus - Library	1	All	112	112	-	-	-	0,18	-	-	-	-	0	21
Academic Campus - Chapel	1	All	200	200	-	-	-	0,04	-	-	-	-	0	9
Academic Campus - Workshops	4	Staff	20	80	-	-	-	2,54	-	-	-	-	3	203
Academic Campus - Dining	1	All	400	400	1,0	-	-	0,09	-	-	-	-	5	2 035
Academic Campus - Dining Ablution Block	1	All	1	1				6,30			0,5		21	21
Academic Campus - Operations Office	1	Staff	5	5				2,10			0,2		8	41
Residential - Male Dorms	8	Students	18	144	-	-	-	0,58	1,0	1,0	1,0	-	96	13 764
Residential - Female Dorms	8	Students	18	144	-	-	-	0,58	1,0	1,0	1,0	-	96	13 764
Residential - Caretakers	4	Staff	5	20				2,10	1,0	1,0	1,0		97	1 942
Residential - 3 Bed	2	Staff	5	10				2,10	1,0	1,0	1,0		97	971
Residential - 2 Bed	2	Staff	4	8				2,63	1,0	1,0	1,0		98	781
Residential - Part Time Staff	4	Staff	2	8				5,25	1,0	1,0	1,0		100	802
Residential - Student Chalet	8	Students	2	16				5,25	1,0	1,0	1,0		100	1 604
Residential - Kitchen	1	Staff	400	400		1,0	1,0	0,03					15	6 011
Campsite - Male Ablution	1	Students	6	6				1,75		0,5	0,5		44	266
Campsite - Female Ablution	1	Students	6	6				1,75		0,5	0,5		44	266
													0	0
													0	0
													0	0
													0	0
													0	0
													0	0
													0	0
													0	0
			DEMAND, PER ACTIVITY		2 000	2 000	4 000	970	3 500	19 580	13 455	0		

C3.2 Total Campus Water Demand

Campus Water Demand

Building	No. of Buildings	User Types	Total Users per Bldg.	Total Campus Users	Drinking (Lpd)	Cooking (Lpd)	Dish Washing (Lpd)	Building Cleaning (Lpd)	Laundry (Lpd)	Bathing (Lpd)	Flush Toilets (Lpd)	Other unit rate (Lpd)	Demand per Day per Bldg (Lpd)	Total Demand per Day All Bldgs (Lpd)
Academic Campus - Admin Building	1	Staff	20	20	-	-	-	47	-	-	150	-	197	197
Academic Campus - Male Ablution Block	1	Students	6	6	-	-	-	6	-	-	90	-	96	96
Academic Campus - Female Ablution Block	1	Students	6	6	-	-	-	6	-	-	90	-	96	96
Academic Campus - Classrooms	9	Students	40	360	-	-	-	207	-	-	2 400	-	290	2 607
Academic Campus - Computer Room	1	Students	20	20	-	-	-	11	-	-	-	-	11	11
Academic Campus - Library	1	All	112	112	-	-	-	21	-	-	-	-	21	21
Academic Campus - Chapel	1	All	200	200	-	-	-	9	-	-	-	-	9	9
Academic Campus - Workshops	4	Staff	20	80	-	-	-	203	-	-	-	-	51	203
Academic Campus - Dining	1	All	400	400	2 000	-	-	35	-	-	-	-	2 035	2 035
Academic Campus - Dining Ablution Block	1	All	1	1	-	-	-	6	-	-	15	-	21	21
Academic Campus - Operations Office	1	Staff	5	5	-	-	-	11	-	-	30	-	41	41
Residential - Male Dorms	8	Students	18	144	-	-	-	84	1 440	7 920	4 320	-	1 721	13 764
Residential - Female Dorms	8	Students	18	144	-	-	-	84	1 440	7 920	4 320	-	1 721	13 764
Residential - Caretakers	4	Staff	5	20	-	-	-	42	200	1 100	600	-	486	1 942
Residential - 3 Bed	2	Staff	5	10	-	-	-	21	100	550	300	-	486	971
Residential - 2 Bed	2	Staff	4	8	-	-	-	21	80	440	240	-	391	781
Residential - Part Time Staff	4	Staff	2	8	-	-	-	42	80	440	240	-	201	802
Residential - Student Chalet	8	Students	2	16	-	-	-	84	160	880	480	-	201	1 604
Residential - Kitchen	1	Staff	400	400	-	2 000	4 000	11	-	-	-	-	6 011	6 011
Campsite - Male Ablution	1	Students	6	6	-	-	-	11	-	165	90	-	266	266
Campsite - Female Ablution	1	Students	6	6	-	-	-	11	-	165	90	-	266	266
			0	0	-	-	-	-	-	-	-	-	0	0
Total Daily Water Demand (Lpd)				DEMAND, PER ACTIVITY	2 000	2 000	4 000	970	3 500	19 580	13 455	-	TOTAL DEMAND, ALL BUILDINGS	45 505

C3.3 Water Storage

Calculated by:	TS	07/24/2023
Reviewed by:	TG	10/06/2023

Storage Size and Configuration

Storage Required	2,0	days =	91 009	L
Tank Shape	Circular			
Tank Battery (Group of Tanks)			**Single Tank Size**	
Tank Diameter	3,00	m	6,21	m
Water Height	3,00	m	3,00	m
Tank Freeboard	0,50	m	0,50	m
Total Tank Height	3,50	m	3,50	m
Tank Volume	21 206	L	91 009	L
Number of Tanks	5			
Tank Spacing	2,00	m		
Number of Tank Rows	1			
Number of Tank Columns	3			
Required Footprint	39,00	m^2		

C3.4 Wastewater Loading

Calculated by:	TS	07/24/2023
Reviewed by:	TG	10/06/2023

Water Demand Information			**Wastewater Production**		
Building	**No. of Buildings**	**Total Water Demand per Day All Bldgs (Lpd)**	**Wastewater Generation Rate (%)**	**Wastewater Load per Bldg (Lpd)**	**Total Wastewater Load to be Treated (Lpd)**
Academic Campus - Admin Building	1	197	90%	177	**177**
Academic Campus - Male Ablution Block	1	96	90%	86	**86**
Academic Campus - Female Ablution Block	1	96	90%	86	**86**
Academic Campus - Classrooms	10	2 607	90%	235	**2 346**
Academic Campus - Computer	1	11	90%	10	**10**
Academic Campus - Library	1	21	90%	19	**19**
Academic Campus - Chapel	1	9	90%	8	**8**
Academic Campus - Workshops	4	203	90%	46	**183**
Academic Campus - Dining	1	2 035	90%	1 832	**1 832**
Academic Campus - Dining Ablution Block	1	21	90%	19	**19**
Academic Campus - Operations Office	1	41	90%	37	**37**
Residential - Male Dorms	8	13 764	90%	1 548	**12 388**
Residential - Female Dorms	8	13 764	90%	1 548	**12 388**
Residential - Caretakers	4	1 942	90%	437	**1 748**
Residential - 3 Bed	2	971	90%	437	**874**
Residential - 2 Bed	2	781	90%	351	**703**
Residential - Part Time Staff	4	802	90%	180	**722**
Residential - Student Chalet	8	1 604	90%	180	**1 444**
Residential - Kitchen	1	6 011	90%	5 410	**5 410**
Campsite - Male Ablution	1	266	90%	239	**239**
Campsite - Female Ablution	1	266	90%	239	**239**
		0	90%	0	**0**
			Campus Wastewater Demand:		**40 957**

C3.5 Wastewater Loading - All Scenarios

Calculated by:	TS	07/24/2023
Reviewed by:	TG	10/06/2023

Wastewater Load per System

Treatment System	Buildings Served	No. of Each Building Type Served	WW Load per Bldg (Lpd)	WW Load for All Bldgs (Lpd)	System Total WW Load (Lpd)
Buildout	Academic Campus - Admin Building	1	177	177	40 957
	Academic Campus - Male Ablution Block	1	86	86	
	Academic Campus - Female Ablution Block	1	86	86	
	Academic Campus - Classrooms	10	235	2 346	
	Academic Campus - Computer Room	1	10	10	
	Academic Campus - Library	1	19	19	
	Academic Campus - Chapel	1	8	8	
	Academic Campus - Workshops	4	46	183	
	Academic Campus - Dining	1	1 832	1 832	
	Academic Campus - Dining Ablution	1	19	19	
	Academic Campus - Operations Office	1	37	37	
	Residential - Male Dorms	8	1 548	12 388	
	Residential - Female Dorms	8	1 548	12 388	
	Residential - Caretakers	4	437	1 748	
	Residential - 3 Bed	2	437	874	
	Residential - 2 Bed	2	351	703	
	Residential - Part Time Staff	4	180	722	
	Residential - Student Chalet	8	180	1 444	
	Residential - Kitchen	1	5 410	5 410	
	Campsite - Male Ablution	1	239	239	
	Campsite - Female Ablution	1	239	239	
Phase 1A	Residential - Male Dorms	8	1 548	12 388	26 698
	Residential - Female Dorms	8	1 548	12 388	
	Residential - Student Chalet	8	180	1 444	
	Campsite - Male Ablution	1	239	239	
	Campsite - Female Ablution	1	239	239	
Phase 1B	Academic Campus - Admin Building	1	177	177	14 260
	Academic Campus - Male Ablution Block	1	86	86	
	Academic Campus - Female Ablution Block	1	86	86	
	Academic Campus - Classrooms	10	235	2 346	
	Academic Campus - Computer Room	1	10	10	
	Academic Campus - Library	1	19	19	
	Academic Campus - Chapel	1	8	8	
	Academic Campus - Workshops	4	46	183	
	Academic Campus - Dining	1	1 832	1 832	
	Academic Campus - Dining Ablution Block	1	19	19	
	Academic Campus - Operations Office	1	37	37	
	Residential - Caretakers	4	437	1 748	
	Residential - 3 Bed	2	437	874	
	Residential - 2 Bed	2	351	703	
	Residential - Part Time Staff	4	180	722	
	Residential - Kitchen	1	5 410	5 410	
			Campus Wastewater Load:		**81 914**

C3.6 Wastewater Treatment and Disposal

System Component	Units	Buildout	Phase 1A	Phase 1B
Loading				
System WW Load	Lpd	40 957	26 698	14 260
Wastewater Primary Treatment (Septic Tank)				
Retention Time	days	2	2	2
Total Volume Required	L	81 914	53 395	28 519
Total Volume Required	m^3	81,9	53,4	28,5
Width	m	4	4	4
Length	m	11	7	4
Length of First Chamber	m	7,333333333	4,666666667	2,666666667
Length of Second Chamber	m	3,666666667	2,333333333	1,333333333
Water Depth	m	2	2	2
Freeboard	m	0,1	0,1	0,1
Height	m	2,1	2,1	2,1
Tank Storage Volume	m^3	88	56	32
Wastewater Secondary Treatment and Disposal Options				
Wastewater Application Rate	Lpd/m^2	25	25	25
Infiltrative Area	m^2	1638	1068	570
Infiltration Trenches				
Proposed Trench Width	m	1	0,5	0,5
Infiltrative Depth	m	1	1	1
Total Required Trench Length	m	546	427	228
Number of Trenches	--	5	5	5
Length of Each Trench	m	109,2	85,4	45,6
Distance Between Trenches	m	3	1,5	1,5
Total Trench System Width	m	17	8,5	8,5
Infiltration Fields				
Number of Pipe Lengths	--	10	10	10
Pipe Spacing	m	1,5	1,5	1,5
Shoulder Width	m	1,5	1,5	1,5
Proposed Field Width	m	16,5	16,5	16,5
Infiltrative Depth	m	1,5	1,5	1,5
Required Field Length	m	84,0	54,8	29,3
Rectangular Pits				
Length	m	3	2	2
Width	m	3	2	2
Depth	m	3	2	2
Bottom Area	m^2	9	4	4
Wall Area	m^2	36	16	16
Number of Pits	--	37	54	29
Circular Pits				
Diameter	m	3	3	3
Bottom Area	m^2	7,1	7,1	7,1
Total Circular Wall Area	m^2	1631,2	1060,8	563,3
Total Required Depth	m	173,1	112,6	59,8
Depth per Pit	m	1	1	1
Number of Pits	--	174	113	60
	Disposal Option Selected?	**Infiltration Fields**	**Infiltration Fields**	**Infiltration Fields**

Existing Residence Block
(photo: Ed Luebben -
LITC, Itezhi Tezhi Zambia)

E | Electrical Annexure

LOAD ESTIMATES: Life Impact Training Center Master Plan (Itezhi Tezhi, Zambia)

Summary

Property Loads	Total (kVA)
Existing Demand	1,11
Removed Demand	0,00
Added Demand	263,06
Loads Total (kVA) =	**264,16**
Transformer Size (kVA) =	**300,00**
Power Percentage Used =	**88,1%**

General Data

Demand Factors	
General Loads	65%
Special Loads	40%
AC Loads	60%

Voltages	
3 Phase	230
1 Phase	230
Power Factor	
PF	0,7

Building Loads

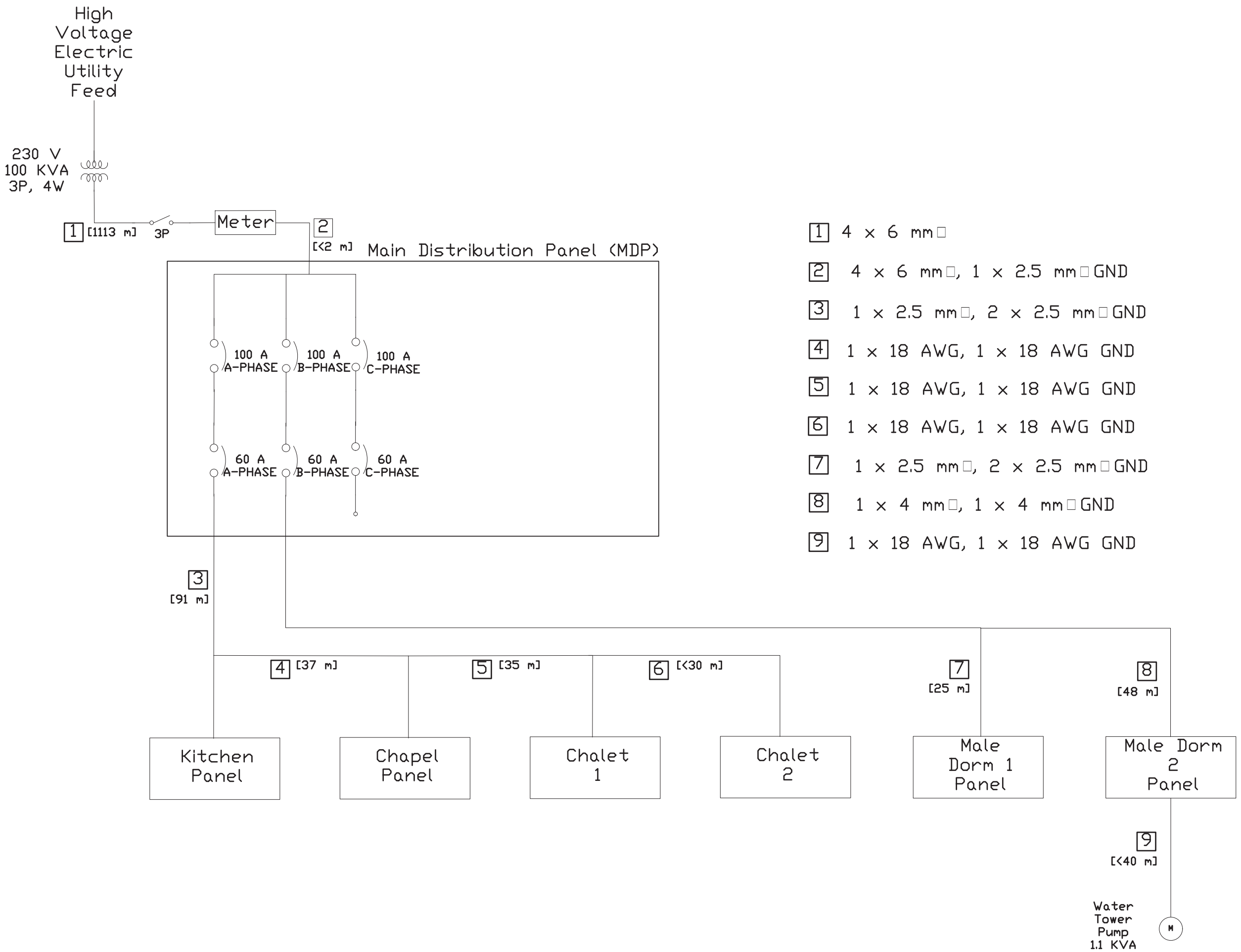
	Building Description	Area (m^2)	Lights' Load (W/m^2)	Outlets + Fans' Load (W/m^2)	General Load (VA)	Special Loads (VA)	AC Loads (VA)	Maximum Demand (VA)	Loads with Demand Factor (VA)	1 or 3 Phase	Line Current (A)	Existing Demand (VA)	Removed Demand (VA)	Added Demand (VA)	Total Demand (VA)	Notes
Existing Buildings	Male Dorms 1	145	2	2	829	7 450	0	8 279	3 519	3	9			3 519	3 519	
	Male Dorms 2	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
	Abolution 1	16	2	2	91	0	0	91	59	1	0			59	59	
	Kitchen	61	2	2	349	31 150	0	31 499	12 687	3	32			12 687	12 687	
	Chapel	205	2	2	1 171	4 636	0	5 807	2 616	3	7			2 616	2 616	
	Chalet 1	24	2	2	137	3 715	0	3 852	1 575	1	7			1 575	1 575	
	Chalet 2	24	2	2	137	3 715	0	3 852	1 575	1	7			1 575	1 575	
	Chalet 3	24	2	2	137	3 715	0	3 852	1 575	1	7			1 575	1 575	
	Chalet 4	24	2	2	137	3 715	0	3 852	1 575	1	7			1 575	1 575	
	Guest/Staff House 1	32	2	2	183	3 955	0	4 138	1 701	1	7			1 701	1 701	
	Guest/Staff House 2	32	2	2	183	3 955	0	4 138	1 701	1	7			1 701	1 701	
	Guest/Staff House 3	32	2	2	183	3 955	0	4 138	1 701	1	7			1 701	1 701	
	Guest/Staff House 4	32	2	2	183	3 955	0	4 138	1 701	3	4			1 701	1 701	
	Campsite Abolution 1	12	2	2	69	0	0	69	45	1	0			45	45	
	Campsite Abolution 2	12	2	2	69	0	0	69	45	1	0			45	45	
	Admin	277	2	2	1 583	11 060	3 432	16 075	7 512	1	33			7 512	7 512	
	Classroom 1 (Tailoring), 2 (Catering), 3	207	2	2	1 183	54 165	0	55 348	22 435	3	56			22 435	22 435	
	Classroom 4, 5, 6	207	2	2	1 183	3 665	0	4 848	2 235	1	10			2 235	2 235	
	Classroom 7, 8, 9	207	2	2	1 183	53 165	0	54 348	22 035	3	55			22 035	22 035	
	Comuter Room	70	2	2	400	6 950	0	7 350	3 040	1	13			3 040	3 040	
	Library	140	2	2	800	1 775	1 716	4 291	2 260	1	10			2 260	2 260	
	Workshop 1	180	2	2	1 029	42 422	0	43 451	17 637	3	44			17 637	17 637	
	Workshop 2	180	2	2	1 029	42 172	0	43 201	17 537	3	44			17 537	17 537	
	Workshop 3	180	2	2	1 029	42 422	0	43 451	17 637	3	44			17 637	17 637	
	Workshop 4	180	2	2	1 029	20 144	0	21 173	8 726	3	22			8 726	8 726	
	Workshop 5	180	2	2	1 029	20 394	0	21 423	8 826	3	22			8 826	8 826	
	Dining	115	2	2	657	3 243	0	3 900	1 724	1	7			1 724	1 724	
	Male Dorms 3	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
	Male Dorms 4	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
	Male Dorms 5	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
	Male Dorms 6	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
	Male Dorms 7	114	2	2	651	7 450	0	8 101	3 403	3	9			3 403	3 403	
	Male Dorms 8	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	

Future Phases

Building Description	Area (m^2)	Lights' Load (W/m^2)	Outlets + Fans' Load (W/m^2)	General Load (VA)	Special Loads (VA)	AC Loads (VA)	Maximum Demand (VA)	Loads with Demand Factor (VA)	1 or 3 Phase	Line Current (A)	Existing Demand (VA)	Removed Demand (VA)	Added Demand (VA)	Total Demand (VA)	Notes
Male Dorms 9	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
Male Dorms 10	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
Female Dorms 1	114	2	2	651	7 450	0	8 101	3 403	3	9			3 403	3 403	
Female Dorms 2	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
Female Dorms 3	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
Female Dorms 4	114	2	2	651	7 450	0	8 101	3 403	1	15			3 403	3 403	
Female Dorms 5	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
Female Dorms 6	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
Female Dorms 7	145	2	2	829	7 450	0	8 279	3 519	3	9			3 519	3 519	
Female Dorms 8	145	2	2	829	7 450	0	8 279	3 519	1	15			3 519	3 519	
Care Takers 1	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Care Takers 2	49	2	2	280	5 655	0	5 935	2 444	3	6			2 444	2 444	
Care Takers 3	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Care Takers 4	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Care Takers 5	49	2	2	280	5 655	0	5 935	2 444	3	6			2 444	2 444	
Care Takers 6	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Care Takers 7	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Care Takers 8	49	2	2	280	5 655	0	5 935	2 444	1	11			2 444	2 444	
Staff 3-bed 1	165	2	2	943	5 655	0	6 598	2 875	3	7			2 875	2 875	
Staff 3-bed 2	165	2	2	943	5 655	0	6 598	2 875	1	12			2 875	2 875	
Staff 2-bed 1	93	2	2	531	5 655	0	6 186	2 607	1	11			2 607	2 607	
Staff 2-bed 2	93	2	2	531	5 655	0	6 186	2 607	1	11			2 607	2 607	
Staff 2-bed 3	93	2	2	531	5 655	0	6 186	2 607	1	11			2 607	2 607	
Abolution 2	12	2	2	69	0	0	69	45	1	0			45	45	
Abolution 3	12	2	2	69	0	0	69	45	1	0			45	45	
													Max Demand (VA) =	614 966	
													Demand with Demand Factors (VA) =	255 556	
													Total Demand (kVA) =	**255,6**	

Site Loads

Load Description	Demand Factor	Power Factor		Special Loads	Special Loads	Maximum	Loads with	1 or 3 Phase	Line	Existing	Removed	Added	Total Demand	Notes
Water Tower Pump	10%	0,92		0	0	0	0	1	0	1108		7500	861	



1 **EXISTING ELECTRICAL SINGLE LINE DIAGRAM**
NOT TO SCALE

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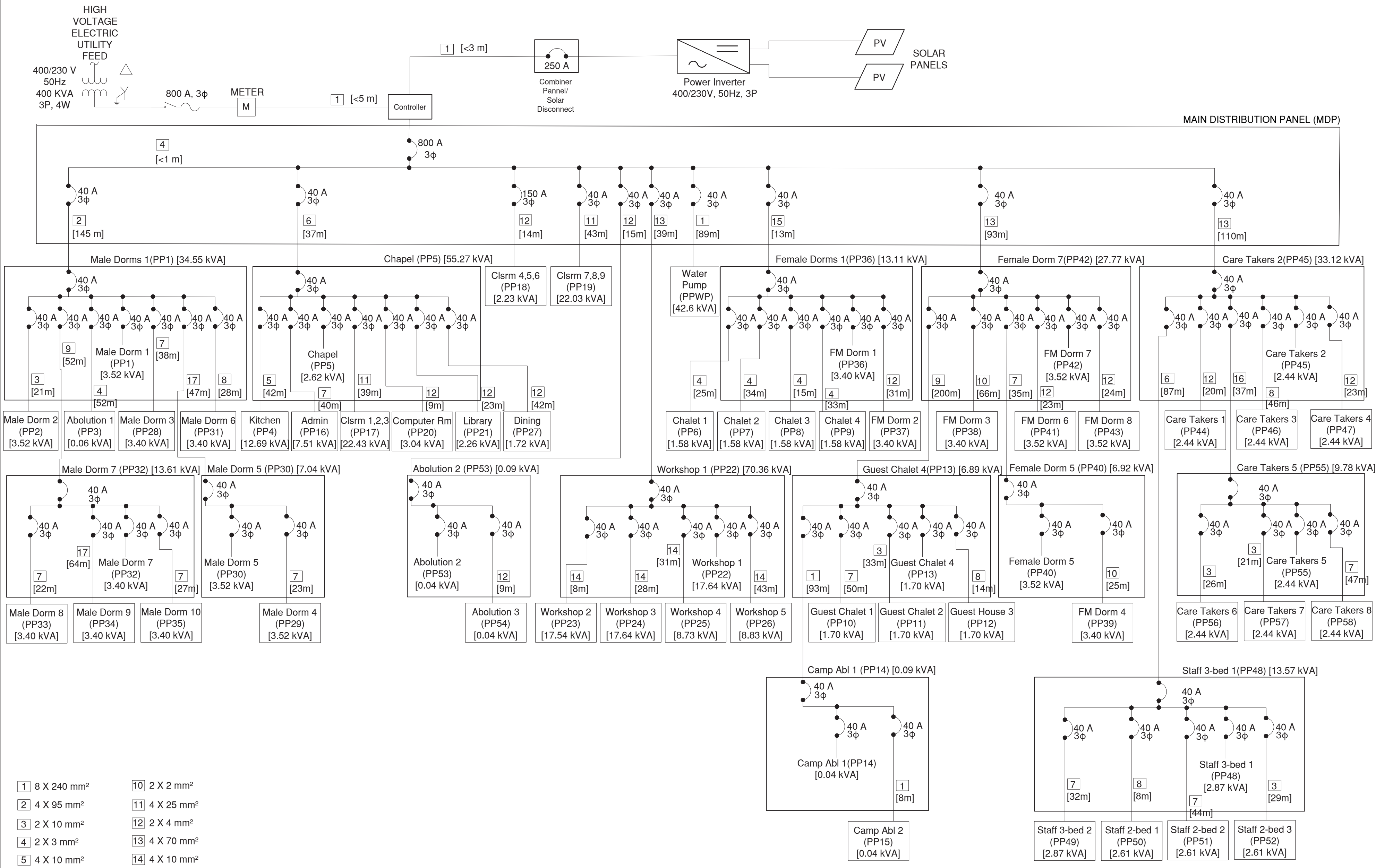
LIFE IMPACT TRAINING CENTER
ITEZHI TEZHI, ZAMBIA

SITE
ELECTRICAL SINGLE LINE DIAGRAM

CONCEPTUAL DRAWINGS NOT FOR CONSTRUCTION
LOCAL REGULATIONS MAY REQUIRE DRAWINGS TO BE FINALIZED BY AN ARCHITECT/ENGINEER LICENSED TO PRACTICE IN COUNTRY

PROJECT: SA-0078
DATE ISSUED: OCT 2023
REVISIONS:

SHEET NUMBER
E 1.1



1 8 X 240 mm²	10 2 X 2 mm²
2 4 X 95 mm²	11 4 X 25 mm²
3 2 X 10 mm²	12 2 X 4 mm²
4 2 X 3 mm²	13 4 X 70 mm²
5 4 X 10 mm²	14 4 X 10 mm²
6 4 X 50 mm²	15 4 X 6 mm²
7 2 X 16 mm²	16 4 X 16 mm²
8 2 X 6 mm²	17 2 X 25 mm²
9 4 X 35 mm²	

NOTE(S):
1. ALL WIRE IS COPPER UNLESS OTHERWISE NOTED
2. ALL WIRE IS UNDERGROUND EXCEPT FOR UTILITY POWER LINES UP TO MAIN ROAD.

1 ELECTRICAL SINGLE LINE DIAGRAM
NOT TO SCALE

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SITE
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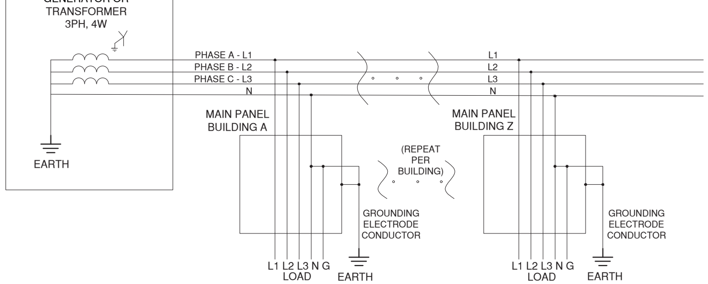
E 1.2

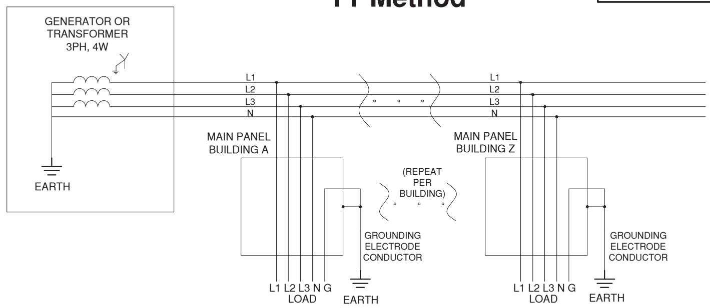
LEGEND

- ELECTRICAL WIRE
- ELECTRICALLY CONNECTED
- POWER PANEL
- CONNECTION TO EARTH GROUND
- TRANSFORMER COIL
- GROUND ROD

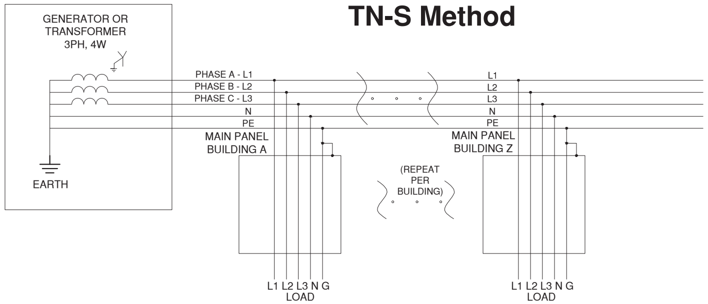
TN-C-S Method



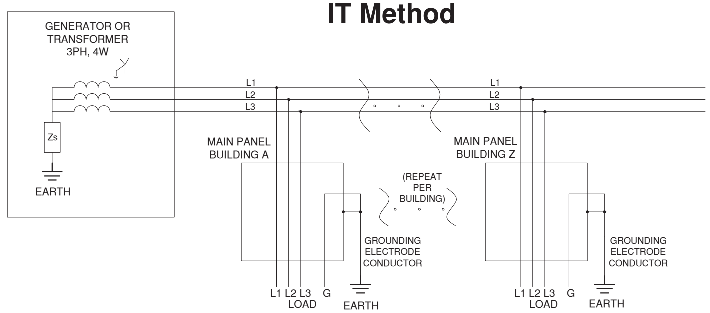
TT Method



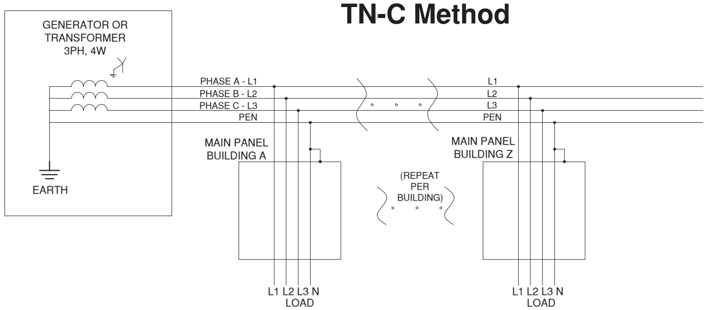
TN-S Method



IT Method



TN-C Method



NOTES:

A. THE ELECTRICAL DESIGNER SHOULD SELECT ONE OF THESE METHODS TO IMPLEMENT ACROSS THE ENTIRE SITE . THE FINAL DRAWING SHOULD ONLY HAVE THE SELECTED METHOD SHOWN.

B. SEE THE EMI ELECTRICAL DESIGN GUIDE CHAPTER TWO AND APPENDIX C FOR AN EXPLANATION OF THESE GROUNDING METHODS.

C. ABBREVIATIONS
- T - TERRE, DIRECT EARTH CONNECTION
- I - ISOLATED, EARTH CONNECTION THROUGH AN IMPEDANCE
- N - NEUTRAL
- C - COMBINED, NEUTRAL AND GROUND/PROTECTIVE EARTH FUNCTIONS ON ONE WIRE
- S - SEPARATE, NEUTRAL AND GROUND/PROTECTIVE EARTH FUNCTIONS ON SEPARATE WIRES
- PE - PROTECTIVE EARTH, ALSO CALLED GROUND IN SOME COUNTRIES
- PEN - PROTECTIVE EARTH AND NEUTRAL COMBINED WIRE
- Zs - IMPENDANCE

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Itezhi Tezhi, Zambia

Life Impact Training Center

SITE

GROUNDING DIAGRAM

CONCEPTUAL DRAWINGS NOT FOR CONSTRUCTION

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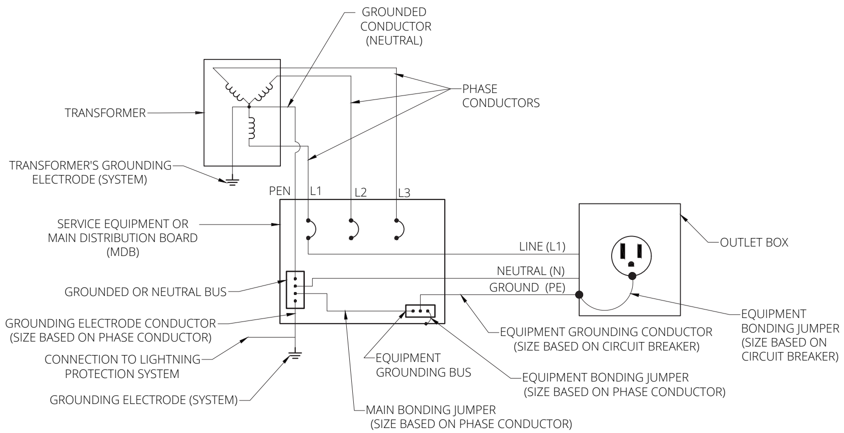
LEGEND

- ELECTRICAL WIRE
- CIRCUIT BREAKER
- POWER PANEL
- CONNECTION TO EARTH GROUND
- TRANSFORMER COIL
- GROUND ROD

NOTE:
1. ADAPTED FROM ACTIVITY 5.1 OF THE NATIONAL ELECTRIC CODE SEMINAR.



1 **PANEL GROUNDING AND BONDING DIAGRAM**
NO SCALE

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Life Impact Training Center
Itezhi Tezhi, Zambia

PANEL GROUNDING AND BONDING DIAGRAM

CONCEPTUAL DRAWINGS NOT FOR CONSTRUCTION

LOCAL REGULATIONS MAY REQUIRE DRAWINGS TO BE FINALIZED BY AN ARCHITECT/ENGINEER LICENSED TO PRACTICE IN COUNTRY

PROJECT:
SA-0078

DATE ISSUED:
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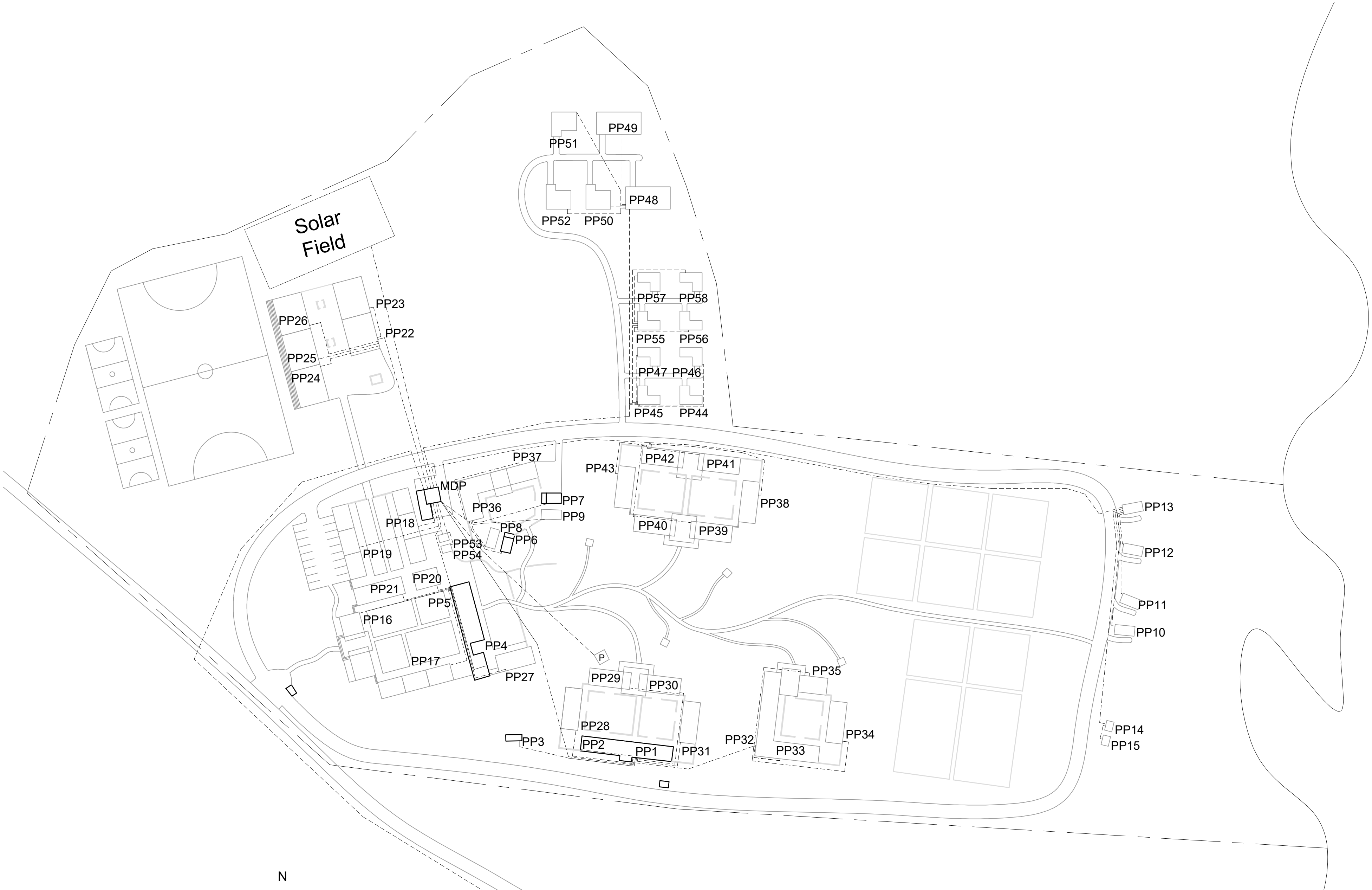

ELECTRICAL PHASING
1:1500 @ A3

0 10 20 40 80M
1:1500

..\EMI-South Africa title block blue-08.png

Life Impact Training Center
Itezhi Tezhi, Zambia

ELECTRICAL SITE PLAN
PHASING

CONCEPTUAL DRAWINGS NOT FOR CONSTRUCTION
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Sunset at Itezhi Tezhi Dam
(photo: Lianti Muller,
Zambia)

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