

Addressing Greywater Management Issues in Langrug Using a Sustainable Reiterative Process



An Interactive Qualifying Project submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science.

ABSTRACT

The informal settlement of Langrug, near Stellenbosch, South Africa, faces a variety of issues stemming from inadequate greywater management. The goal of this project was to use a sustainable process for community-based in situ upgrading of greywater systems. The students worked closely with community co-researchers to develop a self-reforming process and apply it to several greywater intervention projects in Langrug. The co-researchers will continue to use and adapt this process to mobilize the community and implement greywater management systems throughout 2012.

This project report is part of an ongoing research program by students and faculty of the WPI Cape Town Project Centre to explore and develop options for sustainable community development in the informal settlements of South Africa. For more information please go to <http://wp.wpi.edu/capetown/>

The following executive summary has been implemented as a website available at:

<http://wp.wpi.edu/capetown/homepage/projects/2011-2/langrug-greywater/>

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Figure 1: A panorama of Langrug from Nkanini

BACKGROUND

At the end of the apartheid era, South Africa faced rapid urbanization across the country. People in search of jobs in the city illegally squatted on the city outskirts, forming unplanned settlements. The South African government has worked diligently to provide proper housing for people living in these settlements, but the waiting list for housing will take decades to satisfy.[5] Recently, the South African government has made a shift towards in-situ upgrading, which focuses on upgrading the settlements instead of moving the residents into government-built housing. One settlement undergoing this type of upgrading is Langrug, located in Franschhoek, Stellenbosch in the Western Cape Province.

PROBLEM STATEMENT

Although Langrug faces many problems, the issue of greywater is of great importance. Greywater is non-sewage wastewater stemming from sources such as washing and bathing. It contains a variety of contaminants, ranging from salts and chemicals to bacteria. Greywater streams flow through

much of Langrug, mostly unmonitored and uncontrolled, and often clogged with trash and silt. When a stream's path is blocked, the greywater pools, allowing bacteria to feed on food waste and multiply. This can lead to serious health risks, including infections and rashes. Some even attribute greywater to the spread of tuberculosis in Langrug. When heavy rains overwhelm Langrug's greywater drainage system, the problems escalate. During the winter, large quantities of rainwater cause the greywater streams to overflow into people's houses, posing a significant health risk.



Figure 2: A greywater stream

Despite the need for intervention around greywater issues, past efforts to address greywater drainage in Langrug have been met with limited community participation. How-

ever, community participation and a sense of community ownership is vital to the sustainability of the implemented solutions. Thus, it was determined that initiatives addressing greywater in Langrug must be community based in all stages of implementation.

THE BEGINNING

The WPI students began work in Langrug in late October of 2012. Upon their arrival in Langrug, they expected to be working on the analysis of the social factors behind water and sanitation facility misuse and vandalism within the settlement. However, the students found that toilet misuse was not as severe a problem as greywater management issues within Langrug. For this reason, the project focus was redefined around the development of greywater management solutions.

From the start, community participation was deemed key, and all project work was carried out through partnership with four community members, called co-researchers: Trevor Masiy, Sinazo Ndabambi, Sibongile Xenxe, and Kholeka Xuza. Furthermore, a strong partnership between the WPI students, the community of Langrug, the NGO CORC, and the Municipality of Stellenbosch formed the foundation of the work in Langrug.

Having identified greywater as a serious issue in Langrug, the WPI students and co-researchers determined the following goals for their work:

1. Set an example for the community by implementing a greywater intervention in a part of Langrug

which had a severe greywater problem

2. Encourage extensive community participation not only in implementation of greywater interventions, but also in planning and maintenance
3. Develop greywater systems that will serve as sustainable, long-term solutions. Also, ensure that the process by which interventions are implemented is sustainable, so that greywater systems can be continually upgraded throughout the settlement.
4. Equip the co-researchers so they will be able to continue aiding future greywater innovation and intervention work

BUILDING A GREYWATER CHANNEL IN J-SECTION

In order to set an example for the community and to learn more about the dynamics around community-based upgrading, the greywater team,



Figure 3: Working on the J-section channel

composed of the four WPI students and four community co-researchers, implemented a greywater channel in Langrug's J-section. The location was chosen based on the existence of greywater problems and the proximity to a crèche. The greywater team attempted to encourage community involvement through informal discussion with community members, and was able to enlist the help of two community members living near the site. One of these community members helped daily with the work, and became an overseer for other greywater intervention projects after the first channel was finished. A stone-lined, cement-bonded channel was chosen for J-section based on suggestions from community members and discussion among the greywater team members. With support from WPI's Cape Town Project Centre, the greywater team obtained the necessary materials for the channel, which was constructed over the course of about a week. After completing the channel, the greywater team checked and doc-



Figure 4: Father walking son to crèche across from J-section channel

umented its condition periodically. Over time, trash, food waste, and sand began accumulating in the channel, prompting the team to work with the community members living around the channel to develop a plan for regular maintenance and cleaning.

DEVELOPING THE PROCESS

After constructing the J-section channel, the team discussed the steps by which it was implemented. Through this discussion, led by the community co-researchers, the team identified the gaps in the procedure used in J-section. The main issue identified in J-section was the limited community involvement in planning, maintenance, and construction. In order to address this issue, the team created an 8-step process designed to maximize community participation and develop a sense of community ownership, leading to a sustainable intervention. Furthermore, the Process is designed to adapt to the conditions in which it is applied, and to optimize itself over time, as seen in step eight, where the process itself is analyzed and changed in light of the team's experiences with each application to a new project.

1. **Choose an area** - When choosing an area, it is important to keep in mind community needs, level of interest, and the current existence of a greywater stream.
2. **Meet with community to share ideas** - A meeting should be held with the community members in the surrounding area to share ideas, understand the problems they have been experi-

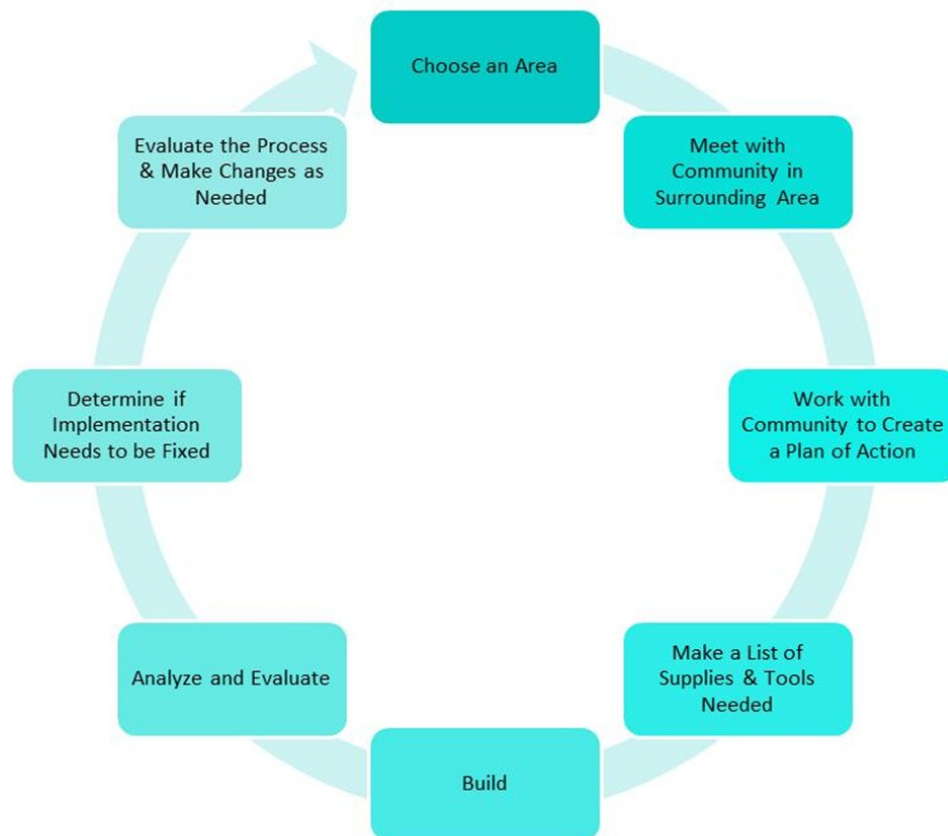


Figure 5: The above figure is the 8 step cycle that the team created based of the events of J-section. Each step is explained below.

- encing, see if they have tried any types of intervention, and understand their visions for the future.
3. **Create a plan of action** - Through further meetings with the community, a plan of action for implementing the selected solutions must be developed under the close supervision of the greywater team.
4. **Make a list of supplies and**

tools needed - A list of necessary supplies and tools must be created in order to determine how the proper materials should be acquired, and to file a request for aid from NGO's or the Municipality, if necessary.

5. **Build** - The construction phase of the project should be done as directed in the guidebook, which contains instructions for the implementation of several different

- types of greywater management.
6. **Analyze and evaluate the solution's effectiveness** – After being implemented, the greywater management solution should be revisited and analysed to understand what is and isn't effective and how it can be improved. Noteworthy strengths and weaknesses of the implementation should be carefully documented.
 7. **Make changes or repairs to solution** - If needed, the community should create and carry out a plan to fix any problems with the greywater solution; this can include making a maintenance schedule, replacing inefficient sections, etc.
 8. **Adapt process based on lessons from implementation** - Once the process has been completed, it should be evaluated for effectiveness. Any steps that were unnecessary or complicated in the process should be adjusted so that the process is the most useful to the community and co-researchers using it.

Although this process was applied specifically to greywater interventions, it can be generalized and adapted to apply to various community-based informal settlement upgrading initiatives. The team subsequently introduced this 8 step process to another team working in Langrug on the issues of water, sanitation, and hygiene, who adapted the process to upgrading ablution blocks and community spaces.



Figure 6: Meeting with the women who were cleaning the I-section channel

APPLYING THE PROCESS IN I-SECTION

After developing the Process, the greywater team applied it to a greywater channel upgrade in Langrug's I-section. This channel was chosen because of the severity of issues described by community members living nearby, and because of community willingness to work on interventions, as evidenced by some community member's self-organized cleaning efforts. Work on the I-section channel served as the first test of the new process, and provided vital lessons regarding various social dynamics involved in greywater interventions. Unlike the J-section channel, most of the work on the I-section channel was organized by the community co-researchers, and the WPI students served as consultants rather than active workers. Keeping with the new Process, work on the I-section began with meetings with the com-

munity members living near the channel. The community members provided further insight regarding greywater issues experienced, past attempts to deal with those issues, and ideas for upgrading the channel. Together with the community members, the co-researchers developed a plan for obtaining materials and constructing the channel and began construction work. Initially, the greywater team had hoped to obtain materials using monetary contributions from the community. However, the community members were more willing to offer manual labour, so materials were gathered from around Langrug or bought with funding from the municipality and CORC. Over the course of about three weeks, the community built about 90 metres of upgraded greywater channel, and cemented about 40 metres. Construction will continue once more cement can be obtained. The co-researchers have already begun discussing

maintenance with the community; community members seem willing to work to keep the channel clean, and a strong sense of community ownership is evident.

LESSONS LEARNED

MAINTENANCE

A couple of days after building the greywater channel in J-section, the greywater team returned to find that the channel was already being clogged by trash and sand. The buildup posed a significant problem. It partially obstructed the flow of greywater, causing pooling in some areas. This almost immediate occurrence demonstrated the critical need to maintain and clean out greywater channels properly. Accordingly, the co-researchers held a meeting with J-section community members living near the channel in which they discussed the need for community maintenance of the channel. Through a series of meetings between the co-researchers and J-section community members, as well as meetings among



Figure 7: I-section channel with water flowing

the J-section community members themselves, a consensus on the need for regular cleaning was reached, and a system of regular cleaning was instituted.



Figure 8: Trash cleaned out of sewage pipe in J-section as routine maintenance

VOLUNTEERISM VS. EMPLOYMENT

While the greywater team's initial efforts towards greywater management throughout Langrug had focused predominantly on mobilizing the community and convincing people to volunteer their time, a couple of days into the construction of the I-section channel we found that the government, CORC, and the community leadership had organised a system of payment for the people working on the channel. In light of the extremely high unemployment rate in Langrug, it is incredibly exciting that the community members can be paid for their work. However, this concept of money as motivation for their work has raised a couple of concerns from our team.

The main concern with using paid jobs to motivate the community stems from the fear that it will set a precedent for greywater upgrading work. If people expect that they will be paid whenever they work with the greywater team to implement a grey-

water intervention, then in the event that the government and associated NGO's are no longer able to pay the community, it seems inevitable that willingness to participate in greywater upgrading will drop significantly. The co-researchers expressed their belief that, now that the community has been introduced to the idea of being paid for their efforts, people will no longer be willing to volunteer their time without compensation.

MOVING FORWARD

In the coming year, the co-researchers will continue to use and optimise the process to implement greywater management solutions throughout Langrug. WPI, CORC, and the Stellenbosch Municipality will support these efforts. The co-researchers have already initiated a large-scale project along a road on the eastern side of Langrug, and they have been able to get extensive community involvement in this project, even instituting a community member as project overseer. The co-researchers plan to act more as guides and advisors in the process, helping community members to understand their options and plan for implementation, but not being deeply involved in the physical labour. In order to aid in these efforts, the WPI students have left the co-researchers with a guidebook detailing the process and describing various greywater management options in detail, as well as a manual which can be used to explain the most pertinent options to community members. Using these resources, the co-researchers plan to experiment with new techniques, where applicable, in order to deter-



Figure 9: The co-researchers walking down the main road, to the project site in I-section

mine the best methods for various conditions. The co-researchers have been awarded WPI Co-researcher Scholarships to continue their work over the coming year and to stay in contact with WPI students and faculty.

CONCLUSIONS

This project focused on addressing greywater issues by means of a self-reforming, reiterative process. The Process is designed to constantly adapt itself to the conditions of the community where it is being applied, and we expect that this adaptive, self-reforming nature can make the greywater upgrading both sustainable and relevant. As greywater upgrading in Langrug is carried forward, careful attention must be paid to adapting the process to the settlement.

Furthermore, communication and cooperation among the major stakeholders will be essential to

the ongoing work in Langrug. The municipality and CORC's resources and expertise will help to drive community efforts forward. The co-researchers will also stay in contact with the WPI students and advisors, keeping them notified of progress, and continuing to work with the WPI members of the greywater team to develop plans for their work. Another essential part of the cooperation behind continuing work on this project is communication with the members of the community who will be carrying out the interventions. It is their input and participation that will lead to relevant interventions and sustainable development.

Through constant cooperation and communication, and continual adaptation of the process to the community of Langrug, this project can lead to sustainable upgrading of the greywater management systems of Langrug.

REFERENCES

1. Barr Engineering Company. (2001, July). Urban Small Sites Best Management Practice Manual. Retrieved December 1, 2011, from Metropolitan Council—Environmental Services: <http://www.metrocouncil.org/environment/water/bmp/manual.htm>
2. Bolnick, A. (2010). Informal Settlement Upgrading. (MyGuru Website Designers) Retrieved November 19, 2011, from landFIRST: http://landfirst.org.za/index.php?option=com_content&view=article&id=103:informal-settlement-upgrading&catid=19:articles&Itemid=63
3. Bouchard, B., Goncalo, A., Susienka, M., & Wilson, K. (2007). Improving Flood Risk Management in Informal Settlements in Cape Town. Worcester: Worcester Polytechnic Institute.
4. Button, K., Jeyaraj, E., Ma, R., & Muniz, E. (2010). Stormwater Management in Monwabisi Park: C Section. Worcester Polytechnic Institute, Interdisciplinary and Global Studies Division. Worcester, MA: Worcester Polytechnic Institute.
5. Carolissen, D. (2011, October 25). Deputy Director: Stellenbosch Municipality Department of Integrated Human Settlements.
6. Winter, K., Armitage, N., Spiegel, A., Carden, K., Kruger, L., Mngqibisa, N., et al. (2008). Let's Fix It: Managing Greywater in Shanty Settlements, South Africa. South Africa: New Zealand Society for Sustainability Science and Engineering.
7. World Health Organization. (2006). Overview of greywater management Health considerations. regional consultation on national priorities and plans of action on management and reuse of water. Amman: World Health Organization.



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