Blackmon Road Community area Constructed Wetlands Assessment and Wastewater Management Report

For

A Place for Hope

1020 Archer Drive
Rock Hill, South Carolina 29730

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DFC&A

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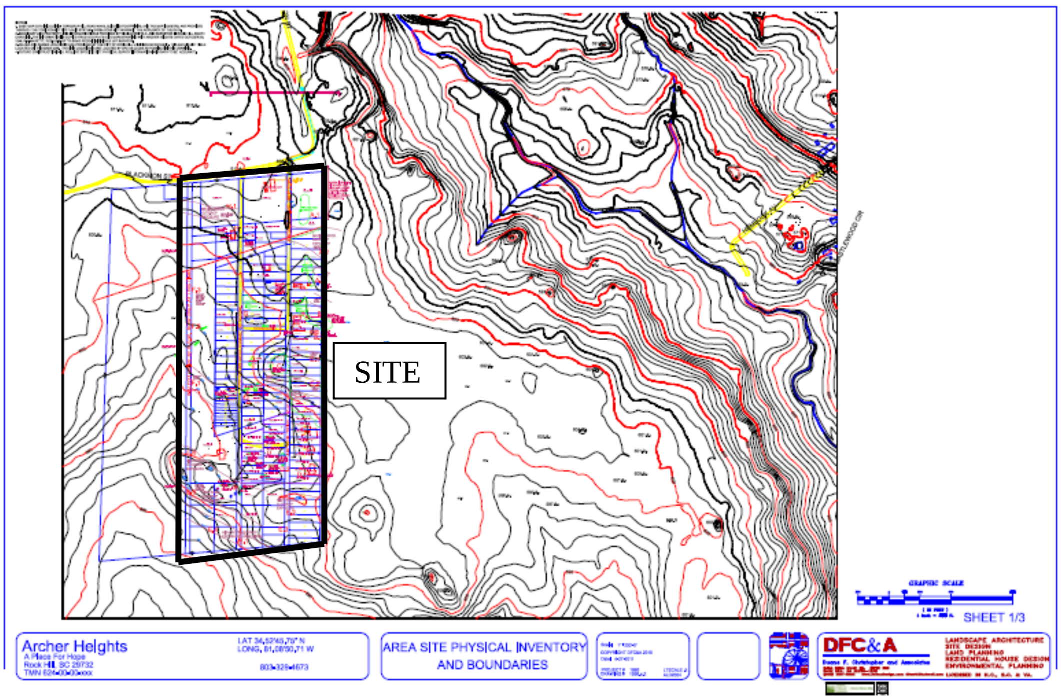
Full size maps are a part of this report.



INTRODUCTION

The site is located in York County, South Carolina adjacent to the Rock Hill City limits. Access to the area is from Blackmon Road which is south of Albright Road.

The project boundary is defined above. There are 48.4 acres defined by the boundary. There are approximately fifty (50) residents in seventeen (17) residential structures. The properties are in need of sustainable long term solutions to waste water treatment and management. Our task was to make an assessment of the environmental conditions and what options if any were available to solve the waste water management based on the site analysis.

The following report is our findings.

The opportunity for a sustainable community using alternative methods of managing wastewater (both black water and gray water) is possible. It is possible through some combination of the alternative collection, pretreatment and simple treatment systems to provide wastewater services and public health protection for this community. Onsite wastewater management using traditional septic tanks and drainfields is currently difficult or impossible due to the existing soil system (rock and/or the lack of suitable soil). Wastewater design constraints include poor soil conditions and a need for simple, low cost, yet sustainable solutions. Wastewater management options for this community include a) conventional alternatives (mound disposal), b) composting toilets to eliminate the discharge of black water, c) engineered wetland treatment systems (individual or clustered), d) decentralized treatment clusters, and/or e) small diameter sewer (pressure or STEP/STEG) to existing sewer lines. Because of the desired goal of wastewater management simplicity, cost effectiveness, and sustainability; it should be noted that gravity flow collection and wetland treatment/disposal are highly valued options, whether centrally located or serving several clusters of living units. Each of the options are described below.

WASTEWATER MANAGEMENT OPTIONS

The following options are discussed to show wastewater management options (and approximate costs) for this small community. As a result of site inspections and analysis, the Blackmon Road area exhibits poor soil conditions, in the form of a) soil type (clays), b) rock outcroppings, and c) high water table. Thus, traditional onsite wastewater management (septic tank and drainfield) is not a viable option for this area. While there may be one or two locations in the area exhibiting soils that could be used for wastewater infiltration, individual septic tank and drainfield systems at each dwelling are not feasible.

In looking at wastewater management options for this area, several strategies should be considered to protect public (and environmental) health. Combinations of alternative collection systems, treatment technologies, disposal technologies, water reduction techniques, and water reuse are needed to provide an effective wastewater management solution. Final wastewater management solutions for this community will depend not only on functionality and costs, but also the availability of funds (private, public, and grant), and feedback from the community itself.

The following descriptions of individual and small community wastewater management alternatives should help identify the best options for the Blackmon Road community. The traditional septic tank and drainfield is described (for comparison), even though it may not be applicable to this area. The traditional septic tank and drainfield system is the least expensive wastewater management solution for an individual dwelling when appropriate soil conditions are available for infiltration of septic tank effluent.

Traditional Onsite Septic Tank and Drainfield

Approximate Cost: $4500* per dwelling

*** depending on flow and site soil conditions**

Advantages: *low cost, low maintenance, sustainable, simple, effective*

Disadvantages: *lack of soil for in-ground tanks and effluent disposal,*

Comments*: can be used, where applicable, to reduce the size and cost of a community system (collection and/or treatment and/or disposal)*

There are 3 primary components of a traditional onsite system:

- a septic tank for solids settling and grease floating
- a subsurface wastewater infiltration system (SWIS), and
- the soil.

The performance of traditional systems relies primarily on the treatment of the wastewater effluent in the soil horizon(s) below the dispersal and infiltration components of the SWIS. Design of traditional onsite systems includes siting, hydraulic and mass loading to the soil, geometry, distribution methods, and setbacks from surface hydrologic features and subsurface groundwater (or impermeable geologic features). Wastewater treatment occurs partially in the septic tank, but predominantly in the soil horizon(s) by physical, chemical, and biological means.

Traditional gravel-filled infiltration trenches have been replaced by “gravel-less” infiltration systems primarily because of ease of installation and cost. Care must be taken to install both septic tanks and infiltration trenches appropriately so that function is not compromised.

By far, traditional onsite systems are the simplest and least expensive wastewater management solution if suitable soils are available so that a 1000 gallon septic tank (typical) and in-ground drain fields can be installed. Very little maintenance/management is required so the homeowner is not burdened with recurring costs or maintenance activities. Depending on use, the septic tank should be inspected routinely (every 5 years, at least) and pumped (accumulated solids removal) when needed (every 10 years, at least). Maintenance cost to the homeowner for inspection and pumping are approximately $40/year (or $3.33/month). This option may only be applicable to a very few residences in the Blackmon road community, but those able to utilize the option should probably do so. Figures 1 and 2 below show a typical onsite system installation, while figure 3 shows gravelless infiltration options.

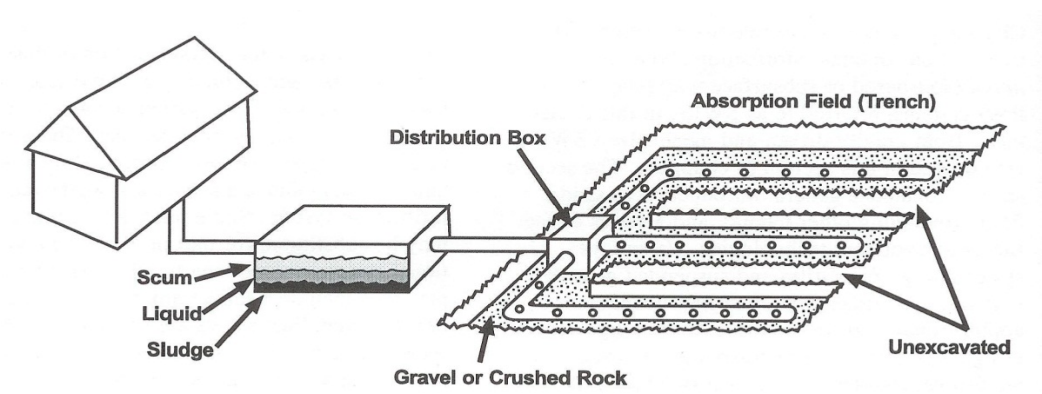


Figure 1. Typical onsite system installation (USEPA, 2002).

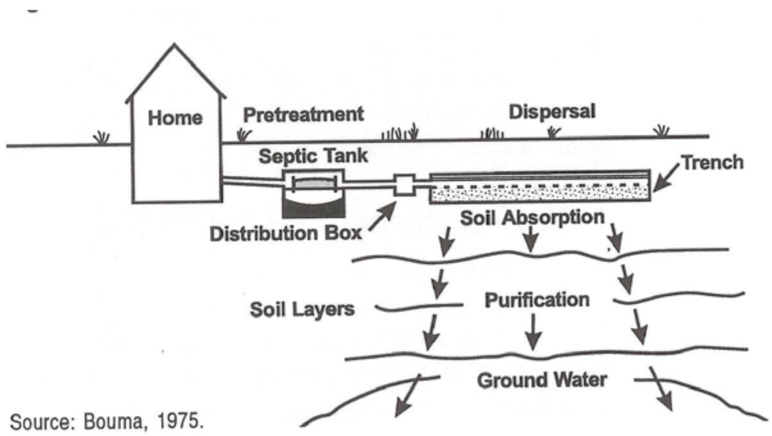


Figure 2. Typical onsite wastewater system installation (profile). (USEPA, 2002)

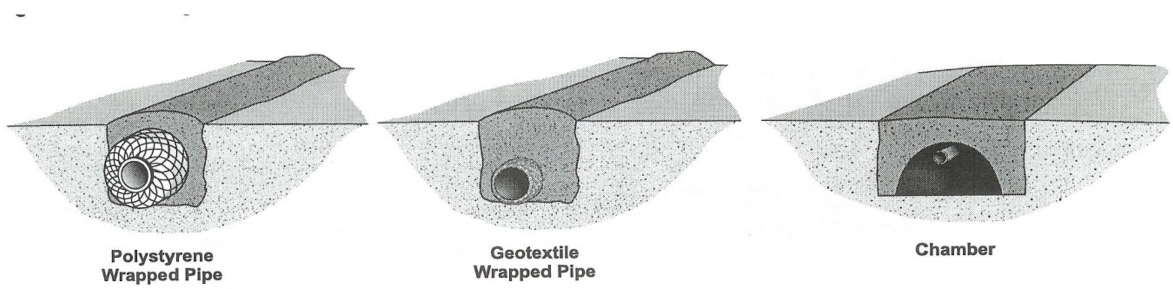


Figure 3. Gravelless infiltration trench options. (USEPA, 2002)

Option 1. Composting Toilets and Gray Water Disposal/Infiltration/Irrigation

Approximate Cost: $6000* per dwelling ($2000 toilet + $4000 drainfield)
***depending on flow and site soil conditions**

Advantages: *low cost, smaller disposal area, simple, sustainable, effective*
Disadvantages: *some maintenance required, lack of soil for disposal*
Comments*: can be used, where applicable, to reduce the size and cost of a community system (collection and/or treatment and/or disposal); public health issues eliminated*

Composting toilets are a viable option for situations where onsite soil disposal of water is a problem. Composting toilets have been an established technology for more than 30 years, and recent advances have made them easy to use and similar in look and feel to regular toilets. As they require little to no water, composting toilet systems can provide a solution to sanitation and environmental problems in un-sewered, rural, and suburban areas (USEPA). A composting toilet is a predominantly aerobic processing system that treats excreta, typically with no water or small volumes of flush water, via composting or managed aerobic decomposition. This is usually a faster process than the anaerobic decomposition at work in most wastewater systems, such as septic systems.

Composting toilets are often used as an alternative to central wastewater treatment plants (sewers) or septic systems. Typically they are chosen (1) to alleviate the need for water to flush toilets, (2) to avoid discharging nutrients and/or potential pathogens into environmentally sensitive areas, or (3) to capture nutrients in human excreta. Several manufactured composting toilet models are on the market, and are available at home supply retail outlets (Lowes, HomeDepot, etc.). Some are electric and some are non-electric. Figure 4 illustrates one composting model that is readily available (other models should also be considered).

Figure 4. A composting toilet.

The use of a composting toilet would 1) eliminate the discharge of nutrients and/or potential pathogens to the environment, and 2) minimize the amount of household water in need of disposal by approximately 30%. This option effectively addresses public health concerns and would require only gray water treatment/disposal, which in most cases could be via smaller-sized traditional infiltration trenches, mound infiltration, wetland treatment and infiltration, or landscape irrigation. Research has shown that household wastewater discharges for those using traditional septic systems average 70 gallons per person per day, so a family of 4 would produce 280 gallons of wastewater per day in need of disposal. With a composting toilet, the gray water produced, in need of disposal, would more likely be 49 gallons per day per person (or 196 gallons per day per family of 4). This composting toilet followed by gray water disposal/infiltration/irrigation either onsite or at a community disposal/infiltration/irrigation area is a very cost effective and public health protective option.

Option 2. **Onsite Septic Tank and Mounded Drainfield**
Approximate Cost: $9,000* per dwelling
***depending on flow and site soil conditions**
Advantages: *simple operation, low maintenance, sustainable, effective*
Disadvantages: *cost, not visually aesthetic, takes up land area, may seep effluent*
Comments*: an applicable alternative in many instances, where some infiltration can occur, but land area can be intensive and the mound can be somewhat unsightly*

When soil is not available to provide appropriate wastewater infiltration and treatment, or when geologic impairments (near-surface bedrock or impermeable soil layers) to infiltration and treatment of wastewater effluent exist, imported fill (or mounded) systems are used to "engineer" a soil-infiltration system. These fill or mounded infiltration systems follow a traditional septic tank. Typically, fill systems involve the importation of suitable off-site soils and placement of these soils over some existing soil adsorption area to overcome limited depth of soil or limited depth to groundwater (Crites and Tchobanoglous, 1998). Care must be taken in selecting suitable soil to use in a fill system, and in how (and when) the placement of fill is performed. Native soil should be scarified prior to the importation of fill and the first 6-inches of fill should be "mixed" with the scarified native soil so that no artificial interfaces (barriers to infiltration) are created.

Mound systems are, in effect, sand or soil filters built by importing sand, gravel, or other soil material to a site and creating an "above-natural-grade" soil system for infiltration of septic tank effluent. Components of a typical mound include a layer of imported soil material, distribution laterals, barrier material, and a soil cap. Mounded infiltration systems are typically pressure dosed (via pump) 4 to 12 times per day. Care must be taken to match the existing soil infiltration rate to the mound loading rate. Figure 5 shows a mound system.

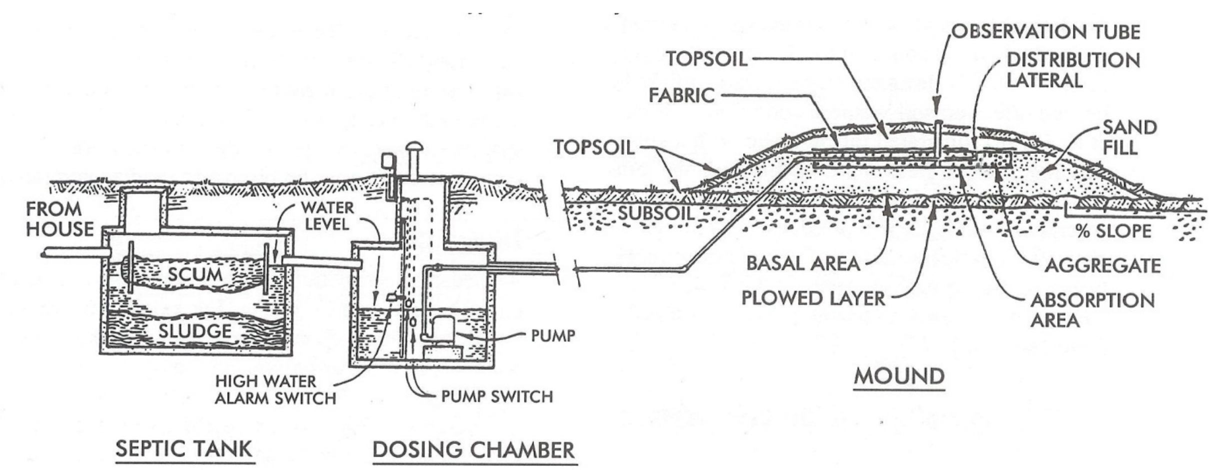


Figure 5. Septic tank and infiltration mound system (USEPA).

While a traditional septic tank and mound system is a viable onsite alternative, it is more costly because of the need for both imported fill material and a pumping system. These systems also require some existing soil (4 to 6 inches, minimum) to accept the treated effluent once it passes through the mound. Some maintenance (~every 5 years) and replacement (~every 10 years) of the pumping system is needed. Costs for maintenance ($75 every 5 years), pump replacement ($350 every 10 years), and power costs ($2.50/month) result in operating costs of approximately $6.70 per month per dwelling ($80/year). Note that a pump many not be necessary if appropriate elevations exist on site. The septic tank and mounded drainfield option is viable, but somewhat more expensive, somewhat unsightly, and dependant on the availability of some amount of existing permeable soil.

Option 3. Alternative Onsite Treatment and Disposal: Engineered Wetlands

Approximate Cost: $10,000 per dwelling

Advantages: *low maintenance, sustainable, simple, effective, aesthetic*
Disadvantages: *cost, size, needs some existing soil for effluent infiltration*
Comments*: can be used for individual residences or for community treatment systems*

Engineered wetland treatment systems are simple and cost effective treatment and disposal systems for both individual residences and small community systems. Engineered wetlands are attached-growth biological filters that utilize vegetation adapted to grow in saturated (or nearly saturated) environments. With the inclusion of vegetation, treatment wetlands have the appearance of a natural wetland habitat and employ many of the biological processes found in natural wetland ecosystems. Within the regulatory and design community, interest in wetland treatment systems has been sustained because of simplicity. Wetland treatment systems can produce a biologically treated effluent (to secondary or better standards) with sufficiently low pathogen content using a minimal amount of mechanical or energy input and operator support (Wallace and Knight, 2006).

Figure 6. VSB wetland.

For onsite or small community applications**, Vegetated Submerged Beds** (VSB) wetlands (also called subsurface flow wetlands) are typically used. This type of engineered wetland consists of shallow gravel beds planted with wetland vegetation. Typically designed to treat primary effluent, a septic tank or other solids remove process is required, and soil infiltration typically follows treatment. A wetland infiltration bed also be designed. Wastewater stays beneath the gravel bed surface and flows in and around the roots and rhizomes of the plants. Because the water is not exposed during the treatment process, the risk associated with human exposure to pathogenic organisms is minimized. Properly operated VSB wetlands do not provide suitable habitat for mosquitoes and other vector organisms (Wallace and Knight, 2006).

VSB wetland systems are generally low cost and low maintenance, and are most applicable to single-family homes or small cluster systems. Figure 6 shows a typical application and a detailed schematic is shown in figure 7. VSB wetlands are typically comprised of inlet piping, a clay or synthetic membrane liner, gravel media, emergent vegetation, berms, and outlet piping with water level control.

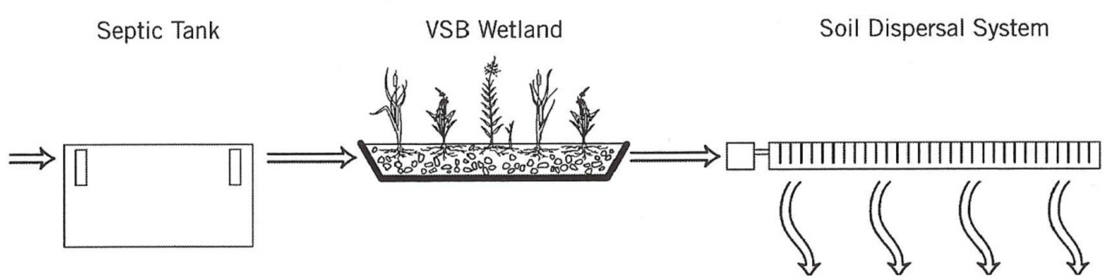


Figure 6. Typical VSB wetland application (Wallace and Knight, 2006).

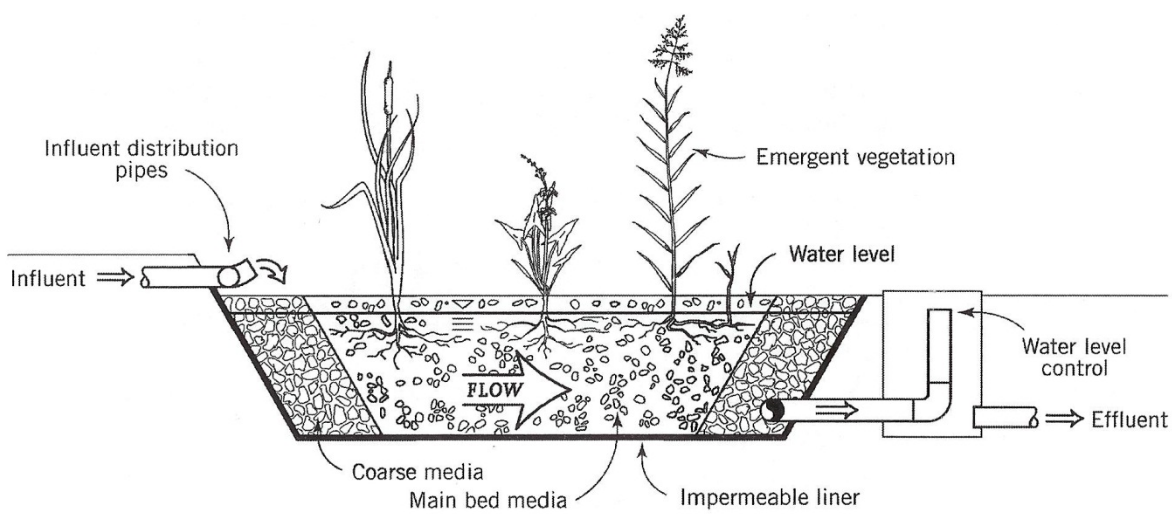


Figure 7. VSB wetland schematic (Wallace and Knight, 2006).

VSB wetland systems can be utilized at individual residences or as a treatment system for a number of dwellings in a "cluster system" arrangement, dependant on the availability of some amount of soil for infiltration of treated effluent. Costs for maintenance ($75 every 5 years), pump replacement ($350 every 10 years), and power costs ($2.50/month) result in operating costs of approximately $6.70 per month per dwelling ($80/year). Note that a pump many not be necessary if appropriate elevations exist on site. The onsite VSB wetland or community wetland is a viable alternative due to its low maintenance and maintenance cost.

Option 4. Alternative Onsite Treatment and Disposal: Other Treatment Options

Approximate Cost: $13,000 per dwelling

Advantages: *effective at advanced wastewater treatment*
Disadvantages: *cost, significant maintenance, lack of soil for in-ground tanks and effluent disposal*
Comments*: effective treatment at a cost, not homeowner friendly; ok for a managed cluster system, however*

Many other commercially available onsite wastewater treatment options are available. These treatment alternatives can be categorized as either a) suspended aerobic biological units (aerated), b) fixed-film biological units, or c) a combination suspended aerobic/fixed-film biological units. Most common are aerobic units and various types of media filters (sand, peat, fabric, foam, plastic, etc.). These treatment systems can be applied to the individual home or to a community treatment system, however most are somewhat more costly from a capital cost point of view, require power and maintenance, require effluent infiltration, and are best used where a utility can oversee long-term maintenance.

Aerobic Treatment Units

In an **Aerobic Treatment Unit** (ATU), waste-water enters a compartment where solids settle and are partially digested by microorganisms. A motor pumps air into the chamber and mixes the liquid, facilitating diffusion of air and supporting aerobic bacteria that further degrade the wastewater. The treated effluent exits the ATU for additional treatment and dispersion through a soil absorption field.

Advantages: ATUs can reduce the total suspended solids and biochemical oxygen demand. A reduction in suspended solids improves the efficiency and life of the soil absorption field.
Disadvantages: ATUs require electricity and have moving parts, requiring frequent inspection and high equipment replacement costs.
Purchase Cost: The cost of an ATU is between $3,500 and $10,000.
Operation and Maintenance Cost: Operation and maintenance costs average between $500 and $700 per year. This includes the cost of electricity to run the air pump and regular inspection costs.

Fixed-Film Media Filters

Media Filters are secondary treatment units involving fixed film treatment processes designed to follow primary treatment in a septic tank and to provide more highly treated effluent for either soil dispersal, or disinfection and surface water discharge. Media Filters provide a fixed material on which a thin biological film is established by organisms in colonies growing on the surface of the media as wastewater passes through the bed. Sand, peat, foam, textiles, and plastic are common media types. The organisms are in contact with wastewater as it percolates over the surfaces and flows slowly in an unsaturated state through the media. The process requires small, frequent doses of effluent to promote unsaturated or "film" flow over the surfaces of media. Air within the pores of the media provides oxygen transfer to the organisms attached to surfaces so that they dominate biological activity is that of aerobic organisms digesting contaminates in the wastewater as the effluent moves slowly through the system. Aeration may be either passive or active depending upon system design or loading rate. The mode of treatment is a combination of filtration and trapping, adsorption, biological decomposition and biochemical transformations.

Media Filters are a beneficial option for onsite systems in environmentally sensitive areas or where it is desired to discharge effluent into soils that are not considered hydraulically acceptable for septic tank effluent. Media Filters are used to produce effluent that is low in biochemical oxygen demand (BOD) and suspended solids (TSS), and has a greatly reduced concentration of pathogenic organisms compared to septic tank effluent. The resulting effluent can be discharged to soils at higher rates than septic tank effluent without developing a biological clogging mat (biomat) at the infiltrative surface of the soil absorption system.

Advantages: Media filters reduce the TSS, BOD, and pathogens from wastewater. A reduction in suspended solids improves the efficiency and life of the soil absorption field.
Disadvantages: Media filters require electricity (pumping) and have moving parts, requiring frequent inspection and equipment replacement costs.
Purchase Cost: The cost of an ATU is between $6000 and $12,000.
Operation and Maintenance Cost: Operation and maintenance costs average approximately $150 per year. This includes the cost of electricity to run the air pump and regular inspection costs.

Option 5. Decentralized Treatment Clusters

Approximate Cost: variable, $10,000-$13,000 per dwelling

Advantages: *moderate cost, moderate maintenance, sustainable, effective, applicable to small communities*
Disadvantages: *needs some maintenance and oversight, lack of soil for in-ground tanks and effluent disposal*
Comments*: optimum for a utility-managed community system*

Decentralized wastewater "cluster" systems are defined as the collection, treatment, and disposal/reuse of wastewater from clusters of homes (or small communities) at or near the point of waste generation (Tchobanoglous, 1995). Optimizing each of these key elements in a small community setting has both size and cost savings.
Alternative sewer systems, particularly small-diameter STEP or STEG systems are often a cost-effective alternative. In this type of collection system, a septic tank at each residence would

collect raw wastewater and settle solids. The liquid effluent (without solids) could then be pumped (from an in-tank filter vault and pump) through a small diameter (2" to 4") PVC pressure line to the treatment unit. High head, stainless steel effluent pumps (½ hp, 10 gpm), housed within an effluent filter, offer long life and reliability. Only liquids are pumped. This type of collection system offers several advantages:

1. Solids are collected in the septic tank and thus do not figure into the treatment component of the system. Treatment costs are thus lower and operation of the treatment system is simpler.

2. Solids management (sludge pumping from the septic tank) occurs infrequently (every 5 to 10 years), thus minimizing management. The schedule for sludge pumping should be controlled by the managing authority and may be performed by the managing authority. Monthly sewer fees (on the utility bill) would cover this infrequent cost.

3. Wastewater pumping costs (pump electricity) are borne by the homeowner (approximately $2.50 per month on the power bill).

4. Small diameter PVC installation costs are significantly lower than conventional sewer line installation ($6-$17 per foot versus $20 per foot or more for conventional sewer).

<u>Treatment System</u>

Recirculating media filters, engineered wetlands, or other low O&M treatment systems are best to optimize treatment and minimize maintenance and costs. Advantages of this type of treatment system include:

1. Simple operation, low maintenance. Recirculating/pressure disposal pumps (½ to 3/4 hp typical) are the only mechanical component. Distribution header cleaning (approx 1 hour) are necessary quarterly. Unskilled maintenance personnel can be used.
2. Cost effective. Construction costs vary from $10 to $22 per treated gallon, depending of local costs.
3. No odors.
4. No sludge handling.
5. Below ground/at grade installation.....nothing visible above ground.

<u>In-Ground Disposal or subsurface drip irrigation reuse</u>

Treated effluent can be infiltrated locally or used for landscape (or crop) irrigation. Subsurface drip irrigation is quite acceptable for landscape irrigation. Advantages of onsite disposal include:

1. Local disposal.
2. Opportunity for reuse.
3. Proven technology.
4. UIC permit instead of NPDES permit (lower reporting requirements).

Utility Management

The key component to the successful implementation of any decentralized wastewater treatment system is the long-term operation and maintenance. Since existing utility entities already provide some type of field maintenance, and have a billing structure in place, it makes sense that the utility provide the stable, long-term maintenance (and management) necessary.

Total construction costs for such clustered decentralized systems typically range from $8500 to $12,000 per home. This includes the septic tanks, pumps, small diameter collection system (about half of the total cost), the treatment system (textile filter etc.), and subsurface drip-irrigation disposal. These costs have been seen in both west coast implementations (Oregon) and new systems (10) in Mobile, Alabama (operational since 2001).

Decentralized treatment clusters are an optimal way to minimize the cost and complexity of small community wastewater treatment and disposal. It is also a way that viable utilities can manage such treatment and disposal, insuring that the system is operational at all times.

Option 6. Small Diameter Sewer Connecting to Existing Sewer

Approximate Cost: variable, $4000 to $7000 on-lot cost + small diameter piping (2 to 4 inch) at $8-$17 per foot

Advantages: *low up-front cost, relatively simple to install, effective*
Disadvantages: *lack of soil for in-ground tanks/pump basins, pressure sewer (w/ grinder pumps) typically exhibit frequent replacement (5-7 years) and high life-cycle costs*
Comments*: utility management needed, pressure sewer has high life-cycle cost; STEP has lower life-cycle costs, but require some type of settling tank (in- or above-ground); effective*

Alternative wastewater collection systems can be cost effective for homes in areas where traditional collection systems are too expensive to install and operate. Pressure sewers are used in sparsely populated or suburban areas in which conventional collection systems would be expensive. These systems generally use smaller diameter pipes with a slight slope or follow the surface contour of the land, reducing excavation and construction costs. Pressure sewers differ from conventional gravity collection systems because they break down large solids in the pumping station before they are transported through the collection system. Their watertight design and the absence of manholes eliminates extraneous flows into the system. Thus, alternative sewer systems may be preferred in areas that have high groundwater that could seep into the sewer, increasing the amount of wastewater to be treated. They also protect groundwater sources by keeping wastewater in the sewer. The disadvantages of alternative sewage systems include increased energy demands, higher maintenance requirements, and greater on-lot costs. In areas with varying terrain and population density, it may prove beneficial to install a combination of sewer types (USEPA)

Pressure sewers are particularly adaptable for rural or semi-rural communities where public contact with effluent from failing drain fields presents a substantial health concern. Since the mains for pressure sewers are, by design, watertight, the pipe connections ensure minimal leakage of sewage. This can be an important consideration in areas subject to groundwater contamination. Two major types of pressure sewer systems are the **septic tank effluent pump (STEP)** system and the **grinder pump (GP)**. Neither requires any modification to plumbing inside the house.

In STEP systems, wastewater flows into a conventional septic tank to capture solids. The liquid effluent flows to a holding tank containing a pump and control devices. The effluent is then pumped and transferred for treatment. Retrofitting existing septic tanks in areas served by septic tank/drain field systems would seem to present an opportunity for cost savings, but a large number (often a majority) must be replaced or expanded over the life of the system because of insufficient capacity, deterioration of concrete tanks, or leaks. In a GP system, sewage flows to a vault where a grinder pump grinds the solids and discharges the sewage into a pressurized pipe system. GP systems do not require a septic tank but may require more horsepower than STEP systems because of the grinding action. A GP system can result in significant capital cost savings for new areas that have no septic tanks or in older areas where many tanks must be replaced or repaired. Figure1showsatypicalseptictankeffluent pump, while Figure 2 shows a typical grinder pump used in residential wastewater treatment (USEPA).

Figure x. STEP sewer, showing the pump tank and small diameter sewer.

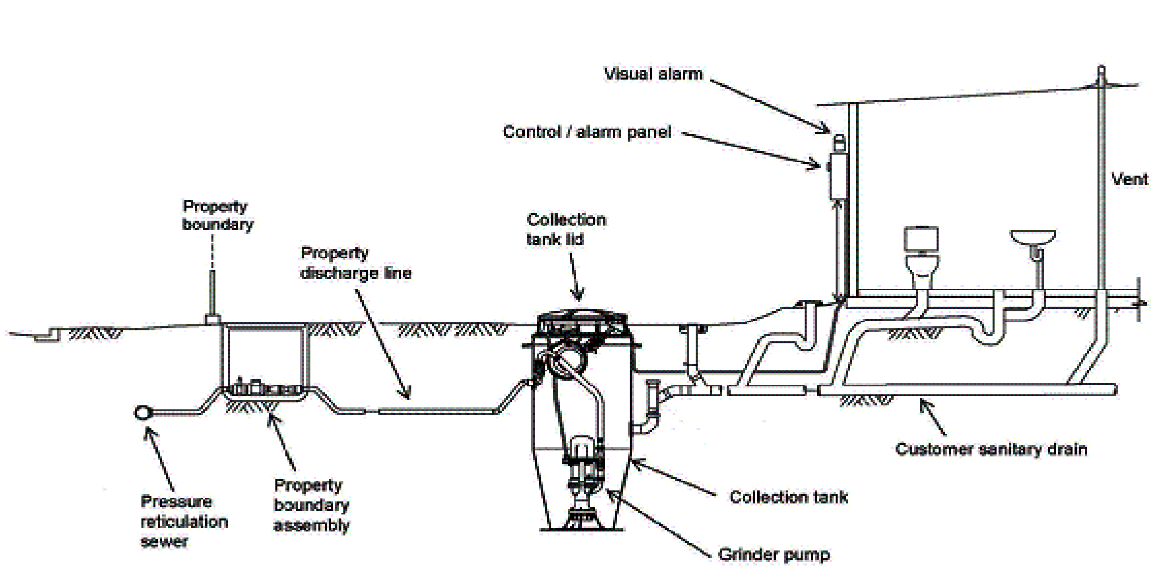


Figure x. Typical pressure sewer (grinder pump) schematic from home (right) to sewer line (left).

Figure x. Typical grinder pump (GP) basin.

The choice between GP and STEP systems depends on three main factors, as described below:
Cost: On-lot facilities, including pumps and tanks, will account for more than 75 percent of total

costs, and may run as high as 90 percent. Thus, there is a strong motivation to use a system with the least expensive on- lot facilities. STEP systems may lower on-lot costs because they allow some gravity service connections due to the continued use of a septic tank. In addition, a grinder pump must be more rugged than a STEP pump to handle the added task of grinding, and, consequently, it is more expensive. If many septic tanks must be replaced, costs will be significantly higher for a STEP system than a GP system (USEPA).

Downstream Treatment: GP systems produce a higher TSS that may not be acceptable at a downstream treatment facility.

Low Flow Conditions: STEP systems will better tolerate low flow conditions that occur in areas with highly fluctuating seasonal occupancy and those with slow build out from a small initial population to the ultimate design population. Thus, STEP systems may be better choices in these areas than GP systems.

APPLICABILITY

Pressure sewer systems are most cost effective where housing density is low, where the terrain has undulations with relatively high relief, and where the system outfall must be at the same or a higher elevation than most or all of the service area. They can also be effective where flat terrain is combined with high ground water or bedrock, making deep cuts and/or multiple lift stations excessively expensive. They can be cost effective even in densely populated areas where difficult construction or right of way conditions exist, or where the terrain will not accommodate gravity sewers. Since pressure systems do not have the large excess capacity typical of conventional gravity sewers, they must be designed with a balanced approach, keeping future growth and internal hydraulic performance in mind.

ADVANTAGES AND DISADVANTAGES (USEPA)

Advantages

Pressure sewer systems that connect several residences to a “cluster” pump station can be less expensive than conventional gravity systems. On-property facilities represent a major portion of the capital cost of the entire system and are shared in a cluster arrangement. This can be an economic advantage since on-property components are not required until a house is constructed and are borne by the homeowner. Low front-end investment makes the present-value cost of the entire system lower than that of conventional gravity sewerage, especially in new development areas where homes are built over many years. Because wastewater is pumped under pressure, gravity flow is not necessary and the strict alignment and slope restrictions for conventional gravity sewers can be relaxed. Network layout does not depend on ground contours: pipes can be laid in any location and extensions can be made in the street right-of-way at a relatively small cost without damage to existing structures. Other advantages of pressure sewers include:

- Material and trenching costs are significantly lower because pipe size and depth requirements are reduced.
- Low-cost clean outs and valve assemblies are used rather than manholes and may be spaced further apart than manholes in a conventional system.
- Infiltration is reduced, resulting in reductions in pipe size.

- The user pays for the electricity to operate the pump unit. The resulting increase in electric bills is small and may replace municipality or community bills for central pumping eliminated by the pressure system.
- Final treatment may be substantially reduced in hydraulic and organic loading in STEP systems. Hydraulic loadings are also reduced for GP systems.
- Because sewage is transported under pressure, more flexibility is allowed in siting final treatment facilities and may help reduce the length of outfall lines or treatment plant construction costs.

Disadvantages

- Requires much institutional involvement because the pressure system has many mechanical components throughout the service area.
- The operation and maintenance (O&M) cost for a pressure system is often higher than a conventional gravity system due to the high number of pumps in use. However, lift stations in a conventional gravity sewer can reverse this situation.
- Annual preventive maintenance calls are usually scheduled for GP components of pressure sewers. STEP systems also require pump-out of septic tanks at two to three year intervals.
- Public education is necessary so the user knows how to deal with emergencies and how to avoid blockages or other maintenance problems.
- The number of pumps that can share the same downstream force main is limited.
- Power outages can result in overflows if standby generators are not available.
- Life cycle replacement costs are expected to be higher because pressure sewers have a lower life expectancy than conventional systems.
- Odors and corrosion are potential problems because the wastewater in the collection sewers is usually septic. Proper ventilation and odor control must be provided in the design and non-corrosive components should be used. Air release valves are often vented to soil beds to minimize odor problems and special discharge and treatment designs are required to avoid terminal discharge problems.

While small diameter sewer is a viable and capital cost effective option, life cycle costs are higher than all other alternatives. Utility management is required.

CONCLUSIONS

THE SITE:
The concluding description of the site after several visits and observation maybe obvious to many who live at the Blackmon Road Community and who have visited, but a true finality of the evidence is that the soils are rich in surface boulders and hard rock. There is very little space between the exposed rocks over much of the properties. The most telling evidence is that the soil samples showed water table at the surface and Expansive Clay. Because of the limited soil depth, rock outcrops, and high water table: soils that are typically utilized for onsite treatment/infiltration are not readily available in this area. Site conditions dictate that water use reduction is appropriate, that onsite or community wastewater treatment is necessary to protect public (and environmental health), and/or that wastewater removal (via sewer) to other locals more appropriate for treatment/disposal/reuse is needed.

WASTE MANAGEMENT OPTIONS:
We conclude this first phase by making the observation that three or four options are actually feasible for the community. Of those options, two could be more economical than the others.

The most economical option is number 1, the composting toilet and some type of onsite or community in-ground treatment/disposal system. It has a low cost entry and the gray water can be dispersed into a soil mound or small constructed wetland located near the individual residence if the grades allow for a gravity flow. One (or more) community soil mounds or wetland systems could potentially serve some cluster of homes.

The second feasible option is option number 3, the onsite or community Engineered Wetlands system, which in either case would be preceded by a septic tank. The drawback to this system is the topographic features and surface rock conditions may make the installation of a pretreatment septic tank difficult or impossible at many locations in the Blackmon Road area.

The third feasible option is number 6, the Connecting to the Existing Sewer line by a small diameter sewer (pressure sewer or STEP). This option, as described above requires either 1) a shallow pump basin and grinder pump onsite (for the pressure sewer system) or 2) a septic tank w/pump (for the STEP system) and a small-diameter pressure pipe system that connects to the existing gravity flow system at the North end of the community. This option avoids the poor soil conditions throughout the area and removes the wastewater completely from the community for treatment and disposal by an existing utility. This option has reasonable up front costs, but requires long-term utility management. And in the case of the pressure sewer option (w/ grinder pumps), life cycle costs are quite high due to the frequent and costly replacement of grinder pumps). A STEP collection system connected to existing sewer lines is a very good option if some form of pretreatment (septic tanks, etc.) at each dwelling can be implemented.

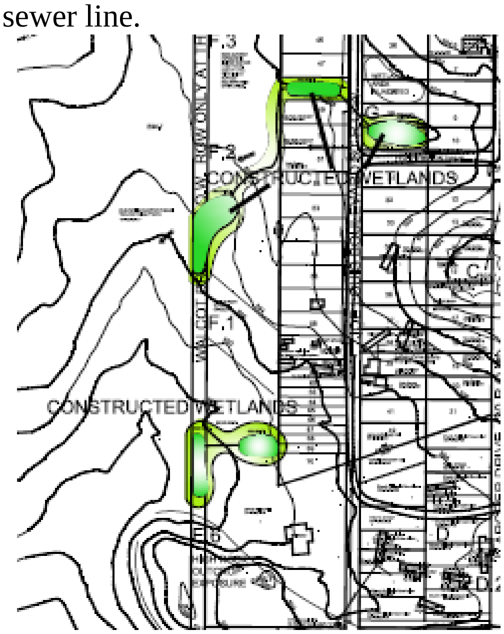
RECOMMENDATIONS

1. Present options to the approval authorities for administrative comments.
2. Present concepts to the property owners and Place of Hope Board for comments.
3. Design and prepare site specific plans for the existing residential wastewater management needs.
4. Prepare a maintenance program for the proposed wastewater management plan.
5. Prepare a comprehensive budget and cost for the proposed systems.

It is proposed that we also evaluate an overall site, sustainable, option in addition to addressing individual dwellings. This more comprehensive view attempts to design with the land and look at possible street reconfigurations that may make simpler, less costly options more viable.

This option might benefit of all property owners and all owners will have to contribute in order to help create the new living space opportunities. Part of this process might use the rock from the site to create the wetland treatment/disposal systems by excavation, rock crushing, and use in the construction of the wetlands. An additional by product of the rock excavation would be the sale of rock to landscape construction companies for their use in landscape installations. In addition, there could be the royalties of selling the crushed rock to the construction industry for driveways and other pavement needs. And finally the rock would be used in the construction of the new road and driveways in this project.

The potential for a new community layout is to organize the properties with the existing occupied dwellings so that they would have the best opportunity to use a gravity flow wastewater collection system. This might require raising the elevation of some homes and the possibility that the septic tanks will be at or above grade. In this situation, fill material would be used to mound around the tank. This raised septic tank and living space option would allow for a gravity flow or for a sump pump type option in the tank that would convey the treated gray water to the wetlands or to the existing sewer line.



Option 1 on site wetlands.

Approximately 0.5 acres of wetlands with and additional 1.5 acres of buffer area.
The treated water could also be used for irrigation for lawns or gardens.

There are no simple solutions to the issues faced by this community as it relates to wastewater management and public health. The conclusion is that there are several options that are feasible. Composting toilets, engineered wetlands, and small diameter collection systems all have some merit. Through the continuation of the design process these workable options can be further evaluated and the most appropriate solutions can be identified for implementation.

Based on existing information (previous reports and site investigations), it appears that optimal wastewater management solutions for the Blackmon Road community will include some combination of:

- Composting toilets followed by some type of onsite disposal at a few dwellings,
- One or more engineered wetlands serving a cluster of several dwellings, and/or
- A small-diameter, pressurized collection system that connects to existing sewer at the northern end of the property.

COST ESTIMATES (based on 20 dwellings served):

1. Engineering: System designs and drawings, plan processing, and construction oversight.
   Estimated Cost: $28,500 - $34,500
2. System Installation
   a. 5 dwellings with composting toilets/onsite disposal, and
      15 dwellings with localized collection/treatment (engineered wetlands)
      Estimated Cost: 5x$6000 + 15x$10,000 = $180,000

      Or

   b. Small diameter Pressure Sewer/STEP sewer connection to existing sewer nearby.
      Estimated Cost: 20x$9000 = $180,000

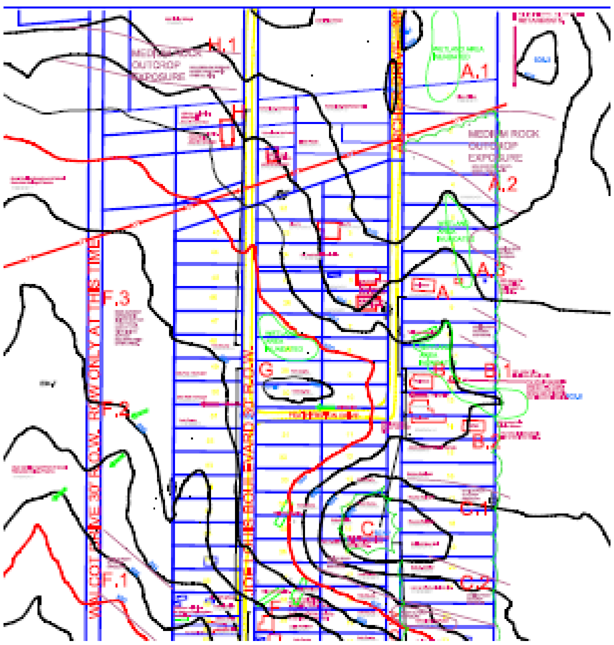
3. Long-term Operation and Maintenance (including replacement)
   a. Approximately $5000 per year (for 20 dwellings)
   b. Approximately $20,000 to per year (for 20 dwellings)

Appendix :

SITE INVESTIGATIONS

A site investigation was performed on April 11, 2011. The investigation took place from 10:00 am until 2:30 pm. Duane Christopher and Christopher Fincham, CPSS, made the site visit.

The following observations made on our walk from the northern end of Archer Drive starting at the Place of Hope community center and continuing counter clockwise as indicated by the referenced site map.



The land to the east along Archer Drive has standing water 3 to 6 inches in depth. These areas are wetlands based on the visual observation of the standing water, (hydrology), vegetation, and soils.

SITE A

The first home site on Archer is a single story with no working facilities for septic black or gray water. There is a 4” PVC gray water pipe that comes from under the structure and flows into the surface. They have a well located next to the house on the street side. There is standing water under the structure.


Back of house. Gray water clean out next to house.


Septic flow from house. Side of yard looking towards rear of lot.

The surface shows many boulders and hard rock. No soft crumbling boulders are near the surface that can be seen. There is very little space between the exposed rocks. Soil samples showed water table at the surface and Expansive Clay. Magnesium and iron concretions are very plentiful and throughout the soil samples taken.


The site is very level and has had grading that pushed top soil to the rear of the property with much trash and house hold debris along with the top soil. The soil is also inundated with standing water from 1-5” depths.

SITE B

Approximately 170 feet south along Archer Drive from Site A, we investigated a residential site located at 1081 Archer Dr. The site is very level with very little slope for positive drainage away from the home structure. In back of the house the water is standing with 2 – 6” in depth. The water is not flowing. The back yard is a storage area for electronic equipment, batteries, auto salvage, bicycle parts and other metal parts. The owner shared that the toilet backs up and doesn’t function all the time especially when it rains. We could not see any evidence of the septic tank due to the piles of salvage material and water standing.


Back yard inundated with standing water and trash materials.

The adjacent residence was clean and draining. The site did not have the standing water nor the salvage and trash. There are side drainage swales allowing for the water to drain towards the street and away from the house. The site has limited access do to a security fence.
See pictures below from the street.


Clear water draining off of side yard and back yard is clear of debris.

SITE C

Approximately 180 feet south along Archer Drive right of way, in which the gravel road is not constructed, we investigated an area that is a high point on the overall site after the northern stretch of Archer Dr. after leaving Place of Hope. The elevation rises six feet from 600 above sea level to 606 and 607. The area was recently cleared, smoothed and seeded for a vegetative cover.

The soil sample showed a lighter color soil with less iron and magnesium concretions, high plasticity with less bubbling of the hydrochloric oxide test, concluding that the water table is not close to the surface.

Boulders are evident on the surface with other boulders piled up near the central part of the space.


Soil sample.


View west towards lots 34 35.


View south lot 17.


View south west towards lot 37 38.

SITE D

Approximately 560 feet south along Archer Drive right of way, the property is more level descending from the 607 elevation to 594 to 595. This area's elevation is lower than the north side of the ridge of area C. The elevation starts on the east side of the property of 600 – 599 above sea level sloping east to 590 and 588. The area is mostly turf grass with scattered exposed rock at the surface. This section of homes, trailers, and a church is approximately 4.5 acres including the right of way.

The existing soil conditions are similar to that of Site B with the water table close to the surface. Exposed rock is scattered through the mowed lawn. There have been a couple of trenches dug for a septic drain field. These are full of water and the excavating shows the subsurface heavy laden with large boulders.

Four out of the six trailers are occupied. None of these trailers have function septic tank systems and associated drain fields. The black and gray water either flows directly into a non functioning pit or out into the lawn area.


Lot 32, TM 162. Attempted drain field showing boulders and water filled excavations.

Boulders on surface.

Attempted drain field trench abandoned.

Septic black and gray water. Typical surface water with high water table.

SITE E

Approximately 150 feet south east from Site D we visually checked the site that has two trailers. One trailer is occupied by an unknown number of people and the other by at least two others. The lot is TM 118. The land is slightly up a grade from the road right of way. Elevation the property is 594 to 595. The surface has exposed boulders covering the majority of the land. We did not perform any soil samples at this visit.

SITE F

Approximately 570 feet north on Joe Louis Boulevard from Site E we inspected and made observations. TM 058, 1157 and the surrounding area have less exposed boulders on the surface. The soil test showed us that the Manganese is of a larger granular size and is saturated through to a minimum depth of 18”. There is standing water of 1-3” to the east on the back property lines. Similar observations were made on the west side of Joe Louis Boulevard on TM 024 and 023.

Soil boring showing solid Manganese granules. Lawn area where soil sample was taken also shows location of well.

Scrub area in back of lot where gray water line empties.

View of Trailer and general area.

SITE G

Approximately 500 feet north on Joe Louis Boulevard from Site F we inspected and made observations. TM 066, 67, and 68, these lots has all been recently cleared and has new vegetative cover. The surrounding area has less exposed boulders on the surface. Soil sample showed Expansive Clay and a high water table within 2-3" of the surface. Shallow pockets in the landscape to the east of lot 48 have standing water. The areas in the lots that are wooded have standing water, Lot 28, 27 as examples.

SITE H

Approximately 500 feet north on Joe Louis Boulevard from Site G we inspected and made observations. TM 104, 105, and 107, has residential buildings. We could not find evidence of septic lines on the surface or gray water on the surface on Lot 1045.
Lot 1040 Joe Louis there is a well house in front of the house. The back yard has boulders on the surface and standing water. An area of heavy green wet foliage appears to be the recipient of the black and gray water. Trash is pushed in the back of the property to the west and standing water indicating a continued high water table. Soils are very Expansive Clay.

Well house in front yard next to the road.

Back yard, foreground showing possible gray water outlet.


View towards the west from the house, gray water outlet and standing water.

View to the west from back of house lot 1040, showing surface boulders, trash pushed back and standing water.

A site investigation was performed on April 22, 2011. The investigation took place from 9:45 am until 10:30 pm. Duane Christopher made the site visit.

The site visit was to observe and record on site physical features. The following observations were made and will relate to the base map lettering as sub-lettering to the first visit.

SITE H.1

The area is covered in a thicket of trees and briers. There is no standing water present. Boulders are very prevalent on the surface. Surface soil is loamy clay.

SITE E.1

South of area E there is an increase in surface boulders to where there are three distinct ridges of rock out crops going North West to south east. Boulders are connected in long lines with some as high as 4’. Much of the area is 95% exposed rock. Only scrub trees and shrubs are present. No standing water.

Site investigation was performed on April 25, 2011. The investigation took place from 9:15 am until 11:45 pm. Duane Christopher made the site visit.

SITE A.1

Entering TMNs 131 and 130 from the AT&T right of way going north reviled much of the area low and wet but not standing water as it was in the previous two visits. I also was able to define the area more on the map. Outside of the area shown as wet there is trash and boulders over 95% of the balance area showing exposed rock. Only scrub trees and shrubs are present. No standing water.

Trash and boulders.

Boulders.

Wet area.

SITE A.2-A.3

Going south from A.1, I entered lots 3,4,5 from the power right of way. This area is dryer with more exposed rock and boulders.



5’ boulders scrub woods with heavy Smilax vine throughout.



Scattered boulders and exposed solid rock out cropping in power ROW in back lot 6.

SITE B.1-B.2

Going south in back of the lots there is a continuation of the wet areas extending into the ROW. The topography shows the drainage going east and how the two houses have created the backup of the normal flow, even though the land is quite level to begin with.




This is the view west into the lots at B.1-B.2 location.

 Looking south down the power ROW.

SITE C.1-C.2

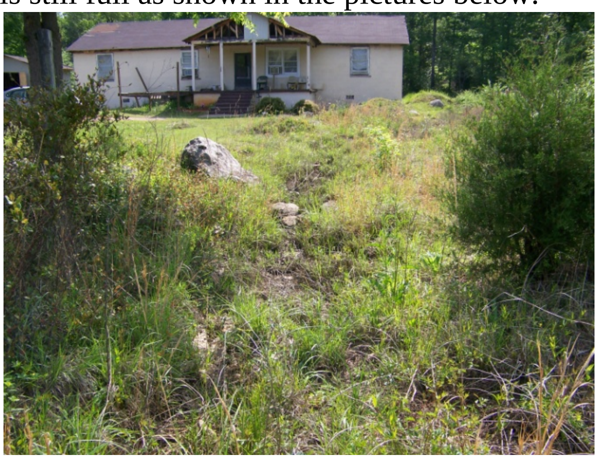
Moving south from B site rising in elevation there was an increase in exposed boulders as well as dryness. From C.1 to C.2 this rise has trash, boulders, and trees. There is very little exposed openness that has soil without rock.



Exposed rock near TMN 152, utility pole for location.

SITE D.1-D.2

Moving south along the right of way of Archer Drive I revisited the previous attempted trench lines and outflows from the trailers. The water levels have gone down since the rains but still have a residual two to four inches of water at the bottom. The one gray and black water outflow is still full as shown in the pictures below.



TMN 162, lot 32.

TMN 026. Out flow from trailer.

SITE E.1-E.4

Advancing south along the right of way of Archer Drive the trees have been cleared for the power lines. The land rises 6 feet in elevation with the ridge being a rock out crop in a north west to south east orientation.

View from cleared ROW north west. View south of ROW with rock outcrop.

Corner pole, southern most point then the lines turns 90 degrees to the west. View west shows the continued rock out crop.


Boulder rock outcrop in ROW looking north. At the end of the ROW **E.4** the ridge of boulders continues North West.

SITE E.5 – E.6


Boulder outcrops of several ridges of exposed boulders from 1’ up to 10’ long. **E.5**
This ridge continues North West of the project property boundary on to the Heritage Preserve.
The topographic information confirms this ridge with high points in the 594 and 596 elevations.

Boundary marker for the Heritage preserve, **E.5**. View looking north along project boundary.

E.5 to E.6 ridge.

A panorama view from project boundary looking east from top of rock outcrop ridge towards residence, at **E.6** location.

SITE F.1 – F.3

From the top of the ridge heading north along the Walcot Drive ROW, the land drops in elevation from 593 to a generally level area of 588. Coming off of the ridge there are still boulders and exposed rocks indicating there is not a major change in the surface structure. In between points F.1 and F.2 there is a minor drainage way with indications of water flow during rain events, but not enough indications for an intermittent stream to be identified.

View south towards **E.6** and house, land is being cleared with burn piles over rock outcroppings.

From **F.2** location, a view east towards Feathersone Dr. **F.3** location mostly low boulder exposure with clear cutting of trees.

CREDITS

I want to thank the following people that were involved with the project; the residents of the Blackmon Road community for allowing us to walk around your properties, to DHEC officials; Karen Sprayberry, Harry Mathis, Leonard Gordon, Chris Fincham and Greg Harrington for helping in coordination, site visits, and enabling the grant to The Place of Hope to fund the study. Also a thank you to Rev. James Hill for allowing us to come to his church to share our findings and The Place of Hope Board of Directors and Mary Hoppmann for their support. Also a thank you to Chris Johnson, past Chairman of the Board that kept the project alive in 2010.

Additionally I want to thank Bill White for providing survey documentation going back to the original subdivision in 1947, to Robert Moody with the Catawba Regional Council of Governments, Toby Holmes with York County Government for back ground data of the community, and the City of Rock Hill water and sewer utility staff for data on existing services.

AUTHOR'S FINAL NOTE

We have now presented our report to the community August 30, 2011. Our hope is that the project continues to fruition based on these findings for a better quality of life for the citizens in the community. It is now in your hands to make a better life for your selves. We will be able to work with you and the greater community to make it happen.