PRELIMINARY DESIGN REPORT FOR THE CIVIL ENGINEERING SERVICES TO SERVE THE INFORMAL SETTLEMENT AREA OF:
ETHEMBENI, KNYSNA
AUGUST 2012

PREPARED FOR:
THE MANAGER: INTERGRATED HUMAN SETTLEMENT
KNYSNA MUNICIPALITY
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KNYSNA
6570

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CONTENTS

1. Executive summary

2. Introduction

3. Site description
   3.1 Existing infrastructure
   3.2 Topography
   3.3 Informal structures

4. Civil Engineering Services
   4.1 Water
   4.2 Sewerage
   4.3 Solid waste
   4.4 Roads & stormwater
      4.4.1 Access
      4.4.2 Road pavement
      4.4.3 Stormwater drainage
   4.5 Availability of bulk services
   4.6 Cost estimate

5. Land Rehabilitation and Top Structures

Attachments:

Annexure A Proposed Site Development by VPM
   Civil Engineering Drawings
   ▪ 140 – P – 01: Water reticulation
   ▪ 140 – P – 02: Sewer reticulation
   ▪ 140 – P – 03: Roads & Stormwater
   ▪ 140 – P – 04: Sewer long sections
   ▪ 140 – P – 05: Road long sections

Annexure B Land Rehabilitation & Top Structure Drawings
   ▪ 140 – P – 06: 40 m² Top Structure: Type 1
   ▪ 140 – P – 07: Type 1: Raft foundation
   ▪ 140 – P – 08: 40 m² Top Structure: Type 2
   ▪ 140 – P – 09: Type 2: Raft foundation
   ▪ 140 – P – 10: Bulk Earthworks: Scenario A
   ▪ 140 – P – 11: Bulk Earthworks: Scenario B
   ▪ 140 – P – 12: Bulk Earthworks: Scenario C
   ▪ 140 – P – 13: Bulk Earthworks: Scenario D

Annexure C 40 m² Top Structure: Cost Estimate & specifications
1. EXECUTIVE SUMMARY

Ethembeni is a relative large development node located across the road from the Masifunde library and new Day Care Centre. It has been used for the purposes of informal residential units for many years identified for the purpose of subsidized low income housing.

There are currently approximately 130 informal structures and a church building on the site and the initial planning provides for the sub-division of 180 single residential erven.

The current level of service is limited to standpipes, portable toilets and partial waterborne sewage reticulation, which have in the meantime been provided throughout the site by the Knysna Municipality.

The site is relatively steep in sections, typical of most areas in the northern areas therefore costly to service but nevertheless justifiable considering the land availability constraints in Knysna within close proximity to municipal bulk services, schools and public transport (the site borders the main bus route). Some sections of the proposed internal road network require considerable cut depths of up to two meters and associated retaining structures. Vehicle access will be limited to erven with direct access to internal roads only.

However, the Municipality has indicated to us that in general it has limited capacity to provide additional bulk infrastructure services, particular sewerage treatment capacity, to service new developments in the whole of Knysna Greater Area and not particularly for this specific site in isolation.

It is nevertheless our opinion that the effluent generated by the additional 120 housing units is relatively moderate and unlikely to have any significant impact on the existing bulk services, although the existing pumpstation will have to be upgraded to deal with the additional effluent.

The total estimated cost including services and top structures is R 23 680 379-20 excluding Value Added Tax.

- Provision of services  R  6,375,146.80
- Top structures & Platforms  R  18,295,232.40
- Total  R  24,670,379.20
- Cost per stand  R  137,057.66
2. INTRODUCTION

Sintec Engineering Consultants were instructed by the Knysna Municipality to submit this report for the purpose of the N6 application currently being processed by SSI.

The report includes a general overview identifying the availability of bulk services, preliminary internal design of civil engineering services and respective cost estimate.

The extent of the development is depicted in the Locality Plan enclosed in the attached appendix as Annexure A. It consists of the consolidation and subdivision of various erven in order to provide 180 single residential erven (refer to VPM Planning’s report).

3. SITE DESCRIPTION

3.1 Existing infrastructure

The area earmarked for subdivision is currently used as an informal settlement. Basic services, including limited waterborne sewage reticulation and water reticulation has been installed.

The sewage discharges into a pumpstation located on the western boundary of the site which in turn pumps upstream into another pumpstation located next to the Masifunde library.

Existing roadways are generally in poor condition.

Approximately 60 erven are currently serviced mainly along the entrance road and church site.

3.2 Topography

- The areas identified for subdivision are generally very steep,
- Large sectors of the site are characterized with gradients of approximately 30% or steeper (refer to slope analysis drawing produced by VPM),
- The eastern section of the proposed subdivision (east and north of the church site) is bisected by a natural watercourse flowing steeply in a northerly direction,
- The western area (west of the church site) is also bisected by a natural water course flowing in a northwesterly direction.

3.3 Informal structures

There are currently approximately 130 informal structures in this area, most of which will eventually have to give way to formalized housing units.
4. CIVIL ENGINEERING SERVICES

Calculations are based on the guidelines for Human Settlements Planning & Design for the estimation of water and sewerage services.

4.1 WATER

The water reticulation system will consist of the following (Refer drawing 140 – P – 01):

- 75mm & 110 mm ø Class 9 uPVC mainline and shall comply with SABS 966,
- All water lines will comply with the requirements of SABS 1200 L: Medium Pressure Pipe lines,
- All Flanges and accessories shall be drilled to comply with BS 4504, table 16/11 for working pressure of 1600 kPa,
- All cast iron fittings shall be Rilsan coated and after installation all fittings, specials, valves and the appurtenant nuts and bolts shall be covered with a protective paste (Densopaste or similar) and thereafter the smeared surfaces shall be wrapped in an impregnated tape (Densotape or similar). All bolts and nuts shall be stainless steel as per SABS,
- Isolating valves shall be class 10 resilient seal valves, epoxy coated, double Socketed, anti-clockwise closing, with capped top and non-rising spindle,
- Fire hydrant will be the London Round Thread Type,
- All pipe lines will be bedded on a selected granular material. These materials shall comply to Class B bedding and SABS 1200 LB and shall be non-cohesive and free-draining.

Water demand generated by the proposed development:

- 180 erven @ 600l/day/erf = 108 m³/day (1.25 l/s),
- Peak Demand (PF = 5) = 6.25 l/sec

Storage requirements:

- Domestic: 48 hrs = 216.0 m³
- Fire flow (moderate risk) = 57.6 m³
- Total storage required = 273.6 m³

Water supply will be initially extracted from the existing 90mm Ø main. There is however a newly proposed 200 mm Ø connection point situated at the Masifunde node that would serve as the permanent connection to serve this area.

4.2 SEWERAGE

This system of pipes collects effluent water, which may contain solids in suspension from the individual sites, to two (2) newly proposed sewer pump stations.

These pumpstation would discharge into the existing pipe network as shown on drawing 140 – P – 02.

The proposed system would consist of the following:
- 160 mm ø uPVC Solid Wall SABS 791 Class 34 400 kPA or similar spigot & socket pipes for mainline,
- 110 mm ø uPVC Solid Wall SABS 791 Class 34 400 kPA or similar spigot & socket pipes for residential connections. All sewer mains will have a minimum grade of 1 in 100,
- Internal drainage will have a minimum grade of 1 in 60,
- Sewer manholes will be 1.05 m ø ROCLA or similar approved precast concrete rings with concrete covers and frames. Medium duty covers for roadside verges and non trafficked areas and heavy duty concrete covers and frames will be specified for trafficked areas. It is recommended that all the joints on the precast rings be sealed for water ingress with a 100 x 1 mm wide Polyurethane Bandage,
- All pipe lines will be bedded on a selected granular material. These materials shall comply to Class B bedding and SABS 1200 LB and be non-cohesive and be free-draining. Initial tests have shown that the on-site material would be suitable for selected fill.

The new pumpstations will be equipped with two submersible pumps and a sump (“wet well system”). The size and depth of the sump will be sized to accommodate six hours of emergency storage based on the average dry weather flow (ADWF) which reaches the pumpstation.

In the hydraulic design both minor and major losses will be taken into account. Deposition of solids must be prevented by maintaining a velocity of at least 0.7 m/s. Very high velocities should be avoided in order to limit friction losses. For this reason a maximum of 2.5 m/s is prescribed.

No allowance for emergency power failure has been provided.

The following aspects will make up this system:

- Two (2) Flyghts’ or similar approved submersible pumps. These pumps will be capable of pumping solids of up to 85 mm ø and will be equipped to be able to self cleanse the bottom of the well. These small pumps are less likely to block as they will be fitted with low efficiency vortex impellers,
- Starting and stopping of the pumps will automatically occur by predetermined water levels in the sump. This will be done using float controls or electrodes. The controls will be placed as to restrict pump starts to between 4 to 8 per hour for the submersible pumps,
- Provision will be made for controlling pumps manually during emergencies and also for maintenance purposes.
Ef fluent

Using the Harmon Formula to determine the peak factor (calculated at 3.8) and an average of 50% infiltration we summarize as follows:

- **ADWF:** 90 m³ / day (1.04 l/s),
- **PWWF:** 684 m³ / day (7.92 l/s),

4.3 **SOLID WASTE**

- Average solid waste per household = 0.12 m³ / week,
- Total solid waste = 21.6 m³ / week.

4.4 **ROADS & STORMWATER**

4.4.1 **Access**

The proposed access to the site is the existing entrance from the bus route opposite the new Day Care Centre as indicated in VPM Planning’s layout and our road layout plan.

4.4.2 **Roadways** (refer to Drg no. 140 – P - 03)

The proposed width of the internal roads is 4.50 m consisting of two structural layers and concrete paving blocks. It may be necessary to import rockfill on the lower sections of the road due to geotechnical characteristics.

The layer works will be designed for the anticipated traffic loads.

- Bottom layer: 150 mm thick in-situ layer compacted to 95% mod. ASSHTO;
- Sub-base layer: 150 mm thick G7 layer imported from commercial sources and compacted to 95% mod. AASHTO;
- Base layer: 150 mm thick G5 layer imported from commercial sources compacted to 98% mod AASHTO;
- The wearing surface of all the roads will consist of segmented paving blocks, 65 mm thick and placed on 25mm thick bedding sand. Edges will be constructed with a concrete edge kerbing,
- The minimum road cross fall will be 2.5% and be mostly sloping against the natural gradient of the site. A minimum longitudinal fall of 0.5% shall be adhered to.
- Road gradients vary from flat along the bottom section up to a maximum of 18% in Road 2.

4.4.3 **Stormwater drainage**

Provision for effective stormwater drainage should be made by means of a combination of underground pipes and concrete lined V-drains running parallel to the roadways and discharging into the natural two natural water courses bisecting the site into strategically placed energy dissipater.
Although municipal water and sewer connection points are available in the proximity of the site, the Municipality's Technical Department has indicated that currently they do not have the additional capacity to accommodate additional sewage in their treatment works.

Mr. R Parry has further informed us that SSI has been appointed by the Municipality for the evaluation and administration of bulk supply issues.

4.6 Cost Estimate

These civil engineering costs are based on current (August 2012) rates received through contracts of similar nature and is for the complete servicing of the 180 residential stands:

We highlight the following pertaining to the costs (all costs exclude VAT):

- Total cost for the provision of services = R 6,375,146.80
- Estimated cost per Erf excl VAT = R 35,417.48
- Includes 10% contingencies
- Includes professional fees
- Excludes any bulk infrastructure contributions and upgrading

<table>
<thead>
<tr>
<th>LINE</th>
<th>SECTION</th>
<th>DESCRIPTION</th>
<th>AMOUNT</th>
<th>AMOUNT PER ERF</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>PRELIMINARY &amp; GENERAL</td>
<td>R 569,960.19</td>
<td>R 3,110.89</td>
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<td>B</td>
<td>2</td>
<td>WATER RETICULATION</td>
<td>R 524,159.26</td>
<td>R 2,912.00</td>
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<td>C</td>
<td>3</td>
<td>SEWER RETICULATION (INCL. PUMPSTATIONS)</td>
<td>R 2,001,033.40</td>
<td>R 11,116.85</td>
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<td>D</td>
<td>4</td>
<td>ROADS</td>
<td>R 1,695,126.21</td>
<td>R 9,417.37</td>
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<td>E</td>
<td>5</td>
<td>STORMWATER</td>
<td>R 269,362.08</td>
<td>R 1,440.90</td>
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<td>F</td>
<td></td>
<td>SUB-TOTAL: (LINES A + B + C + D + E )</td>
<td>R 6,038,641.74</td>
<td>R 27,998.01</td>
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<tr>
<td>G</td>
<td></td>
<td>ALLOW 10% FOR CONTINGENCIES</td>
<td>R 503,964.17</td>
<td>R 2,799.80</td>
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<td>H</td>
<td></td>
<td>SUB-TOTAL: (LINES F + G)</td>
<td>R 6,543,605.91</td>
<td>R 30,797.81</td>
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<td>I</td>
<td></td>
<td>ALLOW 15% FOR PROFESSIONAL FEES + DISBURSEMENTS</td>
<td>R 831,540.89</td>
<td>R 4,619.07</td>
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<td>K</td>
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<td>TOTAL: CIVIL ENGINEERING WORKS: (LINES I + J)</td>
<td>R 6,375,146.80</td>
<td>R 35,417.48</td>
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</tbody>
</table>
Assuming that the top structures will be administered in terms of the PHP housing scheme, the cost of implementation is tabled below: (A detailed housing material breakdown and specification is included part Annexure C):

Due to the steep topography of the terrain, a considerable number of platforms and retaining walls are envisaged. In order to arrive at an average cost per stand we have considered different options as these are included part Annexure C.

The total estimate cost for land rehabilitation and top structures:

- **Land rehabilitation (platforms)** = ±R 20,500.00
- **Complete top structure** = ±R 81,140.18
- **Total cost per top structure** = ±R 101,640.18
- **Total for 180 top structures** = ±R 18,295,232.40

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<tr>
<th>LINE</th>
<th>SECTION</th>
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<th>AMOUNT PER ERF</th>
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<td>A</td>
<td>1</td>
<td>BLOCKS &amp; OTHER MASONRY UNITS</td>
<td>R 1,437,201.50</td>
<td>R 7,984.45</td>
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<td>B</td>
<td>2</td>
<td>SANDS &amp; AGGREGATES</td>
<td>R 143,326.19</td>
<td>R 796.26</td>
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<td>C</td>
<td>3</td>
<td>GENERAL ITEMS</td>
<td>R 1,559,197.41</td>
<td>R 8,682.21</td>
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<td>D</td>
<td>4</td>
<td>PLUMBING</td>
<td>R 477,361.07</td>
<td>R 2,652.01</td>
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<td>5</td>
<td>ROOF STRUCTURE</td>
<td>R 1,474,703.45</td>
<td>R 8,192.90</td>
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<td>F</td>
<td>6</td>
<td>WINDOWS</td>
<td>R 525,797.65</td>
<td>R 3,476.85</td>
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<td>G</td>
<td>7</td>
<td>CEMENT</td>
<td>R 381,988.00</td>
<td>R 2,122.16</td>
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<td>H</td>
<td>8</td>
<td>RAFT FOUNDATIONS</td>
<td>R 3,087,000.00</td>
<td>R 17,150.00</td>
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<td></td>
<td><strong>SUB-TOTAL: (LINES A TO H)</strong></td>
<td>R 9,106,575.27</td>
<td>R 51,036.53</td>
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<tr>
<td>J</td>
<td></td>
<td>ALLOW 10% FOR CONTINGENCIES</td>
<td>R 918,667.63</td>
<td>R 5,103.65</td>
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<tr>
<td>K</td>
<td></td>
<td><strong>SUB-TOTAL: (LINES I + J)</strong></td>
<td>R 10,105,232.80</td>
<td>R 56,140.18</td>
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<tr>
<td>L</td>
<td></td>
<td>PHP PROCESS: ADMINISTRATION &amp; LABOUR</td>
<td>R 4,500,000.00</td>
<td>R 26,000.00</td>
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<td>N</td>
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<td><strong>TOTAL: TOP STRUCTURE ESTIMATE: (LINES K + L)</strong></td>
<td>R 14,605,232.80</td>
<td>R 81,140.18</td>
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PRELIMINARY DESIGN
TYPICAL PLACING OF 40m² DWELLING ON TERRAIN SLOPES OF 1:3 (33% GRADIENT)
(WORST CASE SCENARIO)

COST ESTIMATE: SITE GROUNDWORKS

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear &amp; Grub</td>
<td>m²</td>
<td>146.96</td>
<td>R 5.86</td>
<td>R 856.27</td>
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<tr>
<td>Excavate in soft material (incl. spoil)</td>
<td>m³</td>
<td>115.03</td>
<td>R 83.16</td>
<td>R 9,713.40</td>
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<tr>
<td>Retaining Wall complete (2.25m)</td>
<td>m²</td>
<td>33.76</td>
<td>R374.50</td>
<td>R12,636.28</td>
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<tr>
<td>Trim, shape &amp; compact V-drain</td>
<td>m</td>
<td>33.51</td>
<td>R 30.05</td>
<td>R 1,009.88</td>
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<tr>
<td>Clean, trim &amp; make good site</td>
<td>m</td>
<td>1.00</td>
<td>R155.73</td>
<td>R 155.73</td>
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<tr>
<td>Allowance for environmental control</td>
<td>m</td>
<td>1.00</td>
<td>R535.00</td>
<td>R 535.00</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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<td>R28,066.79</td>
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15 x 10m ERF
SLOPE 1:3
Scale 1:150

SILTY Sands & Sands

Section C - C
Scale 1:100

ETHEMBENI INFORMAL SETTLEMENT

KNYSNA MUNICIPALITY

SITE GROUNDWORKS AND EXCAVATION DETAILS TYPE C

Designed: HI
Drawn: HI
Checked: HI
Approved: HI
Issued: HI
Scale: 1:100

140 - P - 12
REV. A
TYPICAL PLACING OF 40m² DWELLING ON TERRAIN SLOPES OF 1:4 (25% GRADIENT)
(EXPECTED TYPICAL SCENARIO)

COST ESTIMATE: SITE GROUNDWORKS

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<th>Unit</th>
<th>Quantity</th>
<th>Rate</th>
<th>Cost</th>
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<tr>
<td>1. Clear &amp; Grub</td>
<td>m³</td>
<td>154.77</td>
<td>R 5.86</td>
<td>R 920.56</td>
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<td>2. Excavate in soft material (incl. spoil)</td>
<td>m³</td>
<td>81.40</td>
<td>R 20.16</td>
<td>R 1664.22</td>
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<tr>
<td>3. Construct Retaining Wall complete (1.5m)</td>
<td>m²</td>
<td>22.50</td>
<td>R7374.02</td>
<td>R 8426.25</td>
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<tr>
<td>4. Trim, shape &amp; compact V-drain</td>
<td>m</td>
<td>33.61</td>
<td>R 30.05</td>
<td>R 1008.98</td>
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<tr>
<td>5. Clean, trim &amp; make good site</td>
<td>sum</td>
<td>1.00</td>
<td>R200.73</td>
<td>R 200.73</td>
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<tr>
<td>6. Allowance for environmental control</td>
<td>sum</td>
<td>1.20</td>
<td>R535.69</td>
<td>R 642.82</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
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<td><strong>R 18,768.04</strong></td>
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15 x 10m ERF
SLOPE 1:4
Scale 1:150

SILTY SANDS & SANDS
TYPICAL SECTION - NEW ROAD
NOT TO SCALE

80mm CONC. PAVERS

20mm THICK SAND BEDDING
150mm BASE COURSE LAYER
COMPACTED TO 96% MOD AASHTO
150 mm SUB BASE COURSE LAYER
COMPACTED TO 93% MOD AASHTO
INISITU SOIL COMPACTED TO BE
COMPACTED TO 90% MOD AASTHO

1:3 slope

2.5% CROSSFALL

APPROX. POSITION OF SERVICES

ERF BOUNDARY