

**Vehicle Recycling**  
**on**  
**South Tarawa**

**An Initial Feasibility Study**

**Te Kaoki Mange Project**

**Report prepared by: Alice Leney  
Project Coordinator**

**Foundation for the Peoples of the South Pacific Kiribati**

**March 2004**

# Vehicle Recycling on South Tarawa

## An Initial Feasibility Study

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## Executive Summary

Vehicle traffic in Tarawa is increasing rapidly with the importation of more and more vehicles. Vehicle waste is of course also increasing, and as the upsurge in vehicles imported in the last few years feeds through, and those vehicles are no longer in service, the waste issue is set to increase dramatically. On an atoll any waste is a problem, and large wastes such as vehicles are particular problems. They also contain liquid and toxic wastes that need dealing with in a systematic manner, that are currently a major source of ground water pollution.

This small study is an initial feasibility study, designed to give some indication of the numbers of vehicles and the economics of any waste management system that might be appropriate to dealing with the problem. This study looks at two issues: what does it take to strip a typical wrecked Tarawa vehicle so that it can be recycled; and how many vehicles might there be in South Tarawa that need some waste management.

This study is entirely funded with a grant of A\$2,500 from the Australian High Commission on Tarawa to look into the problem, and to see if vehicle wastes can be incorporated into the existing recycling system. It is conducted by the FSP Kiribati Kaoki Mange! Project, which is currently setting up a commercial scale recycling operation of aluminium cans, PET and HDPE plastics, and cardboard. The Kaoki Mange has been running for 12 months, and has 45 collection points set around South Tarawa up to collect recyclables.

Part One of the study deals with the mechanics of stripping a typical vehicle, and the associated economics. In particular the value of recoverable spares that could be used to repair other vehicles was carefully monitored. Tarawa is fortunate in that there is a high consistency of vehicle types present on the road; a very high Toyota percentage, and with in that certain models predominate. New automotive spare parts are hard to obtain in Kiribati, and when available expensive. Many repairable vehicles are lost due to lack of spares, or excessive periods of disuse awaiting repair. The study clearly indicates that the value of any recoverable spares is an essential part of the economic equation of recycling cars on Tarawa. The study also determined some indication of the quantity of recyclable plastics that might also be available for sale to Australia for recycling.

Part Two attempts to make some estimates of vehicles available for reprocessing today, and future projections based on import data. Part two also involved a surveyor searching the area from Betio to Temeiku on foot, looking for vehicles that might be suitable for recycling. As vehicles degrade very rapidly in this environment, this work has given a clear indication of the potential numbers of vehicles available. A conservative estimate would indicate that around 300 vehicles per year could be processed on South Tarawa at a suitable yard facility, and at very least three jobs would be created by this activity. Economic activity generated by the process would be of the order of at least A\$50,000/annum turnover.

## Conclusions and Recommendations

There is clearly potential to deal with a serious pollution problem on Tarawa, as well as generate some economic activity and indicates where further investigation is required. This study provides a sound basis to look into the issues further by conducting inquiries on a regional level to determine costs and availability of equipment for crushing cars, and also potentials for regional cooperation with other near-by atoll nations.

Any processing of Vehicles on Tarawa would clearly benefit from cost sharing with some other similar process, so as to spread administrative costs in particular, and make most use of valuable land resources. This type of activity can be easily amalgamated with similar resource recovery activities in a Materials Recovery Facility (MRF). Such a facility could handle liquid wastes – such as waste oils, and toxic wastes, such as lead-acid batteries.

## **Part One: Vehicle Processing**

### **1.1 Purpose of this section**

This exercise is intended to supply some primary indicative data that would help determine what spare parts of value might be easily recoverable, and the labour and tools required to strip a typical car for crushing and subsequent export and recycling.

### **1.2 Method**

A Toyota Corolla of about 1994 vintage was purchased for the purpose of this study. The vehicle had had a head-on collision with a stationary truck in July 2003. The driver's side front was the main point of impact. Windscreen, front lights, radiator, off-side front wheel and front chassis where all severely damaged or destroyed. The vehicle has sat at Tarawa Motors for 6 months, along with about 15 other damaged cars, taking up parking space on a paved area of the yard. Vehicle damage and resulting situation are typical of accidents in Tarawa. Figure 1 shows the vehicle prior to stripping. Agreement was made with Tarawa Motors to assist in providing tools, and an assistant where required, in order to strip the car to determine recoverable parts, and prepare the vehicle for crushing as if it were to be crushed in a car crusher. In return for this logistical support, any useful parts were donated to Tarawa Motors for use in repairing other vehicles.

The stripping exercise was spread over three days. First day was dedicated to removing useful parts from the vehicle that were easily accessible, and of clear value in repairing other vehicles. On the second day, the vehicle was stripped for crushing in a typical compacter of the type used for crushing wrecked cars. This took about a half day. The rest of that day and the next day were spent looking for other valuable parts that could be recovered that might be useful for car repairs. Times and parts recovered were all carefully logged. Some parts were not removed that could have been easily removed as no safe method was available to lift the vehicle, and the position of the vehicle in amongst other wrecked cars meant that it was also difficult, and unsafe, to gain access to lower parts. The wheels were also left on so that the remaining carcass can be easily moved.

### **1.3 Car Crushing**

Vehicles prepared for crushing need to have seats and interior trims removed. Wheels and tyres must be removed. Glass should be removed. Engines can remain. Ideally, large pieces of non-ferrous metals should be removed. Instructions for processing vehicles for crushing were provided by Gamma Corporation of New Zealand, a company that operates mobile car crushes in New Zealand.



**Figure 1 (above):** Toyota Corolla prior to stripping. **Figure 2 (below):** accident damage.



**Figure 3: Car after stripping in preparation for crushing.**



#### **1.4 Reusable Automotive Parts**

Car spare parts are very expensive in Kiribati, and also usually take a long time to arrive from overseas. Vehicles left standing for long periods awaiting spare parts can also suffer other problems whilst waiting to be repaired for the initial problem. Thus it seemed appropriate to recover any parts that might have a higher than scrap value; and also determine at what level of part removal this process might no longer be cost effective.

The first day produced several high value items such as doors and some engine parts, with an estimated value of \$800. Next day, the seats, window glass and trims were removed quite quickly – half a day being very adequate. This left the vehicle in a crushable condition. Other parts were then removed such as starter motor, carburettor, cylinder head, water pump. Estimated value \$250. About \$170 worth of easily recoverable spare parts remained on the car as no safe lifting equipment was available to safely work under the vehicle, and access was very limited.

It is of note that most vehicles on the roads of Tarawa are Toyotas, and that the number of models is small. Thus the chances of parts removed from a vehicle being useful on another vehicle on Tarawa are much higher than if many different makes and models were present.

The parts recovered were valued in two different ways: Tarawa Motors systematically valued each usable part, often using a figure of 25% of the cost of the same new part. This gave a total of \$1305 for all parts removed – or potentially easily removed. The breakdown of these prices is available in Appendix I.

The list of parts was then taken to a local car repair shop in Betio and the owner asked to value the parts as a job lot. He gave a price of \$500.

Parts recovered by stripping for crushing may have little direct value, such as side windows, but have some value for use in a non-automotive application, especially if available in quantity.

### **1.5 Recyclable Plastic Parts**

Research was conducted regarding the use of recyclable plastic in Toyota vehicles. The relevant American Standards from the Society of Automotive Engineers (SAE), which are consistent with International Standards Organisation (ISO) standards, were purchased via the internet in order to identify markings on plastic components and determine their material composition and recyclability.

Plastic components were found to be large part of a single material, polypropylene. This material is easily recyclable. It would best be shredded in a large industrial grade shredder for export to Australia in wool sacks or similar. About 13 kgs of polypropylene recyclable plastic was recovered, mostly from interior trim and bumpers. Details of these parts can be found in Appendix II.

**Figure 4: Plastic parts recovered.**



### **1.6 Tool Costs**

All tools required to fulfil the required tasks were noted down when used. In this way a clear picture of the tools required is gained. Only standard hand tools were required; however the addition of a good trolley jack for lifting the vehicles would be very useful. A larger operation might use a proper car lift.

Tools were kindly lent as required by Tarawa motors, to assist the study. The cost of providing a similar set of good quality set of tools to cover all the tasks required was costed out, and would be expected to cost around \$800 if purchased locally. These prices were determined by visiting tool suppliers in Tarawa, but tool availability is limited and restricted, especially as to quality. Mostly only hand tools are required. A list of tools required is given at Appendix III.

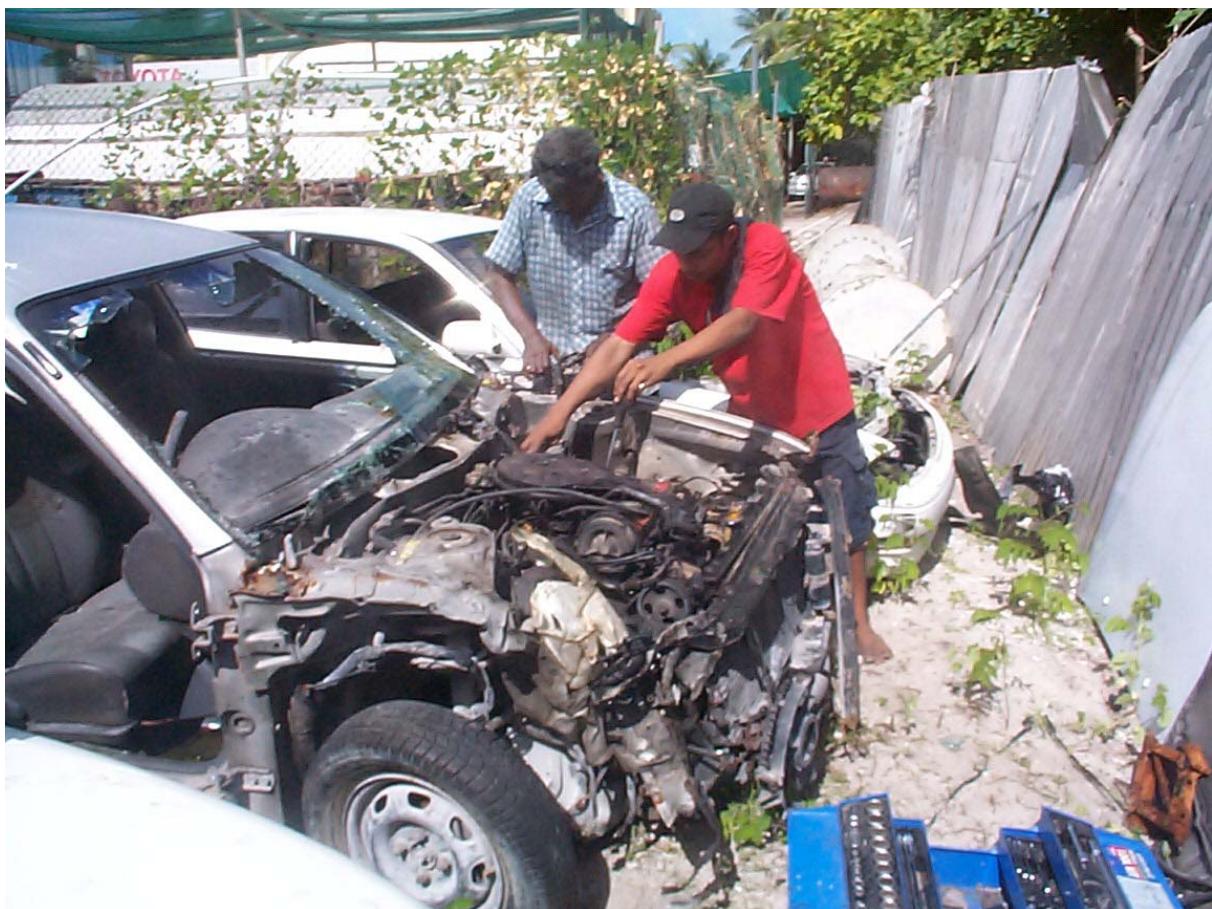
### 1.7 Direct Costs

Labour is valued at \$25/day.

Labour cost to strip car:

- For all useful recoverable parts: three days at \$25/day = \$75
- Just for crushing: one half day = \$15

Details of times are available in Appendix IV. An assistant was working sometimes, but also it is worth noting that days were short and some discussions with Project Coordinator punctuated the proceedings.



**Figure 5: Recovery of usable spare parts.**

## Part Two

### Quantities of Vehicles Available for Recycling

#### 2.1. Analysis of vehicle import data

Import data provided by the Kiribati Customs service was analysed to gain some insight into the quantity of vehicle available for recycling. Data for the following lines was collated:

- New car imports of all engine size;
- Used car imports of all engine size;
- New and used buses (defined as to carry more than ten people);
- Other vehicles up to 5 ton gross vehicle weight.

This covers the vast majority of vehicles that might be available for recycling, and also those classes of vehicle that the survey of South Tarawa vehicle wrecks included.

Numbers were analysed for the years 1999 to 2003, as data for these years is readily available. Numbers are reasonably consistent across years. Total number of vehicles of these classes imported over this four-year period amount to 1,318.

**Table 1: Vehicle Imports to Kiribati 1999 to 2003**

| Vehicle type            | 1999       | 2000       | 2001       | 2002       | 2003       |
|-------------------------|------------|------------|------------|------------|------------|
| Bus - new               | 150        | 44         | 23         | 58         | 49         |
| Bus - used              | 21         | 15         | 6          | 12         | 13         |
| Car – used under 1500cc | 37         | 69         | 28         | 59         | 62         |
| Car – used 1500-3000cc  | 41         | 45         | 17         | 33         | 69         |
| Car – used over 3000cc  | 3          | 31         | 1          | 7          | 6          |
| Car – new 1500-3000cc   | 0          | 0          | 2          | 3          | 0          |
| Truck <5 tonnes g.v.w.  | 77         | 103        | 40         | 94         | 100        |
| <b>Totals</b>           | <b>329</b> | <b>307</b> | <b>117</b> | <b>266</b> | <b>299</b> |

#### 2.2 Car Wreck Survey

A survey of Temeiku to Betio (South Tarawa's most built up areas) looking for car wrecks was conducted between March 5<sup>th</sup> and March 16<sup>th</sup> 2004. The technique was for a surveyor to walk over the islands in a zigzagging manner, and count the different wrecks discovered. .

The survey makes no claim to be exhaustive. It is for indicative purposes only, but should give some indication as to numbers of vehicles available for crushing. Some vehicles deemed to be past recycling were found, but not counted. Also, some vehicles included as suitable for wrecking may not be considered so by the owners. Total number of vehicles found was 455.

**Table 2: Vehicles suitable for wrecking observed between Betio and Temeiku**

| Village           | Cars       | Hilux     | Minibuses  | Bus       | Light Trucks | Lorries   |
|-------------------|------------|-----------|------------|-----------|--------------|-----------|
| Betio             | 69         | 10        | 38         | 5         | 18           | 5         |
| Bairiki           | 31         | 18        | 19         | -         | 8            | 4         |
| Nanikei           | 2          | -         | -          | -         | -            | -         |
| Teaorarereke      | 9          | 6         | 8          | 1         | 2            | 1         |
| Antenon-Banreaba  | 27         | 9         | 36         | 2         | 7            | -         |
| Ambo              | 2          | 3         | 16         | 2         | -            | -         |
| Taborio-Abarao    | 28         | 4         | 11         | -         | 7            | -         |
| Bikenibeu-Temeiku | 24         | 5         | 10         | 1         | 5            | 2         |
| <b>Totals</b>     | <b>192</b> | <b>55</b> | <b>138</b> | <b>11</b> | <b>47</b>    | <b>12</b> |

#### **Notes on Table 2:**

'Hilux' is generic for utility pickup vehicles, although most are Toyota Hilux on Tarawa;  
Minibuses are almost all Toyota HiAce;  
'Bus' is Coaster size bus, about 30 seater  
'Light truck' is usually Toyota Dyna 150 or 200 1.5 or 2 ton truck flatbed.  
'Lorries' are typically medium size 3 to 6 ton tare.

#### **2.3 Comparison of import data and car wrecks found**

Import data indicate some 1,300 vehicles have arrived in the last four years. Vehicle life is not great on south Tarawa due to the highly corrosive conditions and the high incidence of car accidents and subsequent difficulty to effect suitable repairs. Some of those vehicles – especially the light trucks - will have gone to outer islands. To identify 455 vehicles in a casual survey is not unrealistic given the figures and life expectancy of vehicles, especially given the large number of used vehicles imported. Most buses are imported new, but the annual mileage is very high, and buses are frequently involved in accidents due to the manner in which many are operated.

#### **2.4 Economics of Recycling**

If some base assumptions are made, and estimates are kept conservative, then it could be assumed that 300 vehicles a year could be recycled, each vehicle realising \$500 in parts and scrap metals. From this must be deducted the cost of the operation. Labour charges to strip for crushing and recoverable parts, for the purpose of this survey, would be of the order of \$75. Assume \$100 per vehicle to include pick-up labour for vehicle collection. That leaves some room to pay for the crushing and export of the vehicle. From the study:

- Value recoverable after three days work: \$500 - \$1300, plus scrap value.
- Value recoverable after half days work: Estimated A\$70 -\$80/tonne less crushing and shipping cost.

If Kiribati had 300 vehicles per year, each requiring three man-days to process, that is sufficient to keep three people working full time stripping vehicles (assuming 300 working days per year). Those three people would earn about A\$22,000, which they would be expected to spend most in the local economy, buying goods and services. Those 300 vehicles could produce A\$150,000 worth of spare parts, which would displace imports of spare parts, and keep the vehicle fleet moving. They would also remove one of the major waste problems from Tarawa. If we assume each vehicle as a tonne of material for recycling (perhaps not too far off an estimate given the high content of light trucks, that might be over A\$20,000 worth of export income in the form of scrap metal. To that could be added roughly 3 tonnes of Polypropylene scrap plastic for recycling, and a very rough estimate of \$300/tonne as around \$1,000 of recyclable plastics. There are also quantities of aluminium alloy parts that are of high value that could be recovered. In short, the benefits to the local economy at the very least would be:

- A\$22,000 in wages, most spent locally, and not including any supervisors wages;
- A\$150,000 of spare parts, displacing considerable imports so keeping that money in Kiribati instead of it being sent overseas;
- A\$1000 Plastics recycled;
- Undetermined quantity of aluminium parts recycled (at a minimum \$1000/tonne);
- A\$20,000 export income of scrap steel.

Suitable mobile car crushing machines are available that could be shipped in on regular shipping schedules as they are of similar dimensions as a standard shipping container. Processing would need to be done at a central facility as close as practicable to the wharf at Betio. Stripped vehicles would need to be stockpiled waiting for a suitable crushing machine to visit. Ideally, this process would be incorporated with other waste recovery processes at a Materials Recovery Facility (MRF). This would allow considerable savings in overhead costs

as vehicles could be processed alongside other activities and so share the administrative costs of running such a facility, and also maximise use of resources as when vehicles were not being processed other materials could be processed.

It must be noted that any car wrecking and crushing operation would create employment, and also purchase services in the local economy. It would displace imported car parts, and quite possibly keep some vehicles on the road that might otherwise become useless as the time taken to repair them is so long that the vehicle becomes useless through other problems such as corrosion or removal of spares for other vehicles. Then there is the value of ant avoided landfill and pollution costs, costs that are typically borne by the society at large, often through Government, or else through hidden economic costs such as ill health and environmental damage affecting other activities.

### **3 Conclusions**

#### **3.1 Regional Cooperation**

It would appear that there is some value to be recovered by processing wrecked vehicles currently lying around Tarawa. More study and information is clearly required; this study made no claim, and is too small, to be in any way definitive. However, it does give some clear indication of where to look next.

Economies of scale with neighbouring nations are likely to be one area where there is scope for cost reduction. The shipping schedules current in the region would easily allow Kiribati to join with Tuvalu and the Marshall Islands to share the cost of having a crushing machine visit the region on some frequent basis such as annually. This area of collaboration needs looking into closely.

#### **3.2 Recommendations for Further Study**

To determine the viability of such an enterprise would require further study beyond the scope and resources of this report. Such a study would need to determine:

- The availability of a suitable mobile crusher that could visit Kiribati, and possibly other nations in the region;
- The capacity of such a machine, and hence the frequency of visit;
- The cost involved in hiring and shipping such a machine;
- The value of the scrap metals produced;
- The incentives that might be required in Kiribati, or any suitable legislation, so as to encourage the removal of vehicle wrecks from the environment and into the recycling system;
- Any economic tools that might be suitable to utilise to bring about the required outcome of wrecked vehicles being recycled;
- Any existing initiatives in Kiribati that this process could be matched with in order to seek efficiencies in the processing of vehicles;
- Any associated recycling activities that might be required to complement the car recycling, such as shredding of recyclable plastic parts for export and recycling; processing of liquid wastes such as waste oils recovered; and disposal of any toxic materials that might need special attention, such as lead-acid batteries.

Vehicle wastes are currently a major problem all over the world, and particularly in small island states. This problem can clearly be turned into an opportunity, especially when a full cost approach to the country is utilised, to clearly identify all the cost benefits as well as the direct costs.

## Appendix I

### List of Recovered Parts for Toyota Corolla Dismantling

| <b>First stage dismantling</b>     | <b>Estimated value S/H</b> |
|------------------------------------|----------------------------|
| 2 front doors,                     | \$150                      |
| 1 rear passenger door,             | \$98                       |
| 1 tailgate                         | \$150                      |
| 1 Rear bumper,                     | \$56                       |
| 2 rear light ass,                  | \$55                       |
| 1 dead battery                     | -                          |
| 2 windscreen wiper                 | \$29                       |
| Radiator Hoses                     | \$4                        |
| 1 Distributor                      | \$29                       |
| 1 Wiper motor                      | \$22                       |
| 1 Alternator                       | \$49                       |
| 1 set relays                       | \$15                       |
| 1 fuse box and fuses               | \$15                       |
| 3 wheel rims inc. 3 tyres (2 good) | \$105                      |
| 1 door handle                      | \$15                       |

### **Parts removed for crushing**

|                     |      |
|---------------------|------|
| 2 front seats       | \$35 |
| 1 rear bench seat   | \$40 |
| Interior trim parts | -    |
| Glass from windows  | -    |

### **Second Stage Dismantling**

|  |      |
|--|------|
| 1 Engine fan                           | \$9  |
| 1 Carburettor                          | \$29 |
| 1 starter motor                        | \$49 |
| 1 Water Pump                           | \$39 |
| 1 Cylinder Head                        | \$85 |
| 1 Clutch master cylinder               | \$22 |
| 1 exhaust manifold                     | \$23 |
| various nuts and bolts and small parts | \$5  |

### **Still readily available but not removed due to access problems:**

|                  |      |
|------------------|------|
| 2 CV joints      | \$50 |
| Clutch           | \$15 |
| Gear box         | \$55 |
| Clutch cable     | \$15 |
| Gear shift cable | \$10 |
| Hand brake cable | \$10 |
| Exhaust system   | \$22 |

## Appendix II

### **Plastic Parts Removed From Toyota Corolla**

| <b>Part Description</b>     | <b>SAE Marking</b> | <b>Material</b> | <b>Weight kg</b> |
|-----------------------------|--------------------|-----------------|------------------|
| Rear Bumper                 | PP                 | Polypropylene   | 2                |
| Interior trim item          | PP                 |                 | 0.1              |
| Fuel tank lever trim        | R3?                | unknown         | 0.1              |
| Front Bumper/Grill          | PP                 |                 | 4.0              |
| Inside rear L/H trim panel  | PP                 |                 | 1.0              |
| Inside rear R/H Trim panel  | PP                 |                 | 1.0              |
| Door Pillar Trims           | PP                 |                 | 1.0              |
| Under Dashboard L/H trim    | PP                 |                 | 0.5              |
| Door trim parts             | PP                 |                 | 0.5              |
| Cooling Fan housing         | PP                 |                 | 0.5              |
| Glove box and trim surround | PP                 |                 | 1.0              |
| Gear lever consol trim      | PP                 |                 | 0.5              |
| Centre Consol Trim          | PP                 |                 | 1 kg             |

## Appendix III

### **List of Tools Required for Vehicle Dismantling**

Set of Metric Spanners  
½ inch Socket set metric  
Flat screw driver set  
Philips screw driver set  
Lump Hammer  
Engineers Hammer  
Punch  
Crow bar  
Shifters: 150mm, 250mm, 350mm  
Vice grip  
Hacksaw  
Knife  
Wire cutters  
Pliers

## Appendix IV

### Car Recycling Study Time Sheet

Toyota Corolla, front end smash, drivers side

#### **Stage 1:**

Remove high value spare parts easy to get at:

**Start Time: Thursday 26/2/04**

10am                  1.30 pm

Finish Time:    12pm                  3.30pm

Time analysis: 4 hrs Philip, 1 hrs assistant.

Tools Used:

Metric Spanners

½ inch Socket set    10, 12, 14, 17 in particular

Flat screw driver set

Philips screw driver set

Hammer

Punch

Crow bar

Shifter: Small

Wire cutters

Hacksaw

Knife

Wheel jack

#### Items Recovered

2 front doors, 1 rear passenger door, 1 tailgate

1 Rear bumper, 2 rear light ass,

1 dead battery

2 windscreen wiper

Radiator Hoses

1 Distributor

1 Wiper motor

1 Alternator

1 set relays

1 fuse box and fuses

3 wheel rims

3 tyres (2 good)

1 door handle

## **Stage 2**

### **Seats and Trim removal for crushing**

**Start Time:** 3.30pm 26/2 8.30am 27/2

**Finish Time:** 4.30pm 26/2 9.30 am 27/2

**Time analysis:** 1 hrs Philip, 1 hrs assistant

#### **Tools Used:**

Metric Spanners

½ inch Socket set

Flat screw driver set

Philips screw driver set

Hammer

#### **Items Recovered**

2 front seats

1 rear bench seat

plastic trim elements Polypropylene? PP? approx 10 kgs

(internal trims plus damaged front bumper and radiator fan housing)

## **Stage 3**

### **Engine Spares**

Harder to get valuable engine parts:

**Start Time:** 9.30am 27/2 2.30pm

**Finish Time:** 12pm 4.30pm

**Time analysis:** 4.5 hrs Philip, 1hr assistant

#### **Tools Used:**

Metric Spanners

½ inch Socket set

Flat screw driver set

Philips screw driver set

Hammer

Punch

Crow bar

Shifter: Small

Bench Vice

Hacksaw

Knife

Wire cutters

### **Items Recovered**

1 Carburettor  
1 starter motor  
1 Water Pump  
1 Cylinder Head  
1 Clutch master cylinder  
1 exhaust manifold  
various nuts and bolts and small parts

### **Still Available:**

2 CV joints  
Clutch  
Gear box  
Clutch cable  
Gear shift cable  
Hand brake cable  
Exhaust system

(These parts would be easier to remove given more space and ability to lift the vehicle up)

### **Saturday 28/2/04**

**3.5 hrs Philip from 8.30 am to 12 pm**

Left and right rear side glass  
3 brake linings and parts (mostly worn out)  
Engine fan  
Repair car jack  
To remove wheels

### **Stage 4**

### **Alloy Parts**

### **Items Recovered**

Some small rim items  
1 cylinder head (Not stripped) approx 20 kgs

### **Available:**

Damaged Radiator  
Gearbox housing