PipeHawk™

Mk 2 Pipe Locator System

Ground Penetrating Radar System

PipeHawk plc

Operator's Manual – Metric

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Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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The users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology, which shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration. The information provided by the UWB operator shall include the name, address and other pertinent contact information of the user, the desired geographical area(s) of operation, and the FCC ID number and other nomenclature of the UWB device. If the imaging device is intended to be used for mobile applications, the geographical area(s) of operation may be the state(s) or county (ies) in which the equipment will be operated. The operator of an imaging system used for fixed operation shall supply a specific geographical location or the address at which the equipment will be operated. This material shall be submitted to Frequency Coordination Branch, OET, Federal Communications Commission, 445 12th Street, SW, Washington, DC 20554, Attn UWB Coordination.

RECORD OF REVISIONS

REVISION	DATE	CHANGE	NAME
A	11 April 2000	First Release	R J CHIGNELL
B	14 December 2000	Amendment of Section 4.3	R J CHIGNELL
C	10 July 2003	FCC Radio Licensing Notice Added	R J CHIGNELL

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PREFACE

PIPEHAWK PLC'S new **PipeHawk** has been developed using 'State of the Art' technology. This technology offers a means of accurately pinpointing underground piping, whether plastic or metal, providing the operator with an immediate display of its location.

The **PipeHawk** has been built to very high standards, but will require some care and attention. This manual has been designed with the same care as your **PipeHawk** and will provide information on the Operating and Maintenance procedures necessary for the machine to function to the designed performance and reliability.

Read this manual carefully before operating the machine. It should be kept with or near the machine for easy reference.

The PipeHawk single channel ground probing radar system.

PipeHawk radiates a low level radio signal into the ground. Public concern and awareness has been raised about the safety of such systems particularly with regard to cellular telephones. There is no danger to personnel in this regard, during normal operation of **PipeHawk**. The average power radiated is less than a cellular telephone, it originates in the white antenna some distance away from the operator and is directed downwards into the ground where it is dissipated.

It should be noted that as with all radio systems there is the remote possibility that they may cause mutual interference. GPR is no different in this respect. In the UK, the trade association, EuroGPR, has agreed a Code of Practice with the Radiocommunications Agency to manage these unlikely events.

The code draws operator's attention to the increased sensitivity that may surround some radio installations such as airports, prisons, or defence establishments. Copies of the Code of Practice may be obtained from the EuroGPR Secretariat at The Association Bureau, PO Box 1381, Rugby, Warwickshire, CV21 2ZF, or from **PIPEHAWK PLC**.

WARNING

All Operators of the **PipeHawk** should make themselves fully aware of the information presented in this manual.

Service of this machine is to be carried out only by fully trained and authorised personnel.

1.0 INTRODUCTION

PipeHawk is a ground penetrating radar system or ground probing radar system (GPR) designed to locate and map the position of buried pipes and cables. Whilst **PipeHawk** may be used to locate a range of different types of anomalies its on board specialist software is designed only for the detection of linear features, which may normally be interpreted as buried pipes and cables.

The system is designed for one person operation in the field. **PipeHawk** surveys the area of interest by traversing a grid of linear measurement lines termed scans in order to build up information concerning the underground environment.

The depth surveyed varies according to the subsurface ground conditions, and is normally characterised by the depth of penetration of the radar signal. The average penetration will be greater in sandier regions than in clay regions, but will typically be in the range 2.0m to 2.5m. In exceptionally good or exceptionally bad conditions the depth may exceed 3m or be restricted to 1.2m to 1.5m.

The radar is used by being pushed over a linear path to complete a radar scan. When the scan is completed the operator is presented with a virtual image representing a cross section through the ground scanned. The horizontal axis of the image represents the 3m path just surveyed and the vertical axis the depth into the ground. Radar targets, corresponding to objects in the ground are shown as bright areas in a format specified by the processing applied.

PipeHawk is a sensitive radar and has the capability to detect the presence of pipes and cables, and a range of other objects. The operating procedures and processing software has therefore been designed to build up a comprehensive view of the underground environment, to allow pipes and cables to be distinguished from other objects as linear features.

In a sophisticated system like **PipeHawk** there are many features that contribute to the operation and use. This document necessarily must present a wide variety of information and is intended to act as a simple reference for operators, who should have been on an approved PIPEHAWK PLC **PipeHawk** training course.

This document begins with a brief description of the **PipeHawk** radar and a basic technical specification.

2.0 TECHNICAL SPECIFICATION

2.1 Radar System

The **PipeHawk** operates by introducing a fast risetime electromagnetic pulse into the ground. The pulse is scattered by changes in the electrical properties of the ground. The presence of metal generates a major change in electrical properties but the system is sensitive to other changes such as the presence of plastic, water, or air. The scattering produced by changes in ground conditions returns a small fraction of the energy back to the radar.

Figure 2.1 shows a general schematic of the radar part of the system, with a pulse generator acting as a transmitter, feeding a signal to the antenna to be introduced into the ground. The signal returned is then received by the antenna, where it is passed to the digital signal processing hardware for manipulation into a suitable format for display.

The transmitter, antenna elements, and sampling receiver are all found in the white plastic moulding typically described as the antenna.

The yellow case houses the Main Electronics, the display, the battery, and the wheel sensor.

The main power supplies for the system and the signal processing are contained in the Main Electronics. There are two major computer boards and a hard disc.

SCHEMATIC BLOCK DIAGRAM
OF PRINCIPLE NETWORK FOR
GROUND PROBING RADAR
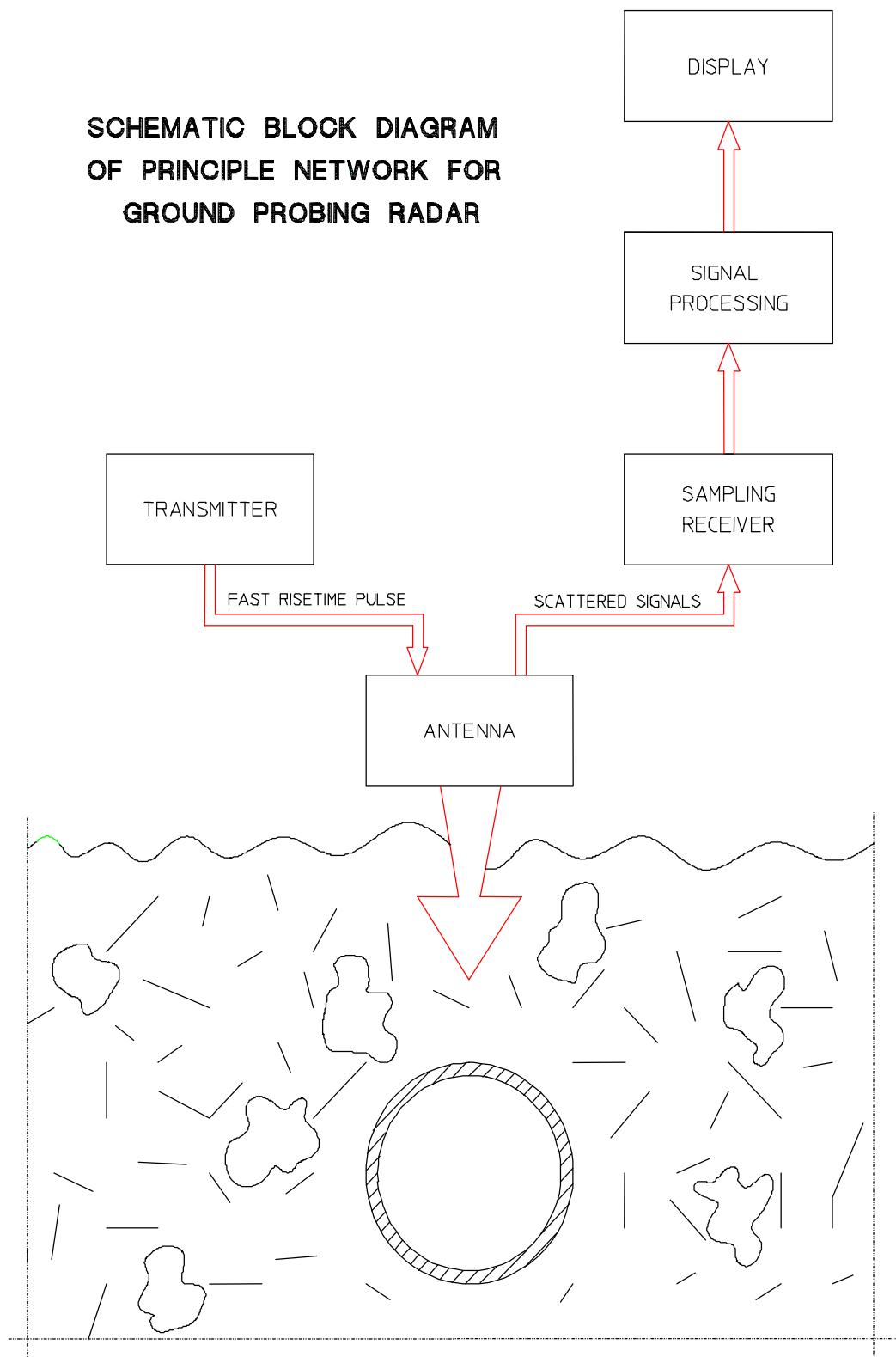
Figure 2.1.............Simplified Radar System

2.2 Technical Specification

2.2.1 Operating and Storage Conditions

Ambient temperature range (operation)   0 °C to 45 °C

2.2.2 Mechanical Data

Mass (approximate)	44 kg	
Dimensions	Handle retracted	Handle extended
Height	710 mm	1014 mm
Length	1360 mm	1796 mm
Overall width	575 mm	

2.2.3 Tyres

Tyre pressures $0.71 \ kg/cm^2$

2.2.4 Electrical Power Requirement

Electrical requirement   Internal – 24V battery (Battery life 3-4 hrs)

2.2.5 Detection

Detection range	5 cm to approximately 2.5m
Pipe material	Any material including plastics and earthenware
Minimum pipe diameter	18 mm
Maximum pipe diameter	1m
Information provided	Horizontal position and depth of detected targets.

2.2.6 Screen

Liquid crystal display   TFT colour/black and white.

2.2.7 Construction

Rotational moulding of impact resistant plastic.

2.2.8   Down Loading Measurement Data

Measurement data can be down-loaded onto a 486 or Pentium based IBM format PC for printing, further investigation, or archiving.

3.0 MAINTENANCE AND CARE OF PIPEHAWK

3.1 Care of PipeHawk

The main requirements for the care of **PipeHawk** are that: -

i. The system should be kept clean.

ii. The underside air vents should be free of obstruction or debris.

iii. The antenna should be fitted with a wear membrane that is complete and free from holes or other excess wear.

iv. The tyres should be inflated to the correct pressure of 0.71 kg/cm^2.

v. A suitably charged battery should be employed.

vi. There is adequate space on the hard disc to store data from the intended site investigation.

All other work should be referred to **PIPEHAWK PLC** or an authorised dealer. The system must be serviced periodically, dependent upon use, with the mechanical parts such as bearings checked for wear and the electronics calibrated. This shall be carried out every twelve months of normal use or six months of heavy use. Check the underside air vents are clear of debris.

CAUTION

Caution shall be exercised when cleaning the system. The minimum amount of water shall be used and pressure must be avoided. It shall be noted that although the main electronics are sealed, the main case contains some sponge like black anechoic material. If this is wet, the performance of the system will be degraded.

Household detergents and water shall be used for cleaning the system. Other cleaning agents may damage the powder or plastic finishes and should not be used.

3.2 The Antenna Wear Membrane

The **PipeHawk** antenna rests upon the ground. When the system is pushed along to complete a radar scan, the antenna is potentially worn by the surface of the ground. A sacrificial plastic wear membrane fits over the antenna to prevent such damage to the antenna itself.

Under **NO** circumstances should the machine be operated without a wear membrane in place. **Check membrane daily for wear. If any part of the membrane is worn through it must be replaced immediately.**

3.3 Pneumatic Tyres

It is important that wherever pneumatic tyres are fitted they are inflated to the correct pressure. For **PipeHawk** it is particularly important that the pressure is correct because a wheel sensor is fitted which is employed to trigger the radar and measure horizontal distance.

Incorrect inflation changes the wheel diameter, and leads to inaccurate horizontal distance measurements. Excessive mud and debris should not be allowed to build up on the wheels because this produces similar errors.

Do not over inflate – check pressure daily. The tyre pressure should be 0.71 kg/cm^2.

3.4 Battery and Battery Charging

PipeHawk uses a 24V, 9.5 AH sealed lead acid battery, housed in a black plastic moulding. The battery life is approximately four hours, dependent upon the use made of the system.

When fully charged, the battery voltage exceeds 24V. As the charge is used the voltage drops, and the battery must be re-charged when the battery voltage drops below 20V. In the main measurement mode, a low battery warning light will appear when the voltage drops below this critical voltage. **If ignored the PipeHawk will shut down automatically**. The software structure is such that in other menus this facility is disabled to allow functions such as uninterrupted file transfer to be carried out. If the operator is not using the measurement menu for long periods, then the battery voltage must be regularly checked via the Tools and Status Menus.

It should be noted that battery performance degrades with time, with excessive temperatures and with the number of battery charging/discharging cycles. As a guide, the battery manufacturers indicate that if the battery is used regularly and not subjected to any extreme conditions its life should approach 500 cycles. This can not be guaranteed by **PIPEHAWK PLC**.

A battery charger is provided with the system. This is the only charger that should be used to re-charge the **PipeHawk** batteries. Use of other chargers may have a significant adverse effect on the life of the batteries and will invalidate any guarantees.

Care is required in connecting the battery charger to the battery. The connectors are shaped so that they can only be connected one way.

The cover of the battery charger must not be removed. The charger must be connected to the mains network in accordance with wiring regulations, only after checking that the voltage rating of the charger is compatible with the local electricity supply.

3.5 Disc Management

Prior to operation each day, the availability of space for data storage upon the hard disc should be checked. This is done on the Hard Disc Status menu, which includes an indication of the length of measurement that can be completed before action is required to remove data from the system. If action is required, the File Transfer Menu, detailed later, should be accessed. It is recommended that data is down loaded and archived on a regular basis.

4.0 THE USER INTERFACE

4.1 Introduction

The **PipeHawk** user interface is designed for simplicity of use, and is based around a backlit liquid crystal display (LCD) and seven user softkeys. Icons at the bottom of the display immediately above the switches indicate their current function. The icons generally do not include text and therefore may be considered to be international.

The display is divided into five main areas (see figure 4.1), with the largest area available for data. There are two areas immediately adjacent to the data area that may be used to present subsidiary data to that in the main area, for example horizontal and vertical depth scales. Seven icons appear along the bottom of the display. The small remaining fifth area of the display is employed for warnings, typically low battery voltage.

The seven softkeys are coloured yellow, apart from the first softkey from the left, which is coloured green. When this button is depressed with the **PipeHawk** switched off, the system is powered on. Various set up menus are then briefly displayed, before the Main Menu shown in figure 4.1 appears. All the operating functions of the system may be accessed beginning with this menu.
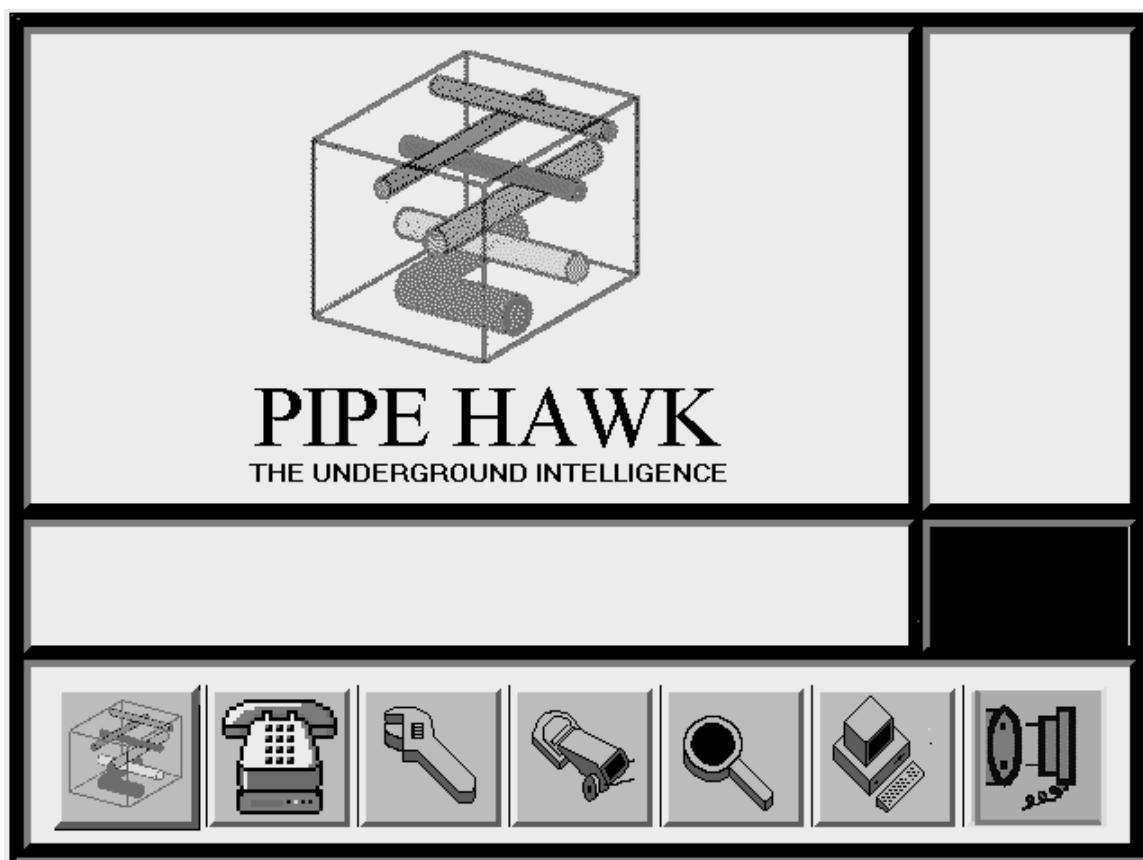
Figure 4.1.............Main Menu

The subsidiary menus that are accessed from the Main Menu are: -
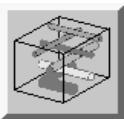
 Changing Display and Scales Menu

 Modem Menu
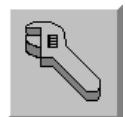
 Status Menu
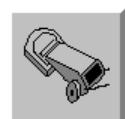
 Data Collection Menu

 Data Review Menu
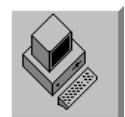
 Data Transfer Menu

 Power Down Menu

It should be noted that in all subsidiary menus, the right hand softkey, number 7, exits the menu back towards the Main Menu.

The most important operational menus are the Data Collection Menu, the Data Review Menu, and the Data Transfer Menu. These will be dealt with in subsequent chapters but the other menus will now be presented.

4.2   Changing Display and Scales Menu

The Changing Display and Scales Menu may be used to set the default settings on the display to monochrome (16 levels) or colour (256 colours). It also allows measurement scales to be changed between Metric and Imperial.

Once set within this menu the scales menu selection will remain the default even when the machine is turned off and then rebooted. The display setting will revert to colour upon reboot.

4.2.1 To Access the Display and Scales Menu from the Main Menu
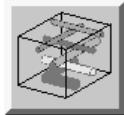
Press Key 1   This accesses the Display and Scale Menu.

4.2.2 To Change the Units from Metric to Imperial or Imperial to Metric

Press Key 3   This changes the units employed.

4.2.3 To Change the Display mode from Monochrome to Colour, or from Colour to Monochrome

Press Key 4   This changes the display mode.

4.2.4 To Exit the Changing Display and Scales Menu back to the Main Menu

Press Key 7   This returns the system to the Main Menu.

4.3 The Modem Menu and Link Up

There may be occasions when **PipeHawk** needs to be connected to **PIPEHAWK PLC's** customer service department. This may be for uploading of new software to the **PipeHawk** or diagnostic work by **PIPEHAWK PLC** engineers. Modems are not supplied to **PipeHawk** customers as telephone regulatory approval varies around the world, and modems must be approved by local administrations.

The recommended modem is : -

3COM US Robotics 56k Fax Modem (V90-x2)

Please note other modems may not work. For information on where to purchase this modem visit www.3com.com.

The procedure for a modem link up with **PIPEHAWK PLC** is as follows: -

1. Contact the **PIPEHAWK PLC** customer service department, and inform them of your direct dial telephone number. This is the telephone to which the modem will be attached. Advise of a time when connection can be made and the reason for a modem link up.

2. Attach the adapter cable to the rear of the **PipeHawk** using the circular connector. Attach the small serial "D" connector on the other end of the cable to the modem cable, and hence the modem cable to the modem.

3. Connect the modem to the externally available telephone line detailed in 1), and also connect to a power supply.

4. Turn on both modem and **PipeHawk**.

5. In the Main Menu: -

Press Key 2   **PipeHawk** is now ready for an external connection to be initiated by **PIPEHAWK PLC**.

6. On a separate telephone line it may be helpful to advise **PIPEHAWK PLC's** customer service department that **PipeHawk** is ready for a modem connection.

7. Connection will now be made by **PIPEHAWK PLC's** customer service department to make any modifications required. Once complete, turn off the **PipeHawk**, and disassemble all peripherals.

8. **PipeHawk** should then be switched on again, to test the system.

4.4   The Status Menu

Within **PipeHawk** the Status Menu enables the user to check on basic diagnostic functions such as battery voltage (nominally 24V), internal and external machine temperature and antenna type. Of the above, the **PipeHawk** is self regulating in terms of temperature. The most common use for this menu is to monitor battery life at the start of a working day and the type of antenna currently connected to your **PipeHawk**.

4.4.1   To Access the Status Menu from the Main Menu

Press Key 3   This accesses the Status Menu.

4.4.2   To View the Status of the System

Press Key 2   The status of the battery voltage together with other voltages and temperatures is now displayed.

4.4.3   To View the Status of the Hard Disc

Press Key 6   The status of the hard disc is now shown as a bar graph, in terms of the percentage of the hard disc that is full of data. (The hard disc allows at least 2 GBytes of data to be stored). The display also indicates how many more 3m scans may be recorded before essential down load.

4.4.4   To Exit the Status Menu and Return to the Main Menu

Press Key 7   Exits the Status Menu and returns to the Main Menu.

Note: When viewing the **PipeHawk** Status Screen, a number of other icons and their relative keys are displayed.

    Key 3.

    Key 4.

    Key 5.

These keys are solely for the use of the **PIPEHAWK PLC** customer service department and should not be accessed by user unless instructed to do so by **PIPEHAWK PLC**.

Pressing these keys can detrimentally affect the performance of your **PipeHawk if done by anyone other than an PIPEHAWK PLC technician**. If in doubt refer to **PIPEHAWK PLC** for advice.

5.0 Configuring and Using PipeHawk for Data Collection (The Data Collection Menu)

5.1 Introduction

In order to obtain the optimum performance from **PipeHawk** it is necessary to set up and use the system in a prescribed manner. This then allows data to be collected in the field and to be suitably documented if returned to the office for processing or archiving.

Radar data is collected by **PipeHawk** in terms of 3m scans, or linear movements of the system. Generally a data file consists of seven such parallel scans which are collected 0.5m apart and characterise a 3m x 3m area. Each scan in the data set is given an extension number, typically .001 to .007 recording the order in which the data is collected.

The operator may choose to record between one and five continuous 3m scans, corresponding to a total length of 3m to 15m. The operator may choose to enter a name that will be associated with the data set. If multiple scans are specified then a numerical suffix is added to the title of the second and subsequent files.

The operator may choose to carry out measurements by pushing the system forwards or pulling the system backwards.

The operator may also set the number of data averages carried out. This process is termed stacking and may aid signal quality. The more stacking that is carried out the higher the signal quality that may result, but the slower the speed at which the operator must push the **PipeHawk**. The number of stackings available ranges from 1 to 128, each increase doubles the value, ie 1, 2, 4, 8, 16, 32 etc. The default value of 8 should be used in most circumstances. With 32 the speed must be low. Higher stacking numbers may be required for deeper pipes.

All of the above parameters must be set to configure the **PipeHawk** to be ready to carry out radar measurements. The configuration steps will now be presented.

5.2 Configuring the PipeHawk for Scanning

5.2.1 *To Access the Data Collection Menu from the Main Menu*
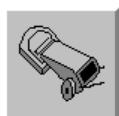
Press Key 4 Accesses the Data Collection Menu.

The operator should then select the number of continuous 3m radar scans to be undertaken. The default value is 1, the maximum is 5.

Press Key 2   To increase the number of continuous scans.

OR

Press Key 3   To decrease the number of continuous scans.

The operator should then select the stacking number. The default value is 8.

Press Key 4   To increase the stacking number.

OR

Press Key 5   To decrease the stacking number.

When the operator has made the selection for the number of continuous scans and the stacking number, the question displayed, "New Site?", should be answered. The options are: -

Press Key 1   For "yes". This action displays the menu for entering a new site name.

OR

Press Key 6   For "no". This actions allows an incomplete measurement to be continued (for example if the battery had become exhausted before completion).

5.3   Entering a Data Set Name

The seven softkeys are used to enter the Data Set Name. Two keys allow the operator to scroll through an extended alphabet in opposite directions to allow the next letter of the name to be selected. Other keys allow the selected letter to be added to the name, or the last letter entered deleted.

A further facility is the ability to recall the last name used and to edit it. This saves time when a whole series of files are to be named, which differ by the final number being progressively indexed.

5.3.1   Selecting a Character to Add to the Data Set Name

Key 1   Progresses through the extended alphabet from A to Z.

Key 2   Progresses through the extended alphabet from Z to A.

5.3.2   Delete the Last Character from the Data Set Name

Key 3   Deletes the last character.

5.3.3   Include the Selected Character to the End of the Data Set Name

Key 4   Includes the selected character.

5.3.4   Recall the Last Data Set Name
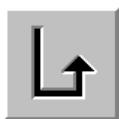
Key 5   Recalls the last data set name.

5.3.5   Confirm the Created Data Set Name

Key 6   Confirms the created data set name and enters it into the memory of the **PipeHawk**. All scanning will now be collated under this name until a new name is entered.

This key causes the Data Collection Menu to be displayed.

Key 7   Return to the Main Menu, causing the measurement to be aborted.

5.4   Data Collection Site Procedures

If the operator wishes to take advantage of the mapping facilities available with the **PipeHawk** software, then it is necessary to observe simple site procedures to ensure that the maps generated are a representation of the area scanned.

The figure below shows the protocol to be observed. It shows a 3m x 3m area to be scanned and the position of the scans if the mapping software is to be employed. As the operator approaches the area to be scanned, the first scan should be at the left of the scan start line, with subsequent scans progressively spaced to the right.
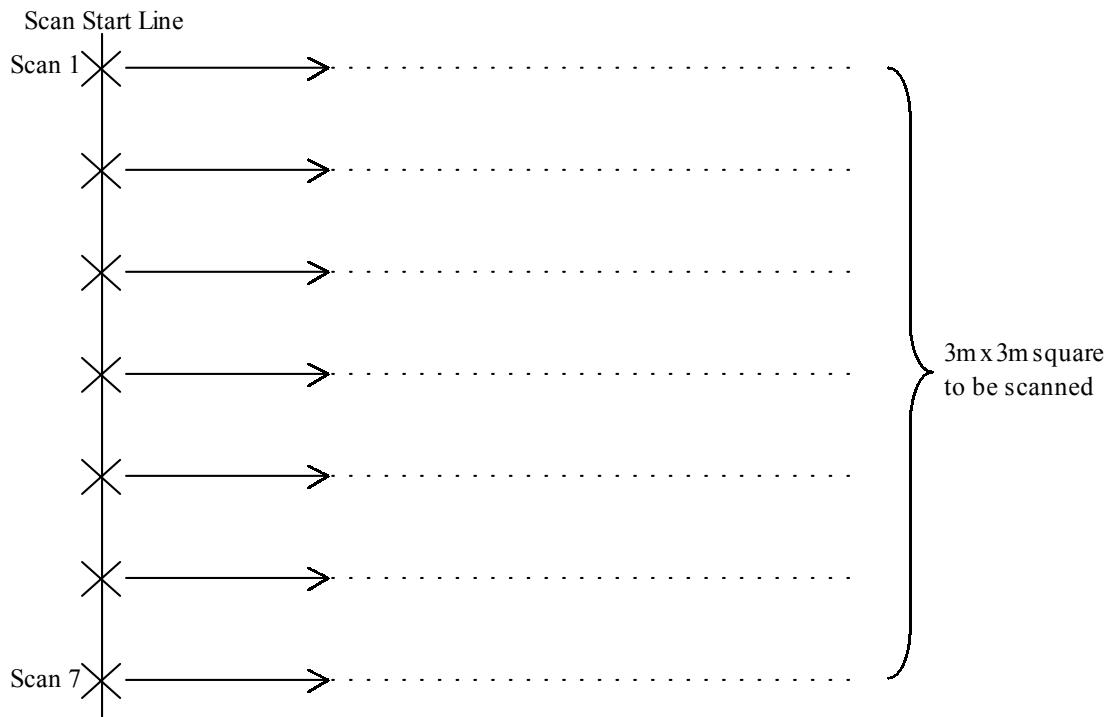
Figure 5.4.............Site Protocol to be Observed if the PipeHawk Mapping Facilities are to be Employed

5.5 Data Collection Menu

When either the new site data set name (5.3.5) is confirmed or the no new site key (key 6, 5.2.1) is pressed while configuring the **PipeHawk**, the Data Collection Menu is entered.

The **PipeHawk** should then be placed with the antenna aligned with the scan start line, and facing the measurement direction. Data collection may then take place.

5.5.1 Setting the Scanning Direction

Press Key 5

To select the scanning direction, which is displayed either as a right or left pointing arrow, in the Icon of Key 1, depending whether the scanning direction is forwards or backwards respectively.

5.5.2   Initiating the Scanning Process

Press Key 1   ▶   Forwards scanning.

OR

This initiates the scanning process, pushing or pulling **PipeHawk** as indicated by the direction of the arrow will trigger the radar to collect data.

◀   Backwards scanning.

The operator should push the machine until the scan is complete. The scanning process will stop automatically upon reaching 3m, 6m, 9m, 12m, or 15m point determined in Section 5.2 "Configuring the **PipeHawk** for Scanning".

If the operator is unable to complete the scanning process, possible because the path is obstructed, the scan may be terminated before it is complete.

5.5.3   Terminating a Scan
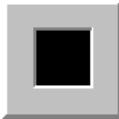
Press Key 3   ■   This will stop the scanning process early. This may be used if an obstruction is reached and the machine can not be pushed or pulled further.

When a scan has been stopped early the operator may either save the scan to memory or prevent it from being saved.

5.5.4   Save a Scan that has been stopped early?

Press Key 1   ✔   This will save the scan to memory.

OR

Press Key 7   ✘   This will prevent the scan from being saved to memory.

In normal operation, at this point the operator has completed one scan. If the mapping facilities within **PipeHawk** are to be employed, then the operator must position the system at the start of the second or subsequent scan as defined in figure 5.4, in the previous section. The operator should then re-initiate the scanning process as defined above and complete the required series of scans.

5.6   On-Site Data Review

Whilst in the Data Collection Menu referred to in the previous section, the Pull Back Function is available. This facility is an aid to on-site mark out, and is only available immediately at the time of measurement.

The on-site data review functions available are: -

5.6.1   The Scan Selection Function

Press Key 2

OR
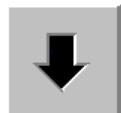
This allows the user to review other scans already collected within the data set. One key selects earlier scans and one key later scans than currently displayed.

Press Key 3

5.6.2   The Pull Back Function

Press Key 4

The Pull Back Function when activated will put a vertical line or cursor, at the right hand side of the display, which is indicative of the centre of the antenna (see figure 5.6). By physically moving **PipeHawk** along the scan line the cursor will move through the data display and enable the user to position the antenna directly over the centre of the target.

Arrows are marked on the side of the antenna to indicate where the ground should be marked.

Key 4 is again pressed to turn the pull back facility off.
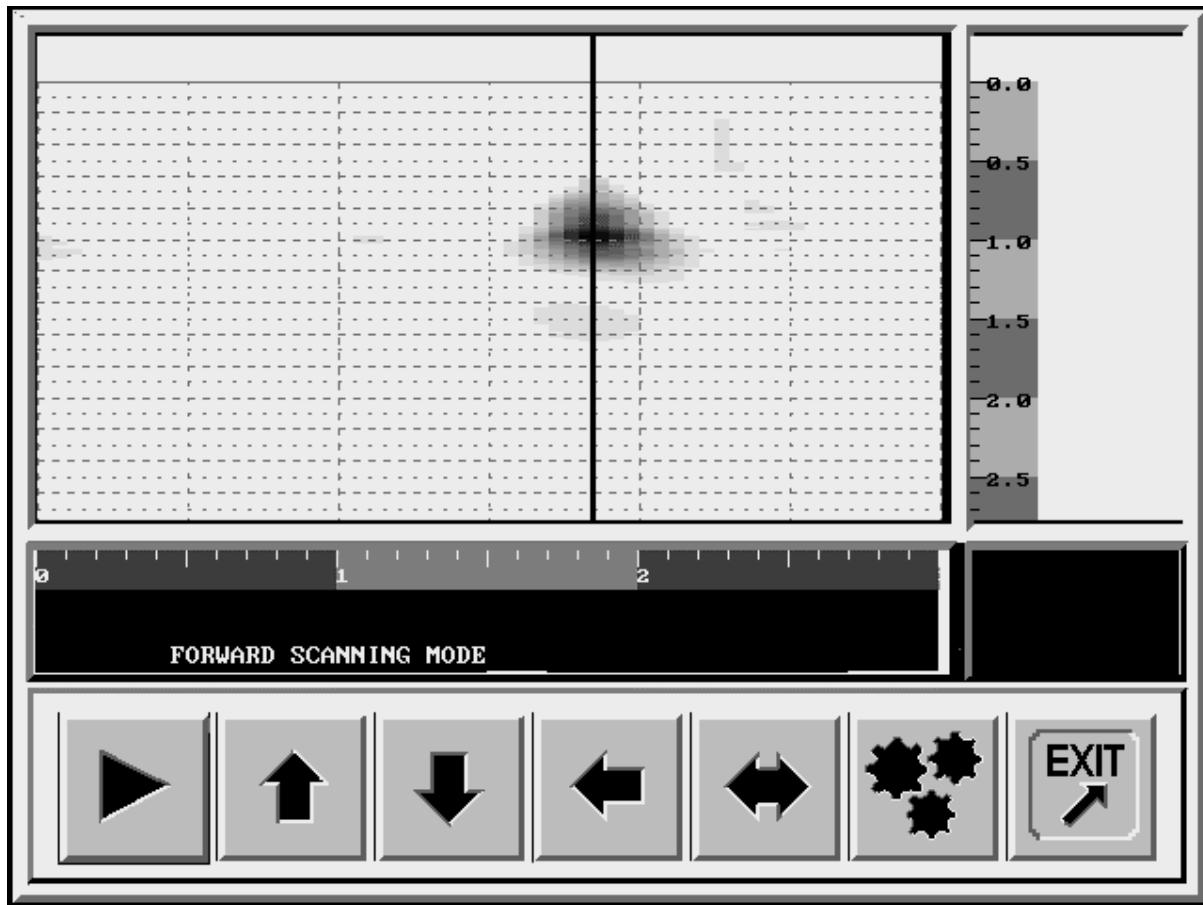
Figure 5.6.............Pull Back Display

5.6.3 Data Processing Options
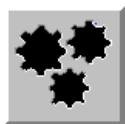
Press Key 6

This allows the user access to the processing controls and hence the ability to view single scan data in more than one processed format. The options available are the same as in the Data Review Menu (see Section 6.0).

5.6.4 Return to Main Menu

Press Key 7   Return to Main Menu.

6.0 DATA REVIEW

6.1 Introduction

The Data Review Menu and functions allow the operator to process and review the data that is stored on the hard disc. These features may be used at any time after the data is collected. When used for on-site mark out, this is immediately after the data collection and provides access to the mapping functions, and a more complete view of the area surveyed, while still on-site.

The data review process involves the selection of the data from the hard disc and the application of a range of processing options and procedures to the data.

6.2 Data Selection

The Data Selection Menu is accessed from the Main Menu by: -

Press Key 5   The Data Selection Menu is then displayed.

The Data Selection Menu displays a list of all the data files or data sets recorded on the hard disc. (If the system has not been down loaded for a long time this list may be long and slow down operations). The data displayed for each file includes the name generated in Section 5.3 and the time and date when it was created. This corresponds to the time and date the first scan was carried out.

Data is selected by scrolling a cursor, the ">" symbol down the left hand side of the list and then selecting a chosen data set or sets, when the "*", indicates the set which is selected. When the selection is confirmed the first scan of the chosen data set is displayed in the Data Processing Menu.

6.2.1 Data Selection

Press Key 1

OR   This scrolls the user up and down through the sequential list of data sets collected and stored on the machine. Move the ">" symbol to indicate a chosen data set.
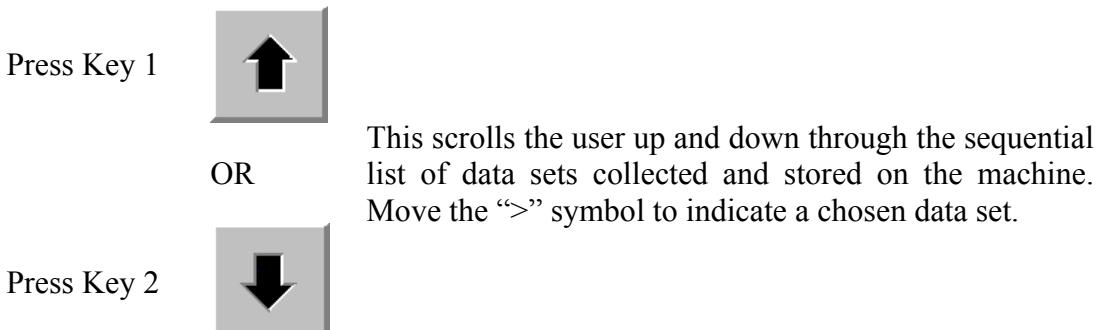
Press Key 2

6.2.2   Select Data

Press Key 3

Highlights the chosen data set with an asterisk "*".
Pressing again deselects the data set.

OR

Press Key 4

Highlights all data sets in memory for selection and
review. (To take advantage of this feature generally
requires effective management of the hard disc (see
Section 7.0), so that typically when this feature is
selected all the data collected in a day's measurement is
processed).

6.2.3   Data Processing Options
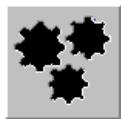
Press Key 6

This allows the user access to the processing controls
and hence the ability to view single scan data in more
than one processed format. The options available are
the same as in the data review menu (see Section 6.0).

6.2.4   Return to Main Menu

Press Key 7

Return to Main Menu.

6.2.5   Confirmation of Data Selection

Press Key 5

Confirms the selection of data set(s). The first scan of
the first data set is displayed in the Data Processing
Menu.

6.3   Data Processing

Following the data selection process the first scan of the selected data set is displayed, and
the operator is presented with a series of review options. These include the ability to: -

i.   Scroll both ways through the scans of the data set.

ii.   Overlay a measurement grid to the data.

iii.   Produce a map or plan images from the data set.

iv.   Select a number of different processing options.

v.   Print scan or map images of the data.

Each of these options will now be presented.

6.3.1 Scrolling Through Scans

Press Key 1

OR

This allows the operator to scroll up and down through the scans of the data set.

Press Key 2

6.3.2 Scale Grid Overlay

Press Key 4
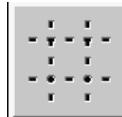
Depressing this key either switches on or off the scale grid overlay depending upon its initial state.

6.3.3 Processing Options

Press Key 6

This selects the Processing Options Menu that allows the data to be processed in different ways.

6.3.4 Mapping

Press Key 5

This selects the Mapping Menu, which processes the data to produce map or plan images of the area surveyed in the selected data set.

6.3.5 Printing

Press Key 1

Prints the radar scan currently displayed. (A further print option is present in the Mapping Menu).

6.3.6 Return to Main Menu

Press Key 7

Return to Main Menu.

6.4   Processing Options Menu

The Processing Options Menu allows data to be analysed in different ways. The two major options are identified as ID 2, which is the default at switch on, and ID 5, which provides the most effective processing for pipe location and mapping.

These two options should primarily be used. ID 2 may be recommended when **PipeHawk** is employed for data collection tasks where there is minimum review on-site. ID 2 incurs no processing delay but provides a representation of signals from pipes that can be recognised with experience. ID 5 carries out extensive processing and presents the radar data to the operator in the simplest format, but a processing delay occurs.

Two representations of the same data processed by ID 2 and ID 5 are shown in figures 6.4.1 and 6.4.2. ID 2 shows the response from a pipe as an extended hyperbola, ID 5 presents a much simpler representation of the same pipe.
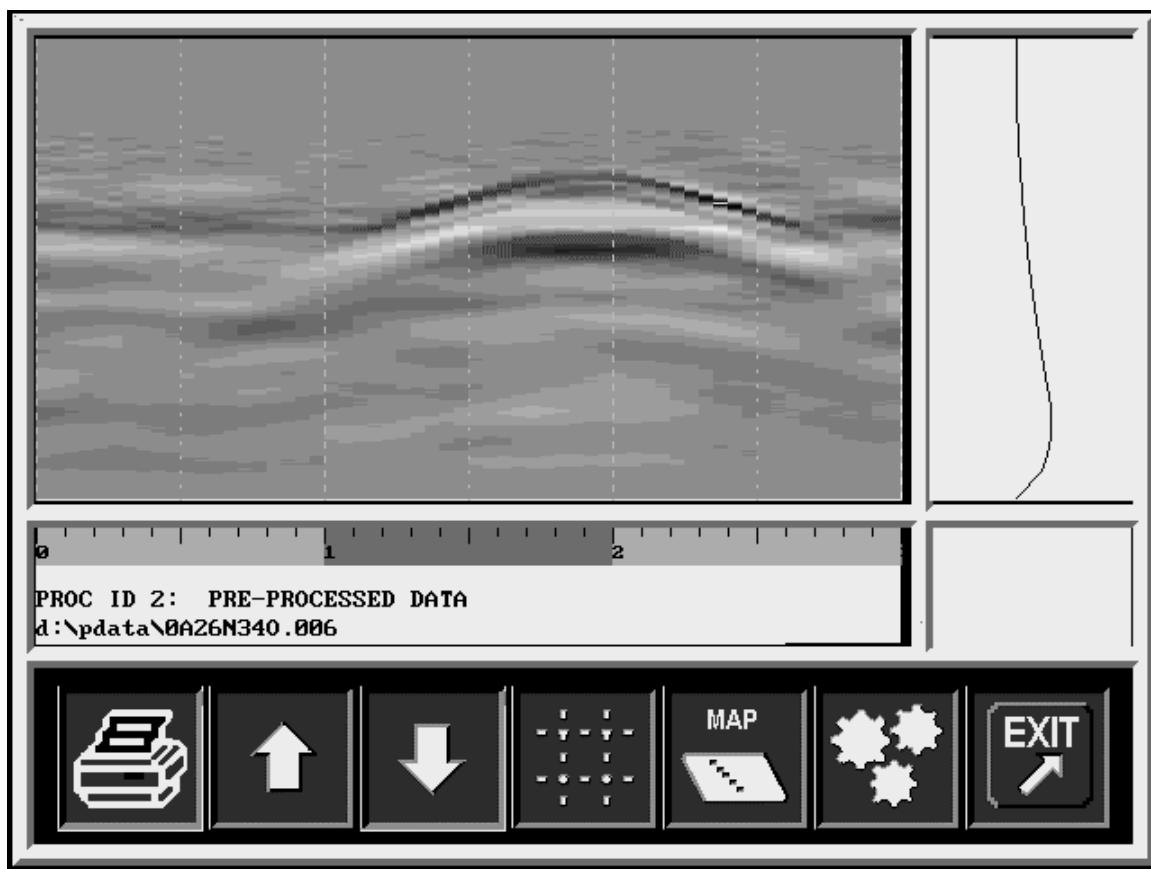

Figure 6.4.1..........ID 2 Processed Data
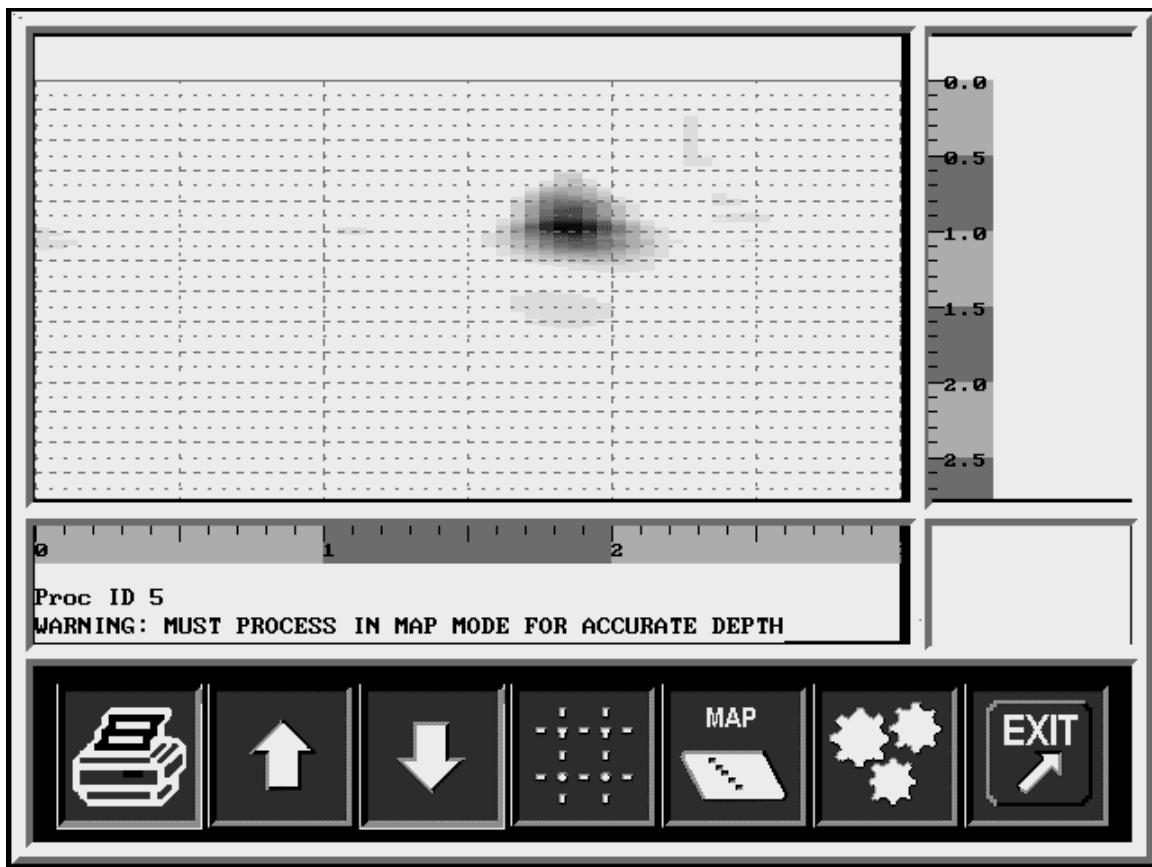
Figure 6.4.2..........ID 5 Full Processing

The images displayed are virtual cross-sections through the ground indicating the presence of a sub-surface anomaly. In ID 5 the target position can be determined approximately in both horizontal position and depth.

PipeHawk is fitted with extensive software that enables data to be processed in a number of different ways. The different processing routines allow the operator to select from either simple procedures that are almost instantaneous, through to extensive procedures that incur a short delay before the data is displayed. The different processes have different identification numbers (IDs) which are detailed below: -

Process ID Types

- ID 0   Raw Data

- ID 1   Profiled Raw Data

- ID 2   Pre-processed Data

- ID 4   Processing

- ID 5   Full Processing

- ID 8   Raw Data Waveforms (Service Use Only)

- ID 9   Processed Raw Data Waveforms (Service Use Only)

Details of the user options are presented below: -

6.4.1   ID 0 Raw Data

This is a grey scale representation of the raw data as recorded by **PipeHawk**, without any significant processing. Generally, the attenuation of the ground means that little information is displayed from deep targets.

6.4.2   ID 1 Profiled Raw Data

This is a grey scale representation of the raw data after it has been profiled to compensate for the effects of loss in the ground. Profiled raw data requires experienced user interpretation but does allow the data from **PipeHawk** to be interrogated for non pipe like sub surface features.

6.4.3   ID 2 Pre-processed Data

This is a grey scale representation of data that has been processed to enhance the presence of pipe like features whilst suppressing layer and background information. This is the default setting upon power up. Using this process the results are displayed to the operator almost instantaneously, however experienced interpretation is required.

6.4.4   ID 4 Processing

This is a cut down version of the full processing algorithm. It is designed to provide the user with a fast interpretation of the sub-surface situation. It should be noted that this processing option will not provide the same degree of accuracy as the full processing option ID 5.

6.4.5   ID 5 Full Processing

Full processing displays the response from each target as a compact response indicating the position of a target.

The other processing options available is to change the profile correction applied to the data to accommodate different soil characteristics. Like ID 0, ID 1, and ID 4, this feature should only be applied by experienced radar operators.

The default profile corresponds to "average" soil conditions, but the options are: -

- Very low loss
- Low loss
- Average
- High loss
- Very high loss

If an incorrect profile is being used information will only be displayed from part of the depth range of the system. Either there will be an emphasis on displaying shallow targets or deep targets. If only shallow targets are shown the profile may be changed to correspond to a higher loss situation. Similarly if only deep targets are shown it may be desirable to use a lower loss profile.

6.4.6 To Access the Processing Options Menu

Press Key 6   Accesses Data Processing Options Menu.

6.4.7 Changing the Processing ID Number

Press Key 1

OR   This cycles through the processing options.

Press Key 2

6.4.8 Changing the Profile
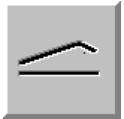
Press Key 4   Pressing this button cycles the profile sequentially through the options from low to high loss. The default is average.

6.4.9 Confirm the Processing Options

Press Key 3   Any changes in the processing options ID number or profile must be confirmed by pressing this key before they are implemented.

Press Key 7   This returns the user to the Data Processing Menu, where if it is pressed a second time the user is returned to the Main Menu.

6.5 Mapping Menu

When the Mapping Menu is accessed from the Data Processing Menu, which should be with ID 5 selected, the system sequentially processes each of the radar scans in the data set starting with the first scan. During the processing the display shows the scan processed, and the information below it indicates the scan number of the data that is currently being processed.

When all the radar scans corresponding to cross-sections in the ground have been processed, the scans are placed side by side, in the manner specified by the site procedures detailed in section 5.4, to form simple maps. The top left of the map corresponds to the starting point of scan 1 in the area surveyed, with the top right corresponding to the end point of scan 1.

There are a number of map options. The simplest option is the SUM map and corresponds to viewing all the radar returns summed together regardless of depth. If only one pipe or cable is present this produces an effective map showing its plan position, as a continuous line on the screen.

In complicated environments, where there are many pipes this simple map may be confused by several pipes at different depths. For these situations the map may be divided into seven equal depth slices, which together represent the full depth recorded.

In the display upon **PipeHawk** only one map may be shown at any one time, but if the print option is employed, all eight maps are printed out upon one sheet of paper as shown in figure 6.5. This shows the maps corresponding to layers 0 to 6 and the sum layer.

FIRST SCAN

LAST SCAN

LAYER 1 DEPTH 0.00-0.37 (m) LAYER 2 DEPTH 0.37-0.73 (m)

LAYER 3 DEPTH 0.73-1.10 (m) LAYER 4 DEPTH 1.10-1.47 (m)

LAYER 5 DEPTH 1.47-1.84 (m) LAYER 6 DEPTH 1.84-2.20 (m)

LAYER 7 DEPTH 2.20-2.57 (m) ALL LAYERS COMBINED
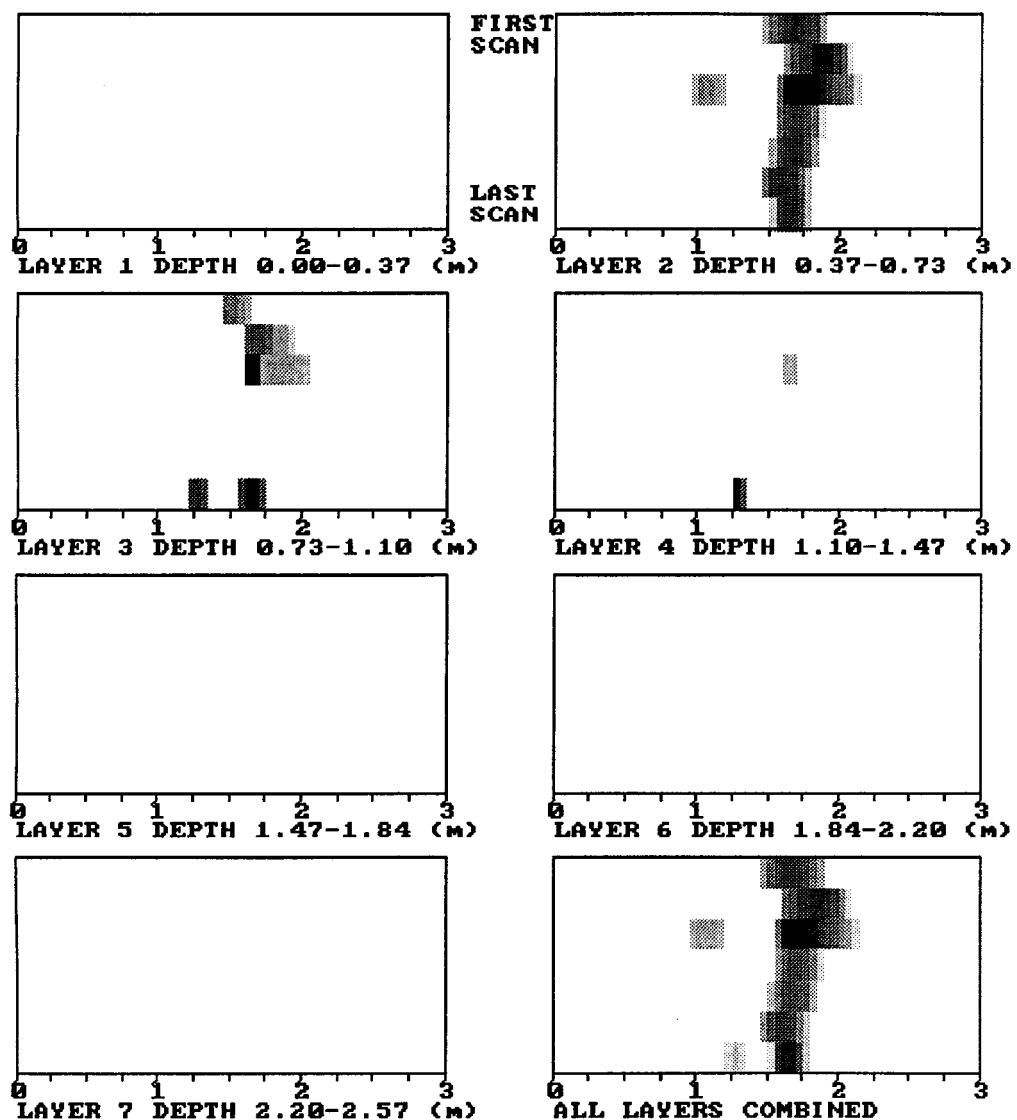
SOFTWARE VERSION 1 (BETA). 28.10.1999.

SCAN DIRECTION ----->>>

DATA OBTAINED FROM SITE
D:\

Figure 6.4.............An Example of the Printed Output from the Mapping Option

The Mapping Menu key press functions will now be defined.

6.5.1   Scroll through Map Layers

Press Key 1

OR

Press Key 2

These keys allow the user to scroll up and down through the map layers to identify the position of linear features.

6.5.2   Map Printing

At any time whilst within this Data Processing Menu a user may print out the data displayed on screen. This is usually sent to the Cannon Bubble Jet Printer provided with the **PipeHawk**. Assuming the adapter cable and printer cable are attached to the **PipeHawk**, printing can be carried out as below (the Cannon Bubble Jet is the default printer).

Press Key 4   Prints the map output (figure 6.5).

6.5.3   Viewing Other Selected Data Sets

Once printing has been carried out the user can view other highlighted data sets by the method outlined below.

Press Key 5

OR

Press Key 6

This shows other maps created from corresponding data sets. Again these can be printed as required.

7.0   DATA MANAGEMENT

7.1   Introduction

PipeHawk is a data measurement and recording system, and for effective operations it is essential that the data captured is properly managed. In order to achieve this three data management procedures are available within the system, they are: -

i.   The ability to down load or transfer data, from **PipeHawk** to a PC. This is normally required when the user has purchased the Office Processing Suite, or for data archiving.

ii.   The ability to transfer data from an external client PC to **PipeHawk**. This may be required if the **PipeHawk** system is the only processing system available for radar data, and it is required to process archived data.

iii.   The ability to delete redundant data from **PipeHawk**. Normally this procedure would be carried out after the data has been transferred to an external PC, and the user has verified the integrity of the transferred data.

Best practice data management procedures, indicate that the **PipeHawk** data should be routinely removed from the system, and office based back-up copies made. Although **PipeHawk** has a large hard disc, disc access times may increase if it contains many files and this may slow down operations.

The three data management functions are all accessed from the Data Transfer Menu and will now be presented. They all require that the **PipeHawk** system is connected to a separate PC.

PipeHawk must be turned off before connecting the adapter cable to the military style connector on the back plate of the machine. From here, the supplied down loading cable (parallel) should be attached to the adapter cable and hence to the printer (parallel) port of the Client PC to be used for down loading.

In order to facilitate data transfer to or from a Client PC, the operator must select the data to be moved, the directory to be used on the Client PC either as a receptacle or source for data, and the data transfer direction.

If data is to be transferred to the Client PC, a data directory should be created within that machine to store the data. This can be done either by using Windows Explorer or via a few simple DOS commands. When the directory is available double click on the Transfer icon on the Client PC (see transfer software installation, in the Transfer Software Manual if not already installed on PC). The Client PC is then ready to accept data and **PipeHawk** should be turned on.

7.2   Data Transfer from PipeHawk to the Client PC

7.2.1   Access the Data Transfer Menu from the Main Menu

Press Key 6   The Data Transfer Menu is accessed allowing the Client PC and **PipeHawk** to recognise each other and to communicate.

The Data Transfer Menu is then displayed. Near the top of the display is shown the options: -

> GO TO PH DIRECTORY

> GO TO PC DIRECTORY

This allows the user to select the source of the data to be transferred, either the **PipeHawk** (PH), or the Client PC (PC). There is only one data directory upon **PipeHawk**. Additionally, by going to the PC directory, it is possible to select the destination directory on the PC where the **PipeHawk** data will be transferred.

Below the directory selection is a list of the files in the selected directory, and at the bottom of the display for information purposes the current directory employed in the Client PC is indicated. The current directory is the destination where **PipeHawk** data will be transferred.

7.2.2   Selecting the Client PC to Accept Data

Press Key 1

Move ">" symbol to line reading

OR

"GO TO PC DIRECTORY"
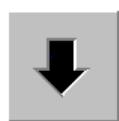
Press Key 2

Press Key 3   This enters the above selection and allows the operator to access the Client PC from **PipeHawk**.

7.2.3 Selecting the Client PC Hard Disc Directory for Data Storage (Assumed to be C:/ drive, but if available other options may be displayed)

Press Key 1 ⬆ Scroll cursor to hard disc drive holding directory for data storage, ie C:/.

OR The text information window near the bottom of the **PipeHawk** display will read: -

Press Key 2 ⬇ Current PC Directory C:/

Press Key 3 ↵ This confirms the above selection.

7.2.4 Selecting the User's Directory upon the Client PC for Data Storage

When the C:/ drive has been selected the available directory options are presented to the operator. The directory employed to receive the data must now be selected. (this is the directory generated in section 7.1).

Press Key 1 ⬆

To select the chosen directory for data storage.

OR The text window will read: -
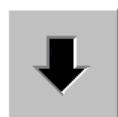
Current PC Directory C:/Data Directory

Press Key 2 ⬇

Press Key 3 ↵ This confirms the above selection.

At this point the directory to receive data on the Client PC has been selected, and the operators attention must now be directed towards selecting the data to be transferred from **PipeHawk**.

7.2.5   Access PipeHawk Directory

Press Key 1

OR

Scroll cursor to highlight: -

"GO TO PH DIRECTORY"

Press Key 2

Press Key 3   This confirms the above selection.
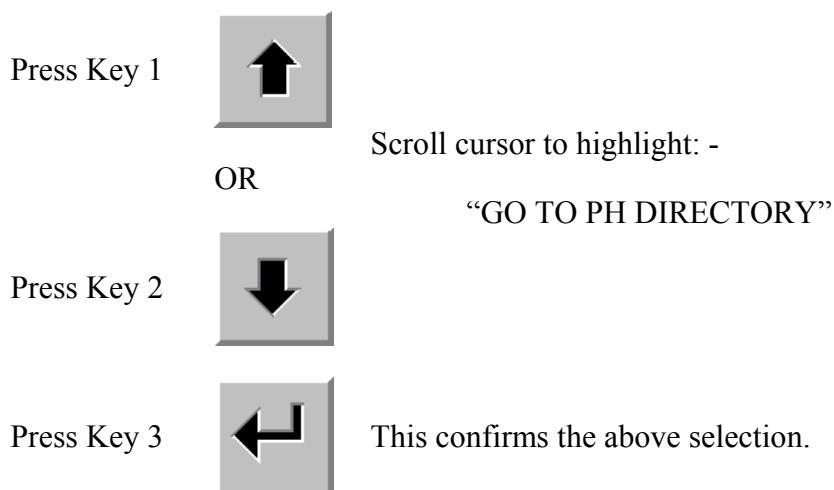
All the data set names resident on the hard disc of the **PipeHawk** are then displayed.   The files for transfer may then be selected in a similar manner to on the Data Review Menu.

7.2.6   Data Selection

Press Key 1

OR

This scrolls the user up and down through the sequential list of data sets collected and stored on the machine. Move the ">" symbol to indicate a chosen data set.

Press Key 2

Press Key 3   Highlights the chosen data set with an asterisk "*". Pressing again deselects the data set.

OR

Press Key 4   Highlights all data sets in memory for selection and transfer.

7.2.7   Data Transfer

Press Key 5   All the chosen data sets (highlighted by an asterisk) are copied from the **PipeHawk** hard disc to the chosen hard disc and directory on the Client PC.

7.3   Transferring Data from a Client PC to PipeHawk

This procedure is essentially very similar to that described above, but the data is transferred in the opposite direction. The requirement for this procedure arises when archived data needs to be reprocessed.

Preparations for this data transfer are made in the manner described in section 7.1, with the **PipeHawk** being turned off to make the cable connection. **PipeHawk** is then turned on. A double click on the Transfer icon on the Client PC ensures that this machine is ready for the transfer.

7.3.1   Access the Data Transfer Menu from the Main Menu

Press Key 6   The Data Transfer Menu is accessed allowing the Client PC and **PipeHawk** to recognise each other and to communicate.

7.3.2   Select the Client PC to Allow Access to the Required Data

Press Key 1

Move ">" symbol to line reading

OR

"GO TO PC DIRECTORY"

Press Key 2

Press Key 3   This confirms the above selection

*7.3.3   Selecting the Client PC's Data Storage Device
(Usually Drive C:/)*

Press Key 1   Scroll cursor to hard disc drive holding directory for data transfer, ie C:/

OR   The text information window near the bottom of the **PipeHawk** display will read: -
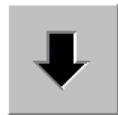
Press Key 2   Current PC Directory C:/

Press Key 3   This confirms the above selection

7.3.4 Select the Directory on the Client PC Containing the Data to be transferred.

When the C:/ drive has been selected the available directory options are presented to the operator. The directory employed to receive the data must now be selected. (This is contains the data to be transferred).

Press Key 1

To select the chosen directory for data storage.

OR   The text window will read: -
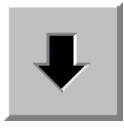
Current PC Directory C:/Data Directory

Press Key 2

Press Key 3   This confirms the above selection.

7.3.5 Data Selection

Press Key 1

This scrolls the user up and down through the sequential list of data sets collected and stored on the machine. Move the ">" symbol to indicate a chosen data set.

OR
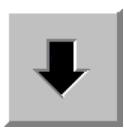
Press Key 2

Press Key 3   Highlights the chosen data set with an asterisk "*". Pressing again deselects the data set.

7.3.6 Data Transfer
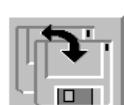
Press Key 5   This copies data from the chosen directory on the Client PC to the **PipeHawk** hard disc.

7.4   Deleting Data

Preparations for deleting data are made in the manner described in section 7.1, with the **PipeHawk** being turned off to make the cable connection. **PipeHawk** is then turned on. A double click on the Transfer icon on the Client PC ensures that this machine is ready for the transfer.

A Client PC must be connected to **PipeHawk** to delete data.

7.4.1   Access the Data Transfer Menu from the Main Menu
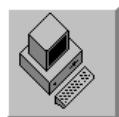
Press Key 6

The Data Transfer Menu is accessed allowing the Client PC and **PipeHawk** to recognise each other and to communicate.

The Data Transfer Menu is then displayed.

7.4.2   Selecting Data

Press Key 1

OR
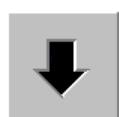
This scrolls the user up and down through the sequential list of data sets collected and stored on the machine. Move the ">" symbol to indicate a chosen data set.

Press Key 2

7.4.3   Delete Data

Press Key 6

This instructs the **PipeHawk** to delete the chosen data sets and accesses the Delete Data Confirm Menu.

7.4.4   Confirm Delete Data

Press Key 1

To confirm the data deletion. The data will then be deleted.

OR

Press Key 6

To decline the deletion.

8.0   PIPEHAWK SHUTDOWN

8.1   Normal Power Down

PipeHawk is powered down by pressing Key 7 of the Main Menu. This then accesses the Confirm Shutdown Menu.

8.1.1   Shutdown

Press Key 7   This begins the shutdown sequence and accesses the confirm shutdown menu.

8.1.2   Confirm Shutdown

Press Key 1   This confirms the shutdown request and the system shuts down.

OR

Press Key 7   Abort shutdown and return to the Main Menu.

8.2   Emergency Shutdown

An emergency shutdown facility is provided, which is not for routine use, but allows the system to be closed down in the event of, for example, the PC in **PipeHawk** crashing.

Press Key 6

and simultaneously   Both keys must be held down simultaneously for at least 10 seconds. The system will then shutdown.

Press Key 7