The Hunter River Basin
Agricultural Impact

- Coliforms (Total, E-Coli)
- Cyanobacteria (Anabaena)
- Ortho Phosphates
- Nitrate, Nitrite and Ammonia
- Turbidity and Conductivity
Monitoring Stations at Williams

- Available data
  - Lat/Long
  - Temperature
  - Water Level
  - Discharge

- Time Intervals
  - Day, Week, Month, 3 Months
## River Monitoring Sites

<table>
<thead>
<tr>
<th>HITS Sites</th>
<th>Station #</th>
<th>Lat</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALLYN RIVER @ HALTON</td>
<td>210022</td>
<td>-32.3078</td>
<td>151.5117</td>
</tr>
<tr>
<td>PATERSON RIVER @ GOSTWYCK</td>
<td>210079</td>
<td>-32.546</td>
<td>151.5909</td>
</tr>
<tr>
<td>CHICHESTER @ CHICHESTER</td>
<td>210136</td>
<td>-32.2028</td>
<td>151.6319</td>
</tr>
<tr>
<td>WILLIAMS RIVER @ DUNGOG</td>
<td>210903</td>
<td>-32.3962</td>
<td>151.7595</td>
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<tr>
<td>WILLIAMS RIVER @ GLEN MARTIN</td>
<td>210010</td>
<td>-32.5602</td>
<td>151.8031</td>
</tr>
<tr>
<td>WILLIAMS RIVER @ TILLEGRA</td>
<td>210011</td>
<td>-32.3203</td>
<td>151.6861</td>
</tr>
</tbody>
</table>
Content

- Funding
- Hardware
- Software
  - Desktop / Laptop
  - Pocket PC
- Data Collection and Data Linking
- GIS and Hydrologic Modeling
- Future Work
Why Wireless

- Seamless Data Sharing Amongst Environmental Engineers
  - In the field
  - @home
- PocketPC to WWW
  - Processing
  - Manipulation
  - Output
Tradeoffs

- Data processing capabilities
- Cost
- Wireless coverage
- Equipment in the field

- Cut original project by $2000!!!!
Why 802.11B – COR-1100

- No Wireless Coverage in the Field
  - Except Satellite Phones
- Normal AP’s range 300ft
- Powerful (3000ft)
- COR-1100 w/ Antenna ranges 16 miles
- iPaq Side is Silver Orinoco
- Data Rate is 11Mbps
- Cost is $2100
## GSM/GPRS vs Satellite

<table>
<thead>
<tr>
<th>Feature</th>
<th>Satellite</th>
<th>GSM/GPRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coverage</td>
<td>100%</td>
<td>Possibly Spotty</td>
</tr>
<tr>
<td>Price</td>
<td>$1624</td>
<td>$1096.90</td>
</tr>
<tr>
<td>Usage</td>
<td>50mins/month</td>
<td>10MBs/month</td>
</tr>
<tr>
<td>Extra Use Cost</td>
<td>$1.39/min</td>
<td>$4.00/MB</td>
</tr>
<tr>
<td>Use Cost in Australia</td>
<td>$2.39/min x 40mins</td>
<td>$10.00/MB x 10MB</td>
</tr>
<tr>
<td></td>
<td>= $95.60</td>
<td>= $100.00</td>
</tr>
<tr>
<td>Data Rate</td>
<td>19.2kbps</td>
<td>Up to 64kbps w/ GPRS</td>
</tr>
</tbody>
</table>

Use Cost in Australia:
- Satellite: $2.39/min x 40mins = $95.60
- GSM/GPRS: $10.00/MB x 10MB = $100.00
## Motorola P280 vs Ericsson T28W

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ericsson T28W</th>
<th>Motorola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Connectivity</td>
<td>Directly to Phone (or PocketPC)</td>
<td>Via Attached Infrared Modem</td>
</tr>
<tr>
<td>Network Capability</td>
<td>GSM</td>
<td>GSM/GPRS</td>
</tr>
<tr>
<td>Price for Equipment and Service</td>
<td>$500</td>
<td>$1096.90</td>
</tr>
<tr>
<td>Data Rate</td>
<td>9.6kbps</td>
<td>Up to 64kbps w/ GPRS</td>
</tr>
</tbody>
</table>
GPRS/GSM Motorola P280

Features

- Reasonable Coverage
- Moderate Cost = $1075
- Data Rate = 64Kbps
- IP internet connection
Input Devices

- **iPaq 1**
  - GPS
  - Hydrolab
    - 3 per Session
  - UI
    - minimal

- **iPaq 2**
  - UI On Session Data
    - Based on ENVIT Calc
  - UI On Flow Data
    - Based on external instruments
Communications

- iPaq 1 to iPaq 2
- iPaq 2 to Laptop
- Laptop to WebServer
- WebServer to Web
- Infra Red (IrDa)
- 802.11b (COR-1100)
- GPRS (GSM Phone)
- MIT Static IP
IrDa

- Through the protective Case
- Only GPS and Hydrolab DBs sent
- Nothing is linked on the iPaq
802.11b

- Silver Orinoco Card in iPaq 2
- Gets fixed IP on Envit Network
- Communicates up to 26 miles to Antenna
- OmniDirectional Antenna is 2.4Ghz
- Attaches to Orinoco Card in COR-1100
- COR-1100 connects to Laptop using Ethernet Cross-over
- Information is transferred via MS ActiveSync on user command.
GPRS

- Laptop connects via USB to phone
- Phone obtains IP from Telstra
- Transfers Data directly to ENVITWEB
Software Architecture (client/server)

User System Interface (Client Layer)

Process Management Layer (Server Layer)

Database Management Layer (Server Layer)
Software Architecture (client/server)

- **Web**
  - Browser
  - SQL Server 2000
  - ADO/ODBC
  - ActiveSync
- **Desktop**
  - Desktop GIS
  - SQL Server 2000
  - ADO/ODBC
  - ActiveSync
- **Laptop**
  - Laptop
  - SQL Server
  - ADO/ODBC
  - ActiveSync
- **PocketPCs**
  - PocketPC
  - SQL Server CE 2000
  - ADOCE/ODBC
  - ActiveSync

User System Interface (Client Layer)

Process Management Layer (Server Layer)

Database Management Layer (Server Layer)
1) GUI's:
   - UISession DB
   - UIHydro/GPS DB
   - UIFlow/GPS DB

2) Database management
   - store/edit/sync data from PocketPCs
     > session data
     > hydro data
     > flow data
     > GPS data

3) ArcView enabled
4) Web enabled
- ArcIMS
  (Web server for GIS)
  to make our
  application Web
  enabled

5) GIS Web Services &
  Location-based Services
- XML requests/responses
- XML Schemas
  (data representation
  format)
- .NET (complete solution)
- (J2EE)
Software Architecture

- Web
  - Browser
  - SQL Server 2000
  - ADO/ODBC
- Desktop
  - Desktop GIS
  - SQL Server 2000
  - ADO/ODBC
- Laptop
  - 
  - SQL Server CE 2000
  - ADO/ODBC
- PocketPCs
  - 
  - SQL Server CE 2000
  - ADO/ODBC

User System Interface/Client Layer (top-tier)

Process Management Layer (middle-tier)

Database Management Layer (bottom-tier)
Software for Pocket PCs

- Recording environmental, geologic data in the field through a more efficient way.
Major Competitor

Field Data Recorder

- RockWare Inc., July/01
- Price: $199 / license

Features

- Store data in MS Access format
- Retrieve X-Y data from GPS
- View data through forms / spreadsheets
- Transfer data to desktop PCs
- Back up data on Compact Flash Cards
Developing Tools and Software Architecture

- Developing Tools
- SQL Server 2000
- SQL Server CE 2000
- Embedded Visual Basic / C++ 3.0
- ActiveSync 3.5
Data Storage and Transfer

- Database / Tables
- ADO / ADOCE
- Remote Data Access
  - ActiveSync / CE
  - Relay
- Microsoft .NET MIT
- Mobile Internet Toolkit (MIT)
- ActiveSync
- ADOCE
- SQL Server CE 2000
- Hydrolab Data
- GPS / GIS Data
- Pocket PC Local Database (SQL Server CE 2000)
## EnviroCom vs. RockWare Inc.

<table>
<thead>
<tr>
<th>Feature</th>
<th>STEFS (EnviroCom)</th>
<th>FDR (RockWare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Interface</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>DB Performance</td>
<td>V (SQL Server CE)</td>
<td>X (MS Access)</td>
</tr>
<tr>
<td>Wireless</td>
<td>V</td>
<td>X</td>
</tr>
<tr>
<td>Multi-threaded Data Collect.</td>
<td>V (HTTP)</td>
<td>X (ActiveSync)</td>
</tr>
<tr>
<td>Data Collect.</td>
<td>V (Manual / Auto)</td>
<td>X (Manual)</td>
</tr>
<tr>
<td>Voice Record.</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Backup DB</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>GPS / GIS</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>Price</td>
<td>Call</td>
<td>$199 / licence</td>
</tr>
</tbody>
</table>
Data Collection & Linking

Planned Data Collection in Australia
Where?
GPS Data
Making a X-section

\[(W/10) \times I\#\]

- Actual Flow Reading Point
- Line Between Average Points
- Adjusted Shore Point

Width Generated by Flow UI
Data Linking (Contd.)

- The GPS Data will be averaged in shore side.
- Two shore side averages will be assigned to a session.
- Three Hydrolab readings will be assigned to a session and positioned based on shore sides only.
- Twenty Flow readings will be assigned to a session and positioned based on shore sides, width, and width interval.
The Watershed Approach

- Investigation of point source and non-point source pollution on a large scale – every drop of water that could possibly find its way to you!

- Impacts on local ecology, drinking water quality, and aesthetics.
Watershed Models

- **FHM-FIPR Hydrologic Model**
  - Foundation for Information Policy Research
- **SWATMOD**
  - Surface Water Assessment Tool
- **HSPF**
  - Hydrological Simulation Program - FORTRAN
Williams River

- Non-Point source pollution from Agricultural Runoff
  - Pesticides
  - Fertilizers
- Our field study
  - Does the excess nutrient loading affect water quality?
  - Can the loading be quantified by existing data and data collected on our field study?
  - Can we predict quality outcomes if parameters change?
Pertinent Data

- Topography
- Soils
- Land Use
- Aerial Images
- Monitoring Stations
  - Stream Flow
  - Rainfall
Hunter Integrated Telemetry System

- Permanent Site Sensors Collect Data and Publish it on the Web for the Hunter River Basin in Australia
<table>
<thead>
<tr>
<th>ID</th>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Add what's new frame</td>
<td>11/9/2001</td>
<td>11/9/2001</td>
<td>1d</td>
</tr>
<tr>
<td>2</td>
<td>Add todo frame</td>
<td>11/9/2001</td>
<td>11/9/2001</td>
<td>1d</td>
</tr>
<tr>
<td>3</td>
<td>Update flash page</td>
<td>11/9/2001</td>
<td>11/9/2001</td>
<td>1d</td>
</tr>
<tr>
<td>5</td>
<td>UIFlow DB</td>
<td>11/9/2001</td>
<td>11/12/2001</td>
<td>2d</td>
</tr>
<tr>
<td>6</td>
<td>UISequence DB</td>
<td>11/12/2001</td>
<td>11/13/2001</td>
<td>2d</td>
</tr>
<tr>
<td>7</td>
<td>SSOIn-Out Equipment Page</td>
<td>11/12/2001</td>
<td>11/13/2001</td>
<td>2d</td>
</tr>
<tr>
<td>8</td>
<td>Standard Syncs for each iPaq</td>
<td>11/9/2001</td>
<td>11/12/2001</td>
<td>2d</td>
</tr>
<tr>
<td>9</td>
<td>Fix Software Page (Orange and make more info)</td>
<td>11/9/2001</td>
<td>11/12/2001</td>
<td>2d</td>
</tr>
<tr>
<td>10</td>
<td>Make prev and forw links</td>
<td>11/9/2001</td>
<td>11/12/2001</td>
<td>2d</td>
</tr>
<tr>
<td>11</td>
<td>Hydro DB</td>
<td>11/12/2001</td>
<td>11/16/2001</td>
<td>5d</td>
</tr>
<tr>
<td>12</td>
<td>UISequence DB</td>
<td>11/12/2001</td>
<td>11/16/2001</td>
<td>5d</td>
</tr>
<tr>
<td>13</td>
<td>UIFlow/GPS DB</td>
<td>11/12/2001</td>
<td>11/23/2001</td>
<td>10d</td>
</tr>
<tr>
<td>14</td>
<td>Hydro/GPS DB</td>
<td>11/12/2001</td>
<td>11/23/2001</td>
<td>10d</td>
</tr>
<tr>
<td>16</td>
<td>Set-up Scheduler to send info regularly</td>
<td>11/12/2001</td>
<td>11/23/2001</td>
<td>10d</td>
</tr>
<tr>
<td>17</td>
<td>Prepare ArcView application</td>
<td>11/12/2001</td>
<td>11/23/2001</td>
<td>10d</td>
</tr>
<tr>
<td>19</td>
<td>Load Envit iPaq on all iPaqs</td>
<td>11/9/2001</td>
<td>11/29/2001</td>
<td>15d</td>
</tr>
</tbody>
</table>
A Glimpse of Russ’s Future