

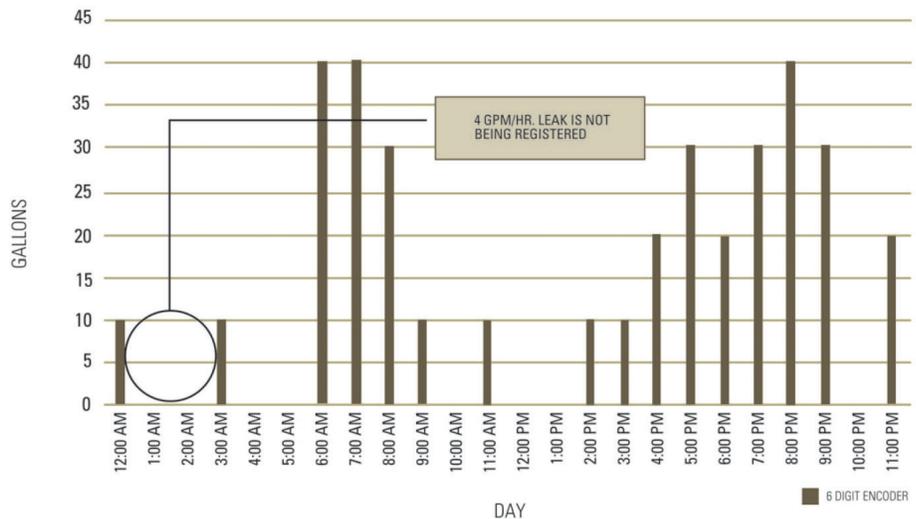


# CONSERVATION, CUSTOMER SERVICE AND ADVANCED LEAK DETECTION THROUGH RADIO FREQUENCY AMR/AMI SYSTEMS

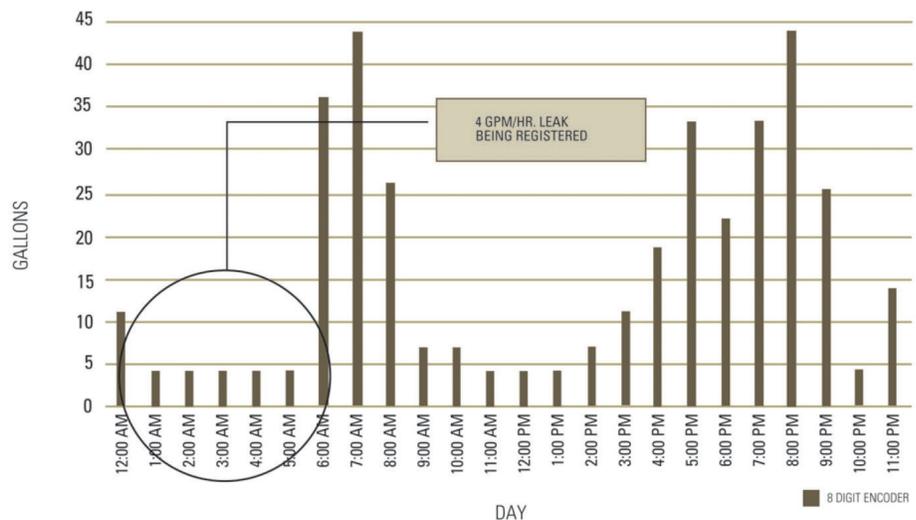
## E-Coder® High-Resolution Data as the Foundation for Leak Detection

In the face of revenue pressures, increasing operational costs, and manpower shortages, utilities can't afford to ignore water loss. Nor can they afford to literally underestimate the problem. As utilities review better methods to conserve water and control costs, leak detection has become a critical component of any modern utility management system. This paper will explore how utilities utilizing Neptune Technology Group's mobile automatic meter reading (AMR) and fixed network advanced metering infrastructure (AMI) systems can build successful leak detection programs.

In either Neptune's AMR or AMI system, the keystone and starting point is the smart encoder – the E-Coder® solid state absolute encoder. An E-Coder-based system provides an advanced level of leak detection and detailed consumption data that accurately identifies water leaks on the customer side of the meter. Providing advanced 8-digit, high-resolution data, the E-Coder provides resolution down to 1/10th of a gallon (1/100th cubic foot, 1 litre). This allows the utility to identify leaks that might otherwise be overlooked by lower-resolution encoder registers that cannot deliver granular enough data to the AMR/AMI system to enable post-processing leak detection.



Graph 1 – 6-digit encoder

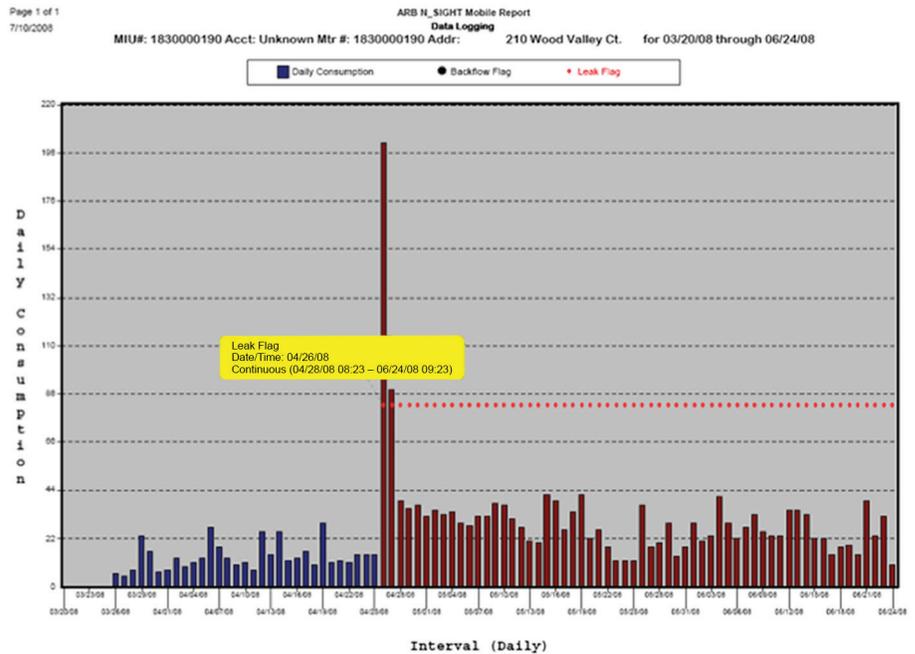


Graph 2 – 8-digit encoder

The E-Coder divides each 24-hour day into 96 15-minute intervals and monitors flow during each of those intervals. The E-Coder continually checks for consumption in each 15-minute interval, while its “smart” metrology distinguishes between intermittent and continuous leak conditions. It also keeps track of the number of days the leak condition has existed. The E-Coder sets flags in the register to mark these leak conditions, updating the flags every 15 minutes. This level of advanced data, E-CoderPLUS data, is a valuable tool in water conservation and customer service.

A small leak may seem insignificant. But if not caught early, it can add up to a significant volume of water. Leak detection for most competitive systems is dependent on meter reading resolutions of 1 to 10 gallons from conventional 6-digit encoders. At best, these systems have to rely on algorithms programmed into the meter interface unit (RF MIU) or software analysis at the host to “infer” that a leak state existed – never really knowing whether there was a true leak. The fact of the matter is that a 6-digit encoder may not increment in an hourly interval with flows that are indicative of leaks, so neither the algorithm in the MIU or post-processing in the host can accurately determine whether a leak has in fact occurred.

Consumption graphs based on Neptune’s E-Coder further illustrate the value of the E-Coder’s 8-digit resolution. Graph 1 shows a typical residential utility service connection using a traditional 6-digit encoder with a visual registration of 10 gallons. Graph 2 demonstrates the same residential utility service connection with the E-Coder’s 8-digit reading, which provides 1/10th of a gallon resolution. This residence developed a four-gallon-per-hour leak at 12:00 a.m. (See the circled area on Graph 2.) The E-Coder’s 8-digit resolution not only identifies the leak but also displays the consumption when the leak starts. Additionally, the E-Coder sets flags for each 15-minute interval during a



Graph 3 – Leak Flag

24-hour period when this leak is present. With a 6-digit encoder, the leak could be masked, as this consumption would not register for three hours until the low-resolution encoder incremented, and in all likelihood would appear as normal consumption.

Neptune’s R900® radio frequency (RF) MIU (as well as the integrated E-Coder®)R900™ unit) offers data logging capabilities, transmitting a rolling 96 days of hourly meter readings, plus leak and reverse flow flags. The hourly readings and leak flag data generated by the E-Coder are transmitted by the MIU, collected via handheld, mobile, or fixed network means, and then automatically imported to N\_SIGHT™ software, where utilities can view reports that identify not only when leaks start but also the duration of the leak event.

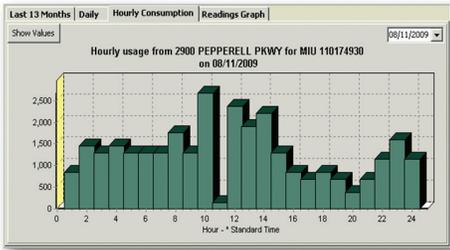
### Data Logging as a Customer Service Tool

Historically, when responding to customer calls regarding high water bills, a utility’s only option was to issue a service order and dispatch a technician to the residence where the complaint occurred. The technician would then go through the process of ensuring that all

of the external faucets were turned off, verify with the customer that no water was running in the home, and then check the leak indicator on the water meter. Sometimes the technician could verify the leak on the spot, but other times he or she would leave the homeowner frustrated and unhappy about their water bill.

Data logging such as that available through Neptune’s E-Coder records consumption as it happens, every hour, allowing utilities to analyze usage patterns as proof of when and how much usage occurred. This historical consumption data can then generate consumption graphs within N\_SIGHT software. These graphs are available for either daily or hourly consumption. Leaks can be identified either when usage does not reach zero over a 24-hour period or when an E-Coder leak flag is triggered. In addition, reverse flow events are also illustrated. For example, Graph 3 indicates daily consumption collected over the time period and shows a leak flag, the start date, and time of the leak.

The daily or hourly consumption graph can be given to the customer – identifying when water was consumed and flagging leak states that



Hourly Usage Graph

Date	Consumption	Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6	Hour 7
08/11/2009	30611	839	1451	1298	1451	1298	1298	1298
08/09/2009	41029	902	902	1312	1722	2338	2543	2748
08/08/2009	42100	1294	833	1465	2096	1886	2307	2729
08/06/2009	37369	1113	926	1300	1300	1300	1487	1487
08/06/2009	37369	1113	926	1300	1300	1300	1487	1487
08/05/2009	33134	1118	1284	1284	1450	1450	1615	2444
08/04/2009	36482	730	1094	1824	1277	1459	1642	2006
08/04/2009	36482	730	1094	1824	1277	1459	1642	2006
08/03/2009	32317	2003	549	872	1033	2326	145	1660
07/31/2009	31228	611	611	1080	1392	1236	1236	1861
07/31/2009	31228	611	611	1080	1392	1236	1236	1861
07/29/2009	29198	946	654	1822	1238	1384	143	1384

Hourly Volumes Table

help justify the amount charged on the bill, and resolve any issues. This kind of proactive approach enhances customer service. Customer service representatives can, with the click of the mouse, pull up hourly, weekly, and monthly usage information to assist in resolving high water bill complaints. Up to two years of consumption history is retained

in the N\_SIGHT™ PLUS host software, and up to 10 in N\_SIGHT™ IQ, so consumption data can be compared from one year to the next for the same period of time. Consumption data is displayed in graphical and tabular formats, making analysis quick and easy.

Utilities that seek to proactively notify their customers of potential leaks can have their billing or customer information system provider transfer the E-Coder leak information directly to their customers' bills, allowing customers to fix water leaks before the condition reaches the point where they issue a high water bill complaint.

### Detecting Leaks on Distribution Mains

For utilities using the R900 System, Neptune has combined its ARB® technology with field-proven acoustic leak monitoring devices. When mounted on a distribution main, the acoustic sensor "listens" for leaks, and transmits that data through the MIU and on upward to the host software for early notification of distribution main leaks. Through this type of supply line monitoring, utilities can take a proactive approach to these conditions and repair leaks prior to distribution main breaks and potential loss of millions of gallons of water.

### Mass Balancing and District Metered Area (DMA) Monitoring

Neptune's fixed network data systems allow utilities to compare production water versus revenue water and conduct District Metered Area (DMA) analyses. Using the system's meter readings, the utility will have the total consumption for any given collection of meters within a district or "area". This total consumption is compared to the master or "bulk" meter(s) servicing the area. Systems having a large discrepancy between the total consumption in the area and the respective master meter(s) are indicative of potential distribution system leaks within a particular area.

Water leaks in any form – leaks at the meter on the customer side or leaks along the distribution system – can be extremely costly for a utility. Using Neptune's smart encoders, data logging, acoustic leak noise sensors, and fixed network AMI data, utilities can help prevent the loss of millions of gallons of water while recapturing revenue.

