Courtesy of Cambridgeshire County Council

Everybody back on the bus

The world's longest guided busway is almost ready in Cambridgeshire. Mark Smulian finds out how it was built, and why the county council didn't want a railway or road

How do you get two buses to pass safely on something only 6m wide? And how do you persuade the occupants of expensive homes in semi-rural locations to swap their cars for a bus?

Cambridgeshire County Council's solution has been a guided busway, which now snakes 20kms from St Ives to the northern edge of Cambridge and then resumes at the city's station and runs 5kms to Trumpington. Buses use conventional roads while crossing the city centre.

It is now likely to open in the early summer, more than two years late. The reasons for this delay are complicated, but the actual construction was simple and the council's head of delivery Bob Menzies thinks busways have "tremendous potential".

Even in the current financial climate Cambridge's booming economy brings huge growth pressures, with new housing being built around the city and a 9,500-homes new town planned for Northstowe, the former RAF Oakington site.

The A14, the main road across Cambridgeshire, was already overcrowded, and the council needed to accommodate the growing economy without bringing traffic to a grinding halt. Luckily, a disused railway ran roughly parallel to the A14 from Cambridge past Northstowe to St Ives.

Rail enthusiasts pressed for reopening, but quite apart from the cost there was the problem of inflexibility; unlike a train, a bus can go anywhere.

'the council needed to accommodate the growing economy without bringing traffic to a grinding halt'

Another option was to use the alignment as a road. That proved impossible because it crossed the Great Ouse floodplain and widening the rail embankment to carry even a normal road would have damaged the vital water management system left when Dutch engineers drained the fens in the 17th century.

So the idea of a guided busway evolved, based on a long-established one at Essen, in Germany.

It uses concrete sections on top of the rail embankment on which buses run guided by small rubber wheels that project from the sides of the vehicles to hold them to the concrete wall. This has the extra benefit of giving an unusually smooth ride.

to keep 'jacking and packing' stuff back up again, so what we have got now is sections on piles and a series of 50m beams that span the piles supported at the ends and middle, so it is a structure rather then a pavement.

"Piled foundations have been laid up to 15m deep through very soft clay then into gravel. The embankment is still there, but it's not doing much structurally."

Ground conditions varied widely with a mix of clays with different properties "so pad foundations have different treatments on them", he says. The short southern section is though on chalk.

Most bridges were high enough to clear double decker buses,

Courtesy of Cambridgeshire County Council

The buses run on fixed tracks 2.6m wide, making the busway only 6m wide with a mere 800mm separation, while a road would be 7.3m wide and need wider support. Passing so close would be unsafe on a normal road, even if reserved for buses, but the guided system meant the embankment could be used without widening and damage to the flood plain. It also means buses can safely run at 56mph – the maximum allowed by public transport speed limiters – for the whole length except for a few level crossings with roads.

While the busway needed the same width of support as the abandoned railway, its nature was very different.

Mr Menzies explains: "We had to remove the ballast and start again. It was not particularly stable because the rail technique is

but a new one was needed at the Windmill, where the busway could not be practically lowered.

A larger project was the replacement of the Great Ouse viaduct. "We had to build it from scratch because the old railway viaduct cast iron spans were completely shot," Mr Menzies says.

"They were craned out and a new bridge built with steel beams on a concrete deck with concrete piers on deep piled foundations."

Because low-lying Cambridgeshire is prone to flooding, careful attention was paid to rebuilding and replacing culverts. Indeed, the busway itself could flood, but only in a once in 25-50 years probability.

The trickiest civil engineering was an underpass for the

Far left: Guided bus on the new busway
Left: Small rubber guide wheel

‘The trickiest civil engineering was an underpass for the busway at Hills Road, on the southern section, adjacent to the main rail line to London’

Courtesy of Cambridgeshire County Council

Left: 15m precast track sections

busway at Hills Road, on the southern section, adjacent to the main rail line to London.

“We did it using top down construction in short slices in a very constrained working area,” he explains.

“It was necessary to punch a new bridge through piled sections, casting a deck in each section and digging out underneath, while squeezed between the railway and a signal box. We had to move railway cables and deal with underground signal cables.

“It was far and away the most complex thing we did, but it was worth it to get underneath the main road because that means we are not obstructed by crossing traffic and buses get a clear run.”

The busway here follows the alignment of the disused Cambridge-Bedford rail line.

A special machine, called the gantry, was built to lay the track, which when going at full speed could lay 100m of double track a day. A traditional crane could not easily have fitted the busway’s constrained width. Track was precast in 15m concrete sections at a temporary factory at Longstanton, the northern section’s mid-point, and taken on transporters to the gantry along sections of track already laid. They were then lifted by four forks to the front of the gantry and set into position on the foundations.

“Our contractor BAM Nuttall came up with the idea of pre-casting units and then using the gantry to put them in place,” Mr Menzies says.

“It needed a special machine because nobody had built anything like this before here, though the gantry had now been broken up for scrap value.”

Construction delays meant the project missed its intended February 2009 opening, but it will now not open until early summer 2011, after a complex dispute over the rectification of what the council says are six defects which led it to miss a revised November 2009 opening date.

Cambridgeshire argues that it cannot open the busway if it might have to suddenly close it again for defect repairs, thus damaging the buses’ reputation with the public. The delay has become sufficiently embarrassing that some buses even bear the

"This is twice as long and half the cost of the Nottingham tramway and gives a flexibility you can't get with trams"
Bob Menzies, Head of Delivery, Cambridgeshire County Council

Above: Casting beams in the temporary factory at Longatanton

slogan "Will I be on the busway soon?" on their sides.

According to the council there are incorrect expansion joints in the Great Ouse viaduct, 'ponding' of rainwater on the St Ives park and ride site, flood risk to the adjacent maintenance track and cycleway, and incorrect thermal expansion gaps between the guideway beams. A dispute over the fire risk of a rubber tyre infill between guideway beams has been resolved. BAM Nuttall declines to discuss the matter.

Mr Menzies says: "It's one of those unfortunate contractual issues, the actual construction has been pretty much as planned.

"The contract now allows us to use another contractor to put these things right.

"There will probably be a long running dispute with BAM Nuttall, but we do not expect to pay any more than the £116m budgeted for it."

That sum comprised £92.5m from the government, with the balance due from planning gain contributions. The recession delayed most expected development near the route and the council has had to borrow the remaining £23.5m, though it expects the strength of Cambridgeshire's economy will soon see it reimbursed by developers.

Mr Menzies is confident that the busway will prove popular

Courtesy of Cambridgeshire County Council

Above: Busway junction with road

once the public experience being whisked smoothly along.

"I think potential for busways is tremendous, though the number that need to be guided is probably fairly limited, but this is twice as long and half the cost of the Nottingham tramway and gives a flexibility you can't get with trams," he says.

"The difficulty is that if the public money isn't there, there's no revenue stream from it."

Bus operators Stagecoach and Go Whippet have signed up to pay access charges, which cover maintenance costs, for five years in return for exclusive use of the busway. They will run services around St Ives and Cambridge on normal roads, joining the busway in between.

Mr Menzies, a civil engineer with the council since 1988, says: "My advice to other busways is about hearts and minds.

"In the early stages people have great difficulty understanding what the busway is, it was only when people saw it for themselves that they understood why we were building it.

"We could have done more with local opinion formers with hindsight," he says. Once the busway opens everyone will have the chance to find out.

Client - Cambridgeshire County Council.
Contractor - BAM Nuttall
Design joint venture - Arup, Parsons Brinckerhoff
Gantry design - Bennett Associates
Bus operators - Stagecoach, Go Whippet