British Dam Society - Durham Conference 2006

Technical Site Visit Description

Pre-Conference Tour Wednesday 6th September 2006 (Optional)

Kielder.
The dam and associated Tyne Tees Tunnel were constructed in the late 1970's to allow the expected raw water demands of the industrial Tees estuary to be met and in particular the planned expansion to steel making at Redcar. This expansion was cancelled due to expected cheap steel flooding the world's markets after British expertise in steel making plant was exported to Korea. The cancellation occurred after Kielder dam and Tyne Tees Tunnel construction was well advanced along with the raw water infrastructure building within the Tees area. Kielder dam and the tunnel were completed as planned initially. Kielder dam, at a late stage, incorporated a hydro-generation plant – the largest one in England. This uses the reservoir releases that are made to reduce the reservoir's frequency of overflow and so moderates the flow along the North Tyne, particularly in times of flood as there is generally flood alleviation storage available in the reservoir. The Environment Agency agrees hydro-generation operating controls with the interested parties along the Tyne and power export and generally income are optimised within the constraints of the other river users.

Transfers for water supply purposes are routinely made during the summer periods to support Derwent reservoir, and to allow minimum maintained flow compliance in the rivers Tyne; Wear and Tees. Reservoir releases are also made to assist salmon migration out of the Tyne estuary and to allow broodstock to be caught to provide eggs for the salmon hatchery.

Kielder Dam summary details

198Mm^3 capacity
51.8m water depth
Catchment area 242sq Km.
420Mld reliable yield as if direct supply

Main Technical Visits Friday 8th September 2006

The conference parties will be split into the following tours on Friday 8th September 2006. The tours will end at the Tees Cottage Pumping Station in Darlington where a Barbeque with entertainment will ensue.

Tour A : Derwent, Warkerley, Smiddy Shaw.
Tour B : Burnhope, Waskerley, Smiddy Shaw.
Tour C : Selset, Balderhead, Hury.
Tour D : Cow Green, Selset, Hury

Derwent.
Derwent dam and the associated infrastructure was built during the early 1960's as a direct supply reservoir providing water to the coastal areas from Gateshead to Peterlee and inland as far as Castleside. The scheme was a shared resource between Durham County Water Board and Sunderland and South Shields Water Company. The reservoir has a reliable yield of 115Mld (reduced from the original design estimates of 146Mld which proved to be optimistic) and supports compensation flow of 23.8Mld; the remaining yield being available for water treatment and distribution through the County Durham area. Recent support available from the Tyne Tees tunnel using Tyne water supported from Kielder as needed has allowed Mosswood treatment to be increased to about 130Mld and in many years can support this flow. The facility to import Tyne water as needed allows maximum use of Derwent's (generally) cheap source of water.

50Mm^3 capacity

36m water depth
Catchment area 110sq Km.
115Mld reliable yield as direct supply

Burnhope

Burnhope dam construction commenced on 1st January 1931 and completed on 30th September 1937 with first fill on 19th March 1936 and was a shared resource between the Durham County Water Board and Sunderland and South Shields Water Company. The raw water connecting pipework to the Durham County reservoirs and treatment works at Waskerley and Tunstall were completed in May 1923 and the tunnel to Honey Hill water treatment works was completed by 1926; the Sunderland and South Shields Water Company treatment works at Wearhead and associated pipes to supply into the Sunderland area were not completed until 1953. These works have recently been replaced with a new treatment works, now called Wear Valley, immediately upstream of the original works.

Burnhope dam has had some minor alterations to its spillway to accommodate the probable maximum flood.

6.4Mm^3 capacity
40m water depth
Catchment area 43sq Km.
46Mld reliable yield as direct supply

Waskerley

Waskerley dam and its catchwaters were completed by 1879 to supply through slow sand filters into the Wear Valley. When constructed it was one of the largest dams in England. The outlet culvert had slip joints, which allowed some articulation. Construction movement due to uneven soil pressures caused the valve shaft to be out of perpendicular by some 10inches over the 70 ft height. The movements lessened, cracks caulked, and the discharge valve encased in concrete with the valve and capstan off-centre. There have been few changes to the dam. Its security of supply has been enhanced by the raw water feed from Burnhope reservoir in 1923 and more recently connection to the Tyne Tees Tunnel with a submersible pump installed into the tunnel's airshaft. The reservoir now supplies to Honey Hill water treatment works through the Muggleswick tunnel constructed in 1926. Tunstall reservoir below Waskerley has a distinction of being the joint first earth embankment when grouting was employed (shared with Cowm dam in Rochdale.)

2.0Mm^3 capacity
24.3m water depth
Catchment area 15sq Km.
12Mld reliable yield as direct supply

Smiddy Shaw

Smiddy Shaw reservoir and its catchwaters were constructed by 1872 to supply new slow sand filters at Honey Hill. There was an existing very old network of spring collection pipework extending to the west of Smiddy Shaw onto Edmondbyers Common developed by the Durham Prince Bishops and incorporated into the Smiddy Shaw system as a catchwater system of some 15sq.Km. A disused lead mine drainage adit was intercepted with a shaft and Presser steam engine driven pump was installed to discharge into the catchwater system by 1905. Redundant lead mining small reservoirs at Sikehead and Burnhead with their catchwaters were also incorporated into Smiddy Shaw catchwater system. The total system reliable yield was about 10Mld but able to support about 15Mld in winter. The air entry system to alleviate the effect of surface ice is described in G.M.Binnie's first book about Victorian Dam (p151)

1.35Mm^3 capacity

12.3m water depth
Catchment area 6.0sq Km. Including Hisehope but excluding catchwaters
10Mld reliable yield as direct supply including catchwaters and springs / pump system.

Cow Green

Cow Green dam was completed in 1971 as one of the highest major reservoirs in England and formed the second river regulatory reservoir for the river Tees, Balderhead was one of the country's first river regulatory reservoirs. The reservoir takes advantage of an extensive flat meandering section of the river as it crosses the Cow Green barytes mine area to create a large reservoir store with a moderate dam height. Recent change has been the installation of increased drawdown capacity from 650Mld to 2100Mld to allow the reservoir to be taken down to 25% contents within 28 days in a normal winter period.

Bronze age summer dwellings have been investigated within the reservoir's perimeter indicating that the summer pastures were productive in the warmer weather experienced then (temperatures on average 3C warmer than now) with stone wall cattle enclosures attached to the dwellings. A burial mound is also close to the dwelling indicating that life and death were never far apart.

The dam that the public notice is the concrete gravity section founded on the whinstone, the equally important earth embankment rarely features on tourist information leaflets. The dam was built after public enquiry with the Teesdale blue gentian gaining prominent attention and found through most of upper Teesdale, Weardale and Tynedale.

40.9Mm^3 capacity
25,8m water depth
Catchment area 59sq Km.
186Mld reliable yield as if direct supply.

Selset

Selset dam was one of the last major puddle clay core embankments to be completed in England by 1960, the next dam to be built in the Tees Valley development was Balderhead and by 1965 was one of the first major rolled clay dams in England. Selset has the largest direct supply reliable yield of the Northumbrian stock of reservoirs and maybe not surprising that when the Probable Maximum Flood calculations were applied the overflow spillway was not sufficient. Opportunity was taken at the same time as spillway changes to improve the dam's upstream protection with an overlay of rip-rap, the original slab construction proved to be insufficiently massive to survive a 1 in 1 winter storm; annual repairs to the upstream slope was the normal summer work. The generous catchment and transfers for treatment makes the site attractive for hydro-generation on the present flows and possibly by the time of the conference visit a generation station may be in the construction stage.

15.32Mm^3 capacity
40.7m water depth
Catchment area 70.6sq Km.
118Mld reliable yield as direct supply

Hury

Hury dam was the first reservoir to be built for water supply from Teesdale. The raw water mains delivered water as far as Broken Scar in Darlington (opposite Tees Cottage Pumping Station) where it was treated and potable water pumped into the distribution network. Local treatment had to wait until 1903 at Lartington. The dam has a puddle clay core and concrete cut-off but a steamroller rolled clay core was proposed in the original specification. This was an experimental process and the contractor had to solve the problems of using 10 to 12 tonne steamrollers on puddle clay moisture contents. He did not succeed presumably because the engineer would not allow the clay to be placed drier and it had to wait for Balderhead dam design in the 1950's for the first large dam rolled clay core to be constructed –

some 80 years after Mansergh's proposal. The original photographs of Teesdale dams' constructions do show steam rollers sunk 'up to their bellies' as they rolled close to the core and indicates the problems of heavy machinery operating adjacent to the soft puddle clay core. The original specification gives good details of concrete and cement testing that would not be inappropriate to modern day quality control.

3.90Mm^3 capacity
32.94m water depth
Direct Catchment area 7.91sq Km. Total catchment area 40.85sq Km.
13Mld reliable yield as direct supply from direct catchment.

Balderhead

Balderhead dam was completed in 1965 and at that time was the highest earth embankment dam in England. It suffered from hydraulic fracture of its core during its first fill and remedial works were carried out by installing a flexible concrete core within the rolled clay core suspect length using bentonite slurry to support the trench walls. The dam has performed well since then. It formed the first major river regulatory reservoir and its relatively small catchment area was sufficient to allow an increased abstraction from the river Tees of about 100Mld. Later reservoirs created at Cow Green and Kielder and steady demand (or slightly dropping) in the Tees area since 1970's has allowed Balderhead to act as direct supply to Lartington Water Treatment Works with subsequent benefit to the recreational users of the Lune and Balder valleys as the reservoirs are kept at higher levels.

19.67Mm^3 capacity
51.71m water depth
Direct Catchment area 20.4sq Km..
47Mld reliable yield as direct supply.