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2013 BUYER'S GUIDE

GEOSYNTHETIC BASED
underground stormwater detention system used at iconic commercial development site

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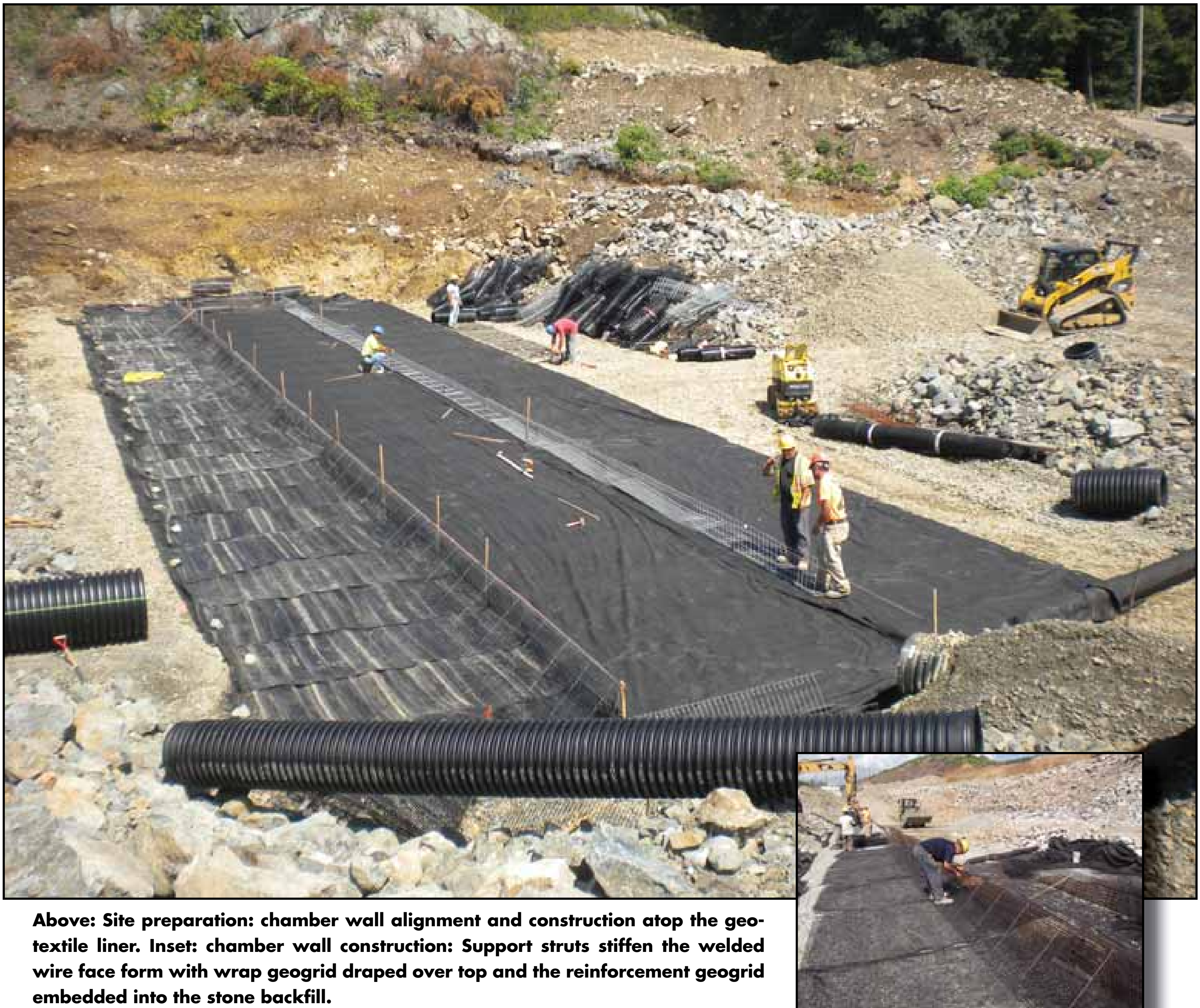
After a disastrous rainfall on Mt. Hood, Oregon, **MAJOR STREAM-BANK RESTORATION** was needed

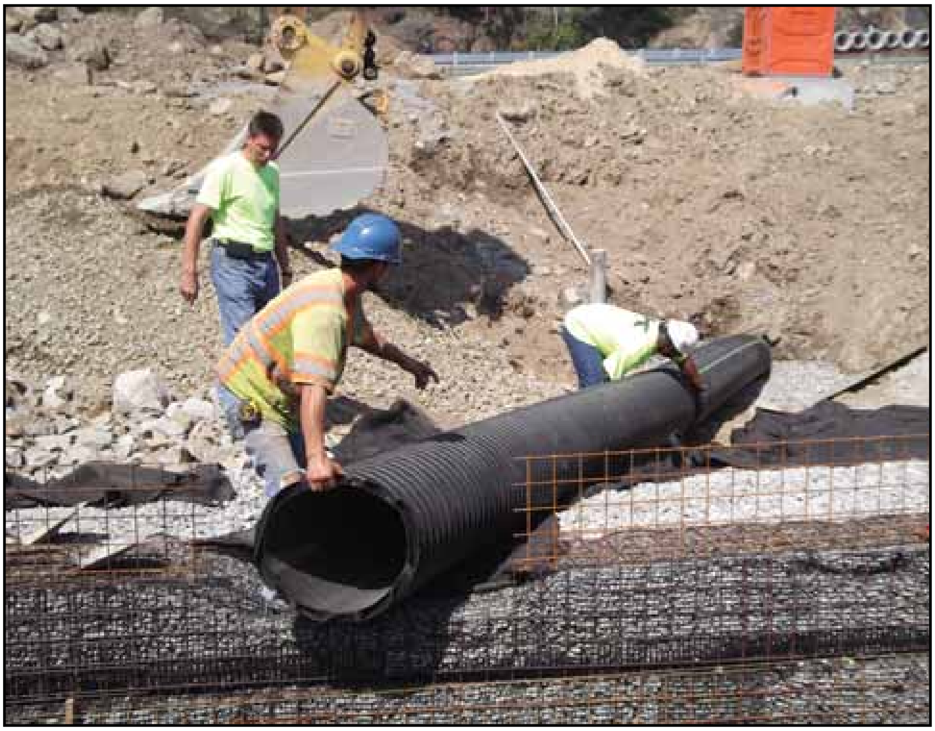
WIRE MESH flexes its muscle in rockfall and **EROSION CONTROL**

Stormwater Management at an Iconic Boston Property



Above: Site preparation: chamber wall alignment and construction atop the geotextile liner. Inset: chamber wall construction: Support struts stiffen the welded wire face form with wrap geogrid draped over top and the reinforcement geogrid embedded into the stone backfill.

From buggy whips to record albums, progress begets obsolescence. Such is the case along Boston's Route 128/I95 "Silicon Valley" corridor. The venerable headquarters of the Polaroid Corporation has sat derelict for years, the victim of unrelenting technological advances. An iconic American company that popularized the instant camera was no match for mar-



Inlet pipe installation.

ket forces moving faster than the Interstate traffic running alongside its home offices.

Sitting on 120 rolling acres of classic New England ledge, this large, prime parcel in the Boston metropolis was a rare stone waiting to be cut into a gem. And cutting was priority number one, as a mountain of bedrock had to be blasted to grade the site for retail stores and offices in one of New England's largest commercial developments. Rich O'Connell, of R J O'Connell & Associates, developed the master plan. Given the size, location and topography of the site, stormwater management was always an important component of the design process. Infiltration basins were located in the lower tiers of the site. Upstream, underground stormwater retention and infiltration was required in an accessible underground system. Inlet pipes were as deep as 27 feet below final grade and space was limited. Rock was plentiful and, need less to say, cost was major consideration.

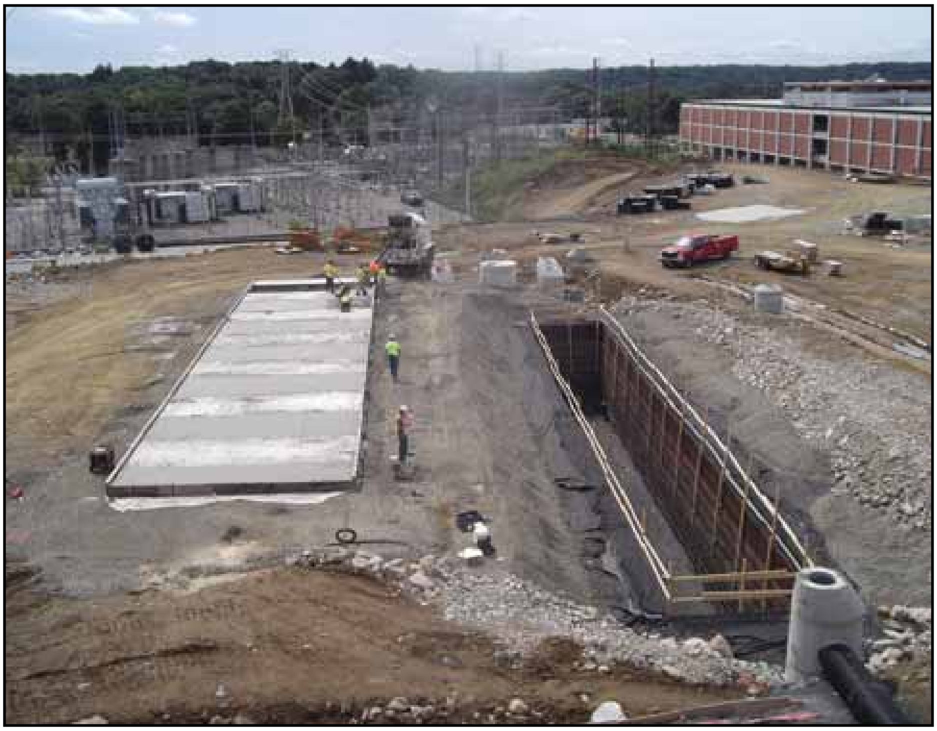
Early on Rich O'Connell engaged the developer and regulatory agencies, MADEP and the Cambridge Water Department, in the stormwater management plan. The site was part of Charles River watershed and drained to the Cambridge Reservoir. As one would expect on a major infill development, there were many concerned parties and a great deal of scrutiny. The site was designed to recharge the local water table and manage a 100 year storm event. Structural stability, accessibility and sustainability were features of the geosynthetic based underground detention system that met with wide approval. "The economic and technical merits of the GeoStorage® Underground Stormwater

Chamber wall construction: stone backfill placed in lifts above geogrid reinforcement.

Detention Systems were evident when we put together our initial plan and the accessibility of the large open chamber was an important component for the regulators" said Rich O'Connell.

GeoStorage® Systems combine geosynthetic reinforced stone walls with a concrete roof to create a large open chamber. The chamber walls and roof are designed using FHWA standards for Geosynthetic Reinforced Structures (GRS) and Integrated Bridge Systems (IBS). As a result, the high chamber walls and large overburdens required for the site could be designed confidently with well established safety factors and a 75+ year design life. D W White Construction, Acushnet, Massachusetts, set up a blasting program and stone crushing operation to process the backfill materials used to construct the chamber walls. With a porosity of 40%, the angular stone also provided significant water storage capacity to augment the volume within the chambers. Rather than import precast reinforced concrete roof slabs, Mark White, the president of D W White Construction, decided to form, pour, pick and place the roof slabs on site. This was a 197,000 CF stormwater detention system that would require a couple of flatbeds and thirty local concrete trucks to supply all the required materials.

A basic crew of five laborers and two operators manning an excavator and front end loader built the chamber walls for the three systems in three weeks supported by a second crew for 10 days. After placing a geotextile separator on the foundation and

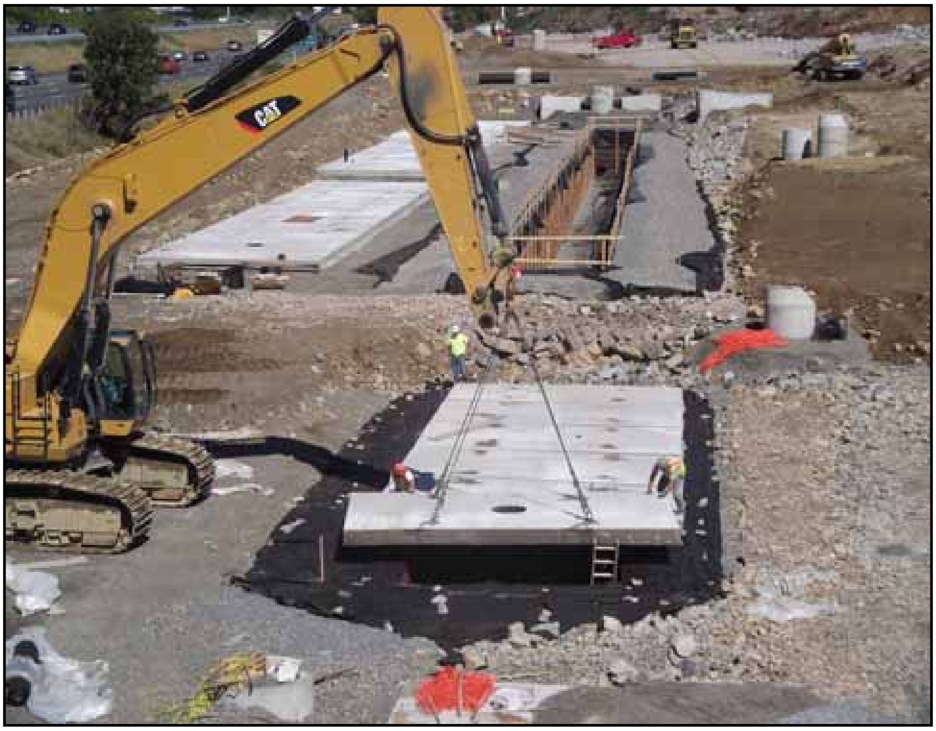


On-site construction of reinforced concrete roof panels.

sidewalls, geogrid and stone were placed in 9 inch lifts for the full height of the walls. Two operations were run concurrently. The backfill operation consisted of a front end loader feeding a stone box while an excavator spread the backfill in layers over the geogrid reinforcement. The detail work was done at the chamber face. The geogrid was sized so the 1 ½" stone would not ravel through the apertures into the chamber. A welded wire mesh bent at ninety degrees was placed at the wall face to pro-

After placing a geotextile separator on the foundation and sidewalls, geogrid and stone were placed in 9 inch lifts for the full height of the walls.

vide support for compaction in this zone. The geogrid was extended up and over the wire mesh and brackets attached the back bottom leg to the top front of the 18 inch high "L" shaped support in order to stiffen the face against compaction forces. When the stone fill was flush with the top of the welded wire mesh form the geogrid was pulled back over the stone backfill and pulled taut before the process was repeated for the next layer. As a result the chamber face has the appearance of a gabion when, in fact, the geogrid behind the wire face façade is providing long term stability. In the top three feet of the chamber walls additional geogrid layers were installed with ¾" stone and a geotextile in the face wrap face to stabilize the bearing pad for the roof



Roof slab installation.

deck. This design and construction operation follows the standards used by the FHWA to build single span bridges across the country.

Typically, the roof slabs are precast off site and heavily reinforced with steel to limit the concrete thickness and optimize freight. D W White elected to pour the slabs on site. With no highway weight limit restriction, the slabs were redesigned with a deeper section and less steel. The "standard" roof deck design supported up to 7 feet of cover as the peak live loads (HS-20 truck traffic) dissipated with height eventually to be equaled by the predominant influence of dead load (cover soil) forces. Sections of the detention system with higher overburdens were capped with more heavily reinforced panels having a wider span to accommodate longer bearing seats. Crews built the forms, installed the reinforcing steel and lifting lugs and poured the concrete on a polyurethane sheet laid over a flat, compacted subgrade. After the concrete break tests met the design strengths, in about 10 days, an excavator from the crushing operation was brought over to lift the panels into place. Two laborers placed the roof slabs in a day and a half, disassembling the safety barricades around the 12-15 foot deep chambers as they progressed and installing stone splash pads below the inlet pipes.

There were many stormwater retention options for this project however, certain site characteristics simplified the selection process. Stone and reinforced concrete would be the two most expensive components. Stormwater would be stored in both the stone pores and the large open chamber formed by the stone, a cost effective combination in normal circumstances would be even more efficient where stone is processed on site. The design and cost of the roof slabs would be the same no matter the height of the chamber. At this site,

There were many stormwater retention options for this project however, certain site characteristics simplified the selection process.

the topography required deep chambers which improved the efficiency of the roof slabs. At the same time, the depths of the stormwater management system precluded the use of many systems that could not handle the loads. From a regulatory standpoint, maintenance crews could access the chamber and monitor and remove sediments that might accumulate on the floor. Where as, in most systems the infiltration bed is inaccessible and maintenance is conducted through standpipes extended to the surface.

The economics of the stormwater retention system were also greatly influenced by the experience of the general contractor. Rock blasting, crushing, processing and trucking operations were performed in house on a massive scale. The crews building the reinforced stone chamber walls had ample experience constructing mechanically stabilized walls for the Massachusetts Department of Transportation. Even the precasting of the reinforced concrete roof panels was brought in house and on-site excavators had plenty of capacity to lift the slabs into place. "Given the geology and topography of the site, deep detention systems utilizing on-site processed stone made perfect sense. Our crews moved through every phase on schedule and within budget", commented Mark White.

Ten miles down the road sits another 120 acre iconic Boston property. Nearly 100 years ago a 10 year old caddy carried the bag for an unknown amateur in the final round of the U.S. Open Golf Championship at The Country Club in Brookline. As they walked to each green and eyed the upcoming putt, little Eddie Lowery was reputed to loudly proclaim to the soon to be world famous U.S. Open champion, Francis Ouimet, "Easy Peasy". Four score and 19 years later, Rich O'Connell and Mark White brought that same attitude back to Boston. **L&W**

by Terence Sheridan

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