

WHERE WE PLAY: USING WSD TO HIT CARBON EMISSIONS OUT OF THE GOLF COURSE



Te Arai Links Golf Course development nearing completion

GOLF COURSES & CO₂



- Golf is played in 209 countries across 38,864 golf courses around the world that covering a combined land larger than Kuwait.
- New Zealand has the second highest number of golf courses per capita of any country in the world, just behind Scotland.
- The development of golf courses results in numerous CO₂ emissions sources.
- A typical 18 holes course generates over 700 metric tonnes of CO₂ for stormwater drainage (Saito, O, 2010).

NEW APPROACHES TO GOLF COURSE DEVELOPMENT

REDUCED
CO₂
EMISSIONS

PROMOTE
CARBON
SEQUESTERING

CREATE A
WORLD
CLASS GOLF
COURSE



THE TE ARAI LINKS DEVELOPMENT



Two 18-hole Golf Courses

Two Clubhouses

Three Restaurants & Bars

48 Short term visitor accommodations

Staff accommodations

A wellness Centre

An extensive maintenance area

15.5 km of internal access roads



THE CLIENT BRIEF

- Make the finished development appear as if it had always been there.
- Keep as much of the stormwater drainage as possible above ground.
- Low or easy maintenance of stormwater assets.
- No nuisance flooding.



Carbon Emissions of stormwater management on a golf course

Table 1 – CO₂ Emissions of manufacture and transport

Stormwater Hardware	CO ₂ Emissions Manufacture & Transport
225 mm diameter Concrete Pipe	17.17 kg per meter
1,200 mm diameter manhole	177 kg per meter of depth
660 mm x 460 mm Catchpit	75 kg

Table 2 – CO₂ Emissions savings using WSD

Stormwater Hardware using traditional drainage - 2 x 18 hole golf courses & Ancillary Services	kg CO ₂ Emissions Manufacture & Transport	Stormwater Hardware -using WSD for Te Arai Links Courses	kg CO ₂ Emissions Manufacture & Transport	Savings kg CO ₂ Emissions
15,600 m of pipe	267,852	2,850 m of pipe	48,934	218,918
150 SW manholes	26,550	20 SW manholes	3,540	23,010
300 SW Catchpits	22,500	71 SW Catchpits	5,325	22,495
Totals	316,902		52,479	264,423



MATERIAL MATTERS



- Coconut matting was chosen over geotextile cloth for landscape stabilising purposes due to the potential of geotextile to shed microplastics into the environment.
- Geotextile cloth generates 2.0 kg of CO₂ emissions per 1 kg of material
- Coconut matting generates 367 g of CO₂ emissions per 1 kg of material

Coconut matting has reduced CO₂ emissions by 80% where ground stabilisation was required

UNQUANTIFIABLE CO₂ EMISSION SAVINGS

CO₂ Emissions for installation of stormwater infrastructure depend on:

- Distance travelled by contractors to the site
- Age & type of earthmoving equipment
- Duration of construction
- Depth of burial
- Soil type



SEQUESTERING CARBON

HOW GRASSES DO IT

- Grasses and rushes grasses use C4 or C3 photosynthesis producing a carbon compound stored as a starch in the roots and rhizomes.



FATE OF CARBON IN GRASSES

Carbon stored below ground by grasses is processed into soil organic carbon by microbes in the soil. Soil organic carbon (SOC) accumulates in the soil. On average of 226 tonnes/ha of SOC is accumulated and sequestered until SOC levels out, becoming part of the long-term carbon cycle



HOW TREES DO IT

All tree species use C3 photosynthesis producing a three carbon atom compound stored as starch in the trunk and woody material.



FATE OF CARBON IN PLANTATION FORESTS

On average 1 ha of pine trees will have sequestered 630 tonnes of CO₂ by the time it is harvested. For New Zealand wood products lifecycles vary between 1-110 years until it is burned or winds up in a landfill site, becoming part of the short-term carbon cycle



Understanding the Carbon Cycle



WORKING WITH THE SOILS

- Te Arai Links is sited on sandy soils.
- The Holocene dune sands underlying the site are between 16 – 22 m deep.
- Average permeability of 180 mm/hr
- Poor in organic material and almost homogenous in makeup
- Low organic content allows greater microbial activity transforming carbon stored in the roots and rhizomes of plants to SOC yielding a higher potential for sequestering carbon.



QUANTIFYING THE CARBON BUDGET



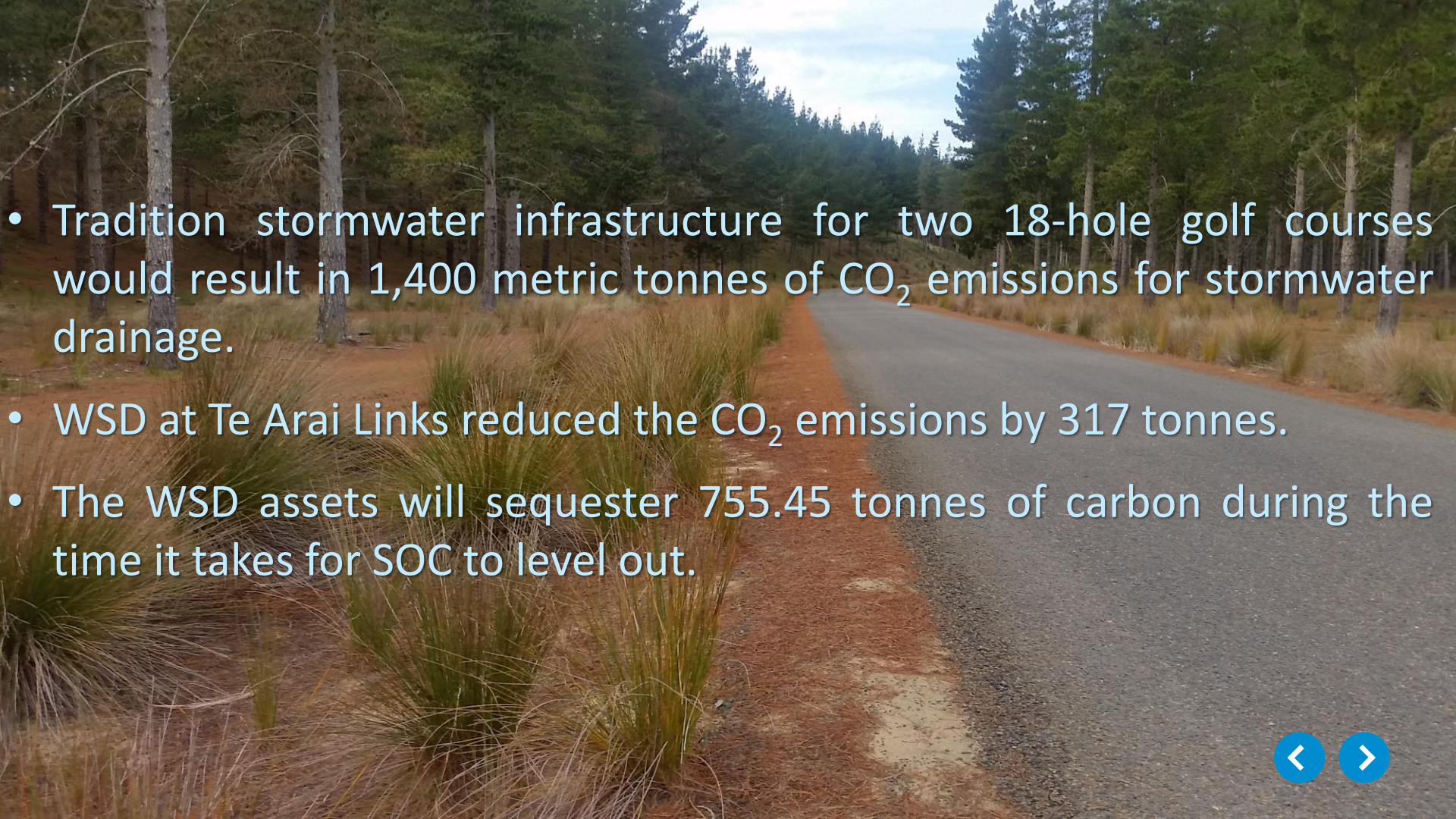
51,000 m² of Roadside Swales

Using the most conservative figure of 3.1 tonnes/ha/year and average of 45 years until SOC levels out the swales will sequester 711.45 tonnes of carbon as SOC



3,135 m² of Infiltration Raingardens

The infiltration raingardens (recently planted) will sequester an additional 44 tonnes of SOC.

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- A paved path leads through a forest. In the foreground, there are clumps of tall, dry grass. The path is bordered by a layer of reddish-brown mulch or pine needles. Tall, thin trees line both sides of the path, leading into the distance under a cloudy sky.
- Tradition stormwater infrastructure for two 18-hole golf courses would result in 1,400 metric tonnes of CO₂ emissions for stormwater drainage.
 - WSD at Te Arai Links reduced the CO₂ emissions by 317 tonnes.
 - The WSD assets will sequester 755.45 tonnes of carbon during the time it takes for SOC to level out.

COST SAVINGS

- Savings for manholes and catchpits are around \$3 million.
- Savings for cost of pipe \$3 million.
- Man-hour savings for installation approximately half of what traditional methods would have cost.
- Maintenance reduction for the life of the stormwater assets.



NEXT STEPS

- Determine the Carbon sequestering potential of New Zealand native grasses.
- Find ways to construct water sensitive design assets that can stay or be embedded directly into the sub straight.
- Develop testing of bio-retention and bio-infiltration media that can examine the potential for storage of soil organic carbon.
- Convince developers and council that water sensitive design can be cost effective and work well.



CONCLUSIONS

WSD on the Te Arai Links development provides:

- Reduced CO₂ emissions embodied in construction materials;
- Reduced CO₂ emissions resulting from construction;
- Reduced CO₂ emissions resulting from maintenance;
- Sequestering of atmospheric carbon into SOC;
- Removal of carbon from the short-term carbon cycle to the long-term carbon cycle;
- Cost savings on construction materials, installation, and maintenance, as well as
- Amenity value



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