CASE STUDY: SLEEMANS SLIP. A GRASS SPILLWAY SOLUTION, USING THE FIVE FUNDAMENTALS OF SUCCESFUL REHABILITATION

J. Johnson (PGG Wrightson Turf – DuraVeg)

ABSTRACT

In June 2017, a one in 50-year storm event caused 1000m3 of material to fall into a water canal which is used to irrigate up 60,000ha of the Canterbury Plains. This material had to be removed and a grassed spillway installed to prevent any more erosion and stabilizing the slope during storm events. The solution was a result of a holistic approach using "The 5 fundamentals of successful rehabilitation". The best form of erosion and sediment control is sustainable vegetation. Implementing the fundamentals lessens the risk of failure and the need to return to projects where vegetation has failed or not met compliance standards.

The first fundamental is understanding the soils we are attempting to rehabilitate. Taking soil samples to analyse the soil structure and deficiencies, and to understand what amelioration may be needed including adding back some much-needed organic matter. Soil testing also assists in specie selection as to what and will not grow in the soil we are rehabilitating.

The second fundamental is selecting the right species for the environment we are working in. This includes but is not limited to, what time of the year will rehabilitation take place, where in the world is the project, what is the long-term desired land use.

The third fundamental is selecting the appropriate method to apply the seed for vegetation establishment. This can be via hydraulic-mulches, drill or rip-seeding, tube stock planting and spreading. What processes can be used to make this selection and what the risks are for soil and erosion control (C-Factor ratings). In this case, it's a hybrid system using a turf reinforcement mat combined with a hydraulically applied erosion control.

The fourth fundamental is making sure the sub-contractor is experienced in the selected application methods. There are tools available (application guides and rates), and techniques that can be followed to ensure the contractor is meeting the specification and the client is getting what they paid for. This is especially important at the quality and assurance stage of the project.

The fifth fundamental is following up inspections and maintenance of the project. When the client or contracted party should be inspecting the site and how frequent. What to look for, species diversity, invasive weeds and wash outs. When to schedule maintenance if required.

KEYWORDS

grass, spillway, rehabilitation, erosion

PRESENTER PROFILE

Joe Johnson has a passion for the environmental sector and worked closely with the likes of CERA (Canterbury Earthquake Recovery Authority) where Joe provided specialist advice on revegetation and erosion control. This led to the specifications of new technologies for revegetation in difficult terrains into the Christchurch earthquake reclamation work. Joe's breadth of knowledge is not limited to hydraulically applied erosion control products, but he also holds a diploma in Sports Turf Management and worked at venues such as St Andrews Links, Scotland and Royal Melbourne, Australia.

1 INTRODUCTION

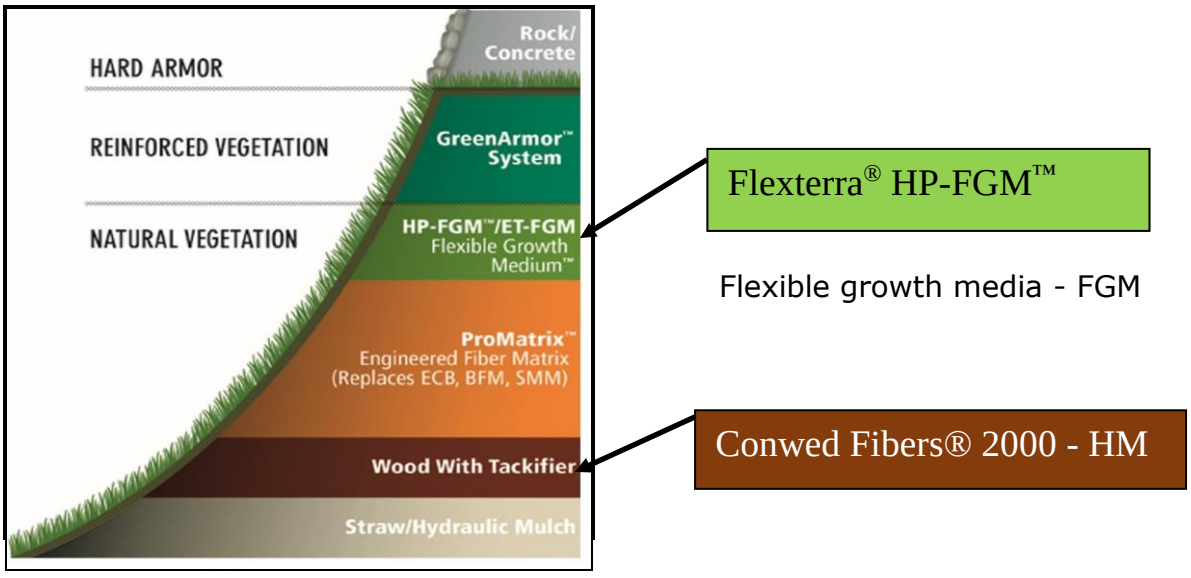
Re-vegetation following geotechnical failures can be challenging. The most common issues are steep slopes, lack of topsoil, limited choice of sowing time, unpredictable weather. Difficult sites are no excuse for sub-standard re-vegetation specifications. Lack of establishment, preventable washout or a quick flush of green followed by collapse are signs of sub-standard specification.

It is challenging for the engineer to adequately specify grass seed mixtures for earthworks re-vegetation projects when each site has different climate, soil, fertility and moisture conditions. There is no single specification suitable for all sites. An inappropriate specification frequently delivers a poor result. Where the system specified was not fit for the task, or where low-quality seed and poorly adapted grass and legume species are chosen the result is always unsatisfactory.

The following is a case study of a holistic approach to provide a grass spillway solution following a geotechnical failure following a storm event.

2 HYDROMULCH PRODUCT PERFORMANCE BASED ON STEEPNESS OF SLOPE

The choice of hydromulch for hydroseeding in revegetation projects is normally based on steepness of slope. Flexterra® HP-FGM™ is a premium product suitable for steep slopes. It would also be specified where rainfall is expected to cause overland flow of water or at airports where jet blast could lift the hydromulch. In this instance similar to a stream or waterway the Green Armour™ system should be used.



Wood fibre hydraulic mulch - HM

Table 1: Hydraulic Mulch selection slope

Flexterra® FGM™ premium high performance hydromulch has exceptional binding properties and tensile strength. It is manufactured by Profile Products from thermally refined wood fibres, biodegradable interlocking man-made fibres, bio-polymers and water absorbents.

On flat to slightly undulating sites Conwed Fibers® Hydro Mulch® 2000 is a suitable choice. It has enhanced tackifier to help prevent washout. It is manufactured by Profile Products from thermally refined wood fibres. The steepness of slope and length of slope define product performance limits.

2.1.1 HYDRAULICALLY APPLIED BIOTIC SOIL MEDIA

On sites where little or no topsoil is available or where it is too steep to use it, a hydraulically applied biotic soil media can be applied before hydroseeding to improve vegetation establishment. ProGanics™ Biotic Soil Media™ is manufactured by Profile Products from thermally refined bark and wood fibres, with a blend of biopolymers, biochar, seaweed extract, humic acid and other beneficial constituents. It is claimed that 3,500 – 5,600 kg/ha of ProGanics™ is equivalent to 100mm depth of topsoil in organic matter.

2.1.2 THE REVEGETATION PROCESS

The first step is to have a soil analysis taken to determine the fertility and liming needed for vegetation to establish. Next the topsoil or lack of it is assessed and the need for ProGanics™. The slope will generally determine the choice of hydromulch. The seed mixture is one chosen for the site. The seed and fertiliser is mixed with the hydromulch and applied hydraulically. When seeding outside the growing season or when difficult weather is expected, consider upgrading to Flexterra® FGM™.

Ecology

Nature is continuously re-vegetating the land following landslides or human induced damage through a process of succession. The first plants to colonise bare ground are mosses and short lived annual grasses. Once they stabilize the surface they are replaced by legumes which build up soil fertility until they are in turn replaced by slow growing perennial grasses or trees that are adapted to low fertility.

The early colonizing grasses can be thought of as rapid establishing, fast growing users of nutrients in abundant supply. They are replaced by perennial grasses that are slower growing but more efficient users of nutrients in short supply.

Examples of early colonizing grasses are annual or perennial ryegrass and annual Poa (*Poa annua*). Perennial species adapted to low fertility are browntop, fine fescue, tall fescue, or in sub-tropical or tropical regions, warm season grass such as Kikuyu or bermudagrass.

It is important to make a correct choice of well adapted perennial grass species because different species are adapted to different fertility and soil moisture conditions. Often when a mixture of species is sown, the species that is best adapted will dominate, and poorly adapted ones will disappear. If all species are poorly adapted, they will all disappear, leaving only weeds. This is frequently what happens when the specification calls for a green cover 6 weeks after seeding, without considering long term persistence.

Adaptation of perennial cool season grass to moisture and fertility.

Let's consider the adaptation of a number of common cool season grass species to soil moisture and fertility. We will only consider perennial grass species and not annuals.

Grass species	Soil fertility requirement	Speed of establishment	Adaptation to drought
Perennial ryegrass	high	high	low
Tall fescue	medium	low	medium
Browntop	low	low	medium
Fine fescue	low	low	medium-low
Hard fescue	low	low	medium-high
Kikuyu	low	low	high

Table 2: Cultivar parameters

Let's look at suitable mixtures for seeding civil works in different parts of the country with different soils and climates. The most adapted species is indicated with two ticks, and other well adapted species with one tick. There is no one best seed mixture for all sites.

	North Shore clay	Murawai sand	Waikato silty clay	Taupo pumice	Central Otago gravelly silt	Northern Southland silt
Fertility	**med-low**	**low**	**medium**	**Low**	**low**	**low**
Moisture	**medium**	**low**	**medium**	**Low-medium**	**med-low**	**med-high**
Perennial ryegrass	✓✓	✓	✓✓	✓	✓	✓
Tall fescue	✓✓		✓			
Browntop	✓	✓	✓	✓✓	✓✓	✓
Fine fescue	✓	✓	✓	✓	✓	✓✓
Hard fescue		✓		✓	✓	✓
Kikuyu	✓	✓✓				

Table 3: Cultivar adaptation chart

Take care interpreting this table as we are only considering a limited number of species and no legumes.

Because different seeds can have vastly different sizes, the most adapted species will usually be sown with the highest number of seeds. Sowing a mixture of species, means that the mixture has a greater chance of establishing in a broader range of conditions, than where just one species is used.

One broad theme that comes out of this exercise is that seed mixtures invariably contain perennial ryegrass for rapid establishment and ground stabilization. In the case of the low

fertility and droughty sites we can expect it to disappear over time and be replaced by grass better adapted to low fertility and drought. Sometimes other short lived but rapid establishing species are used such as annual ryegrass, cereals or ryecorn. Where Flexterra HP FGM is used a short term species may not be required. Many warm season grasses establish rapidly and a short term stabilizer is not necessary.

It is a good idea to have a number of adapted grasses in the mixture. We would consider species such as cocksfoot, Yorkshire fog, crested dogstail, browntop and fine fescue to be low fertility species that are adapted to a wide range of situations.

Including one or two legumes in the mixture is a good idea in most cases where low fertility and subsoils are involved, but might not be a good idea in higher fertility where too much vegetation could be a problem or where mowing costs are a factor.

2.1.3 THE FIVE FUNDAMENTALS OF SUCCESFUL REVEGETATION

1 Substrate evaluation and soil fertility analysis

The first step is to examine the substrate and determine the limitations for establishment and growth of vegetation. A critical step is to have a soil fertility test taken and sent to a soil testing lab such as Hill Laboratories. Soil moisture and nutrient holding are other factors. In some cases, topsoil or topsoil replacement such as ProGanics™ biotic soil media will be needed.

2 Select suitable seed blend

The seed blend chosen will be site specific based on the climate, soils and fertility. Other factors are whether the site will be mowed or grazed and client requirements. The inventory of grass and legume seeds available in New Zealand a worthwhile resource to obtain. Documentary evidence of seed germination is the minimum quality assurance acceptable.

3 Select appropriate hydromulch

In most small-scale cases it is simply a matter of selecting a hydromulch product based on the steepness and length of the slope and the tendency for erosion. It may be necessary to up-spec the hydromulch where vegetation establishment will be delayed because of cold or dry conditions when carried out at a sub-optimal time of year.

4 Contractor application

The specifications need to include the seed and seed quality, the hydromulch and the rate of hydromulch application. Hydromulch can be specified by product name or generic product type code (FGM, BFM, HM). The contractor should ensure specifications are followed and products are applied at manufactures application rates.

5 Supervision of work

Supervision of work is critical to a successful outcome, especially the rates of seeding and hydromulch application. Supervise treating a small area and comparing the outcome with later areas or carry a dry sample for comparison.

3 CONCLUSIONS (CASE STUDY)

Photograph 1: The slip prior to remediation

Sample Name: Sleemans Slip Top **Lab Number:** 1888017.1
Sample Type: TURF General (S8)

Analysis		Level Found	Medium Range	Low / Medium / High
pH	pH Units	6.2	5.5 - 6.5	
Olsen Phosphorus	mg/L	9	20 - 30	
Potassium	me/100g	0.19	0.50 - 1.00	
Calcium	me/100g	4.7	5.0 - 12.0	
Magnesium	me/100g	1.13	0.60 - 2.00	
Sodium	me/100g	0.12	0.00 - 0.50	
CEC	me/100g	10	12 - 25	
Total Base Saturation	%	64	35 - 80	
Volume Weight	g/mL	1.39	0.60 - 1.00	
Organic Matter*	%	1.8	7.0 - 17.0	
Total Carbon*	%	1.0		
K/Mg Ratio		0.2	0.3 - 1.0	
Soil Sample Depth*	mm	0-75		
Base Saturation %		K 2.0	Ca 49	Mg 11.7 Na 1.3
MAF Units		K 5	Ca 8	Mg 35 Na 8

Table 4: soil test results

Photograph 2: Remediation works

2019 Stor

Photograph 3: Installation of Turf Reinforcement Mat and Hydraulic Mulch

Photograph 5: Completed installation

Vegetation establishment 4 weeks following establishment

ACKNOWLEDGEMENTS

Bill Walmsley – PGG Wrightson Turf, Dr Alan Stewart – PGG Wrightson Turf, RST Environmental