# RESTORING ACTIVE BLANKET BOG IN IRELAND

## Project reference: LIFE02NAT/IRL/8490

### A REPORT ON WATER LEVEL CHANGE WITHIN WALRAGS AT BLANKET BOG RESTORATION SITES IN THE WEST OF IRELAND

Compiled by: John Conaghan
11 Dun Ard,
Craughwell,
Co. Galway,
Ireland.
enviroscope@indigo.ie

## 1. Introduction

This report outlines trends in water level change within WAter Level RAnge GaugeS (WALRAGS) installed at sites within the EU-Life/Coillte Irish Blanket bog Restoration Project. The Walrags used in this study essentially consist of a 1.5 metre long length of perforated plastic pipe (Photograph 1), sealed at the bottom and top, within which there is placed a plastic float attached to a metal pointer. When the Walrag is inserted into the peat the water enters the Walrag through the holes in the bottom half. Over time the water level within the pipe moves up and down in response to changes in the soil water level and the water level can be read along a scale inserted in a plastic moulding in the top half of the Walrag (Photograph 2). The insertion of foam plugs into the plastic moulding means that minimum and maximum water level readings may also be obtained.

The monitoring of water levels in peat was undertaken as part of this project in order to assess the effect of tree-felling and drain blocking on the hydrology of blanket peat. Although one of the main aims of this monitoring was to study water levels for at least 6 months prior to the onset of tree felling and drain blocking operations there was generally only 2 or 3 months of pre-restoration monitoring carried out at sites as a result of an unavoidable delay in sourcing essential components for the construction of the Walrags.

Photograph 1. A Walrag before it is inserted into the peat. Note the holes in the bottom half of the pipe, which allow water into the Walrag.


Photograph 2. A close-up of the Walrag pointer area. The height of the pointer is read off the scale (in this case a metal tape measure cut to size) housed in a white plastic moulding. Note the black foam plug at the top of the pointer which provides a measure of the maximum water level reached.

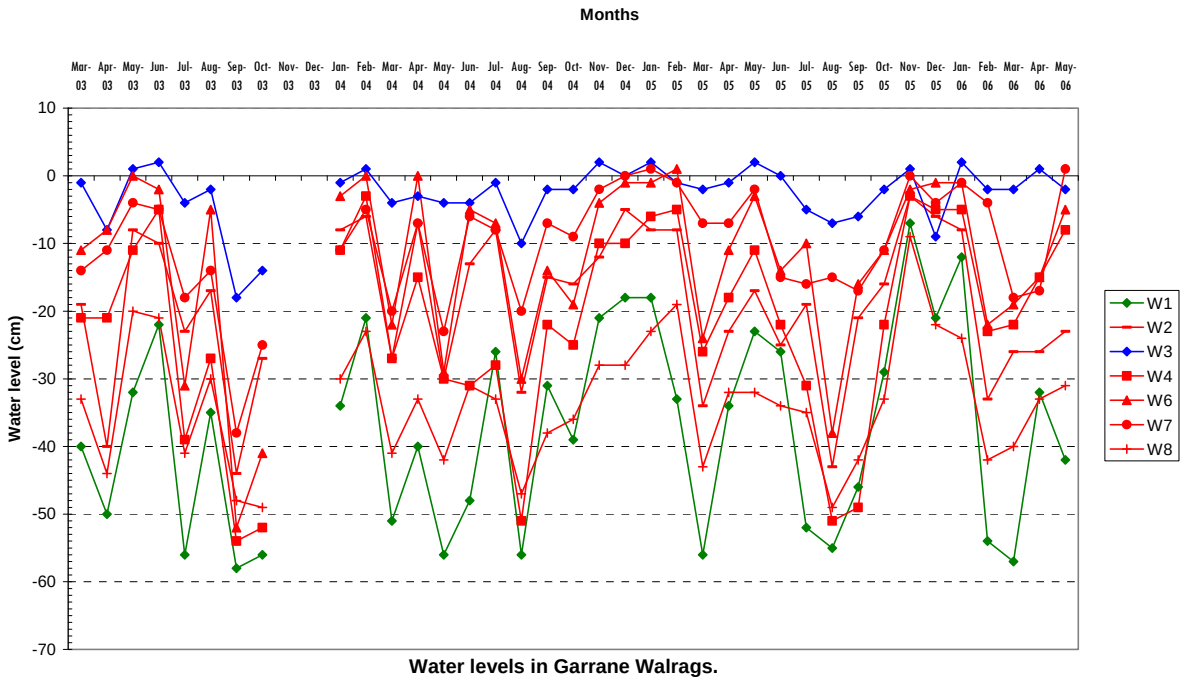
At most sites Walrags were located in areas of afforested bog and intact bog therefore allowing water levels in drained blanket bog systems to be directly compared to adjacent intact systems. Walrags were read once every month by Coillte staff or contractors. In addition to noting the water level on the day of the reading, the minimum and maximum water values in the previous month were also recorded however these have been omitted from the subsequent graphs for purposes of clarity. In the following results section the GPS location (Irish grid) of each Walrag is indicated along with a brief description of the vegetation occurring at the site. It should be noted that some of the Walrags failed to give accurate readings during the lifetime of the monitoring. These failures were mainly a result of the pointers continually sticking in the white plastic moulding. Walrags were installed at a total of 11 sites however results are not available for the Walrags installed at the two Eskeragh subsites.

In the following results sections graphs of water level fluctuation for each site are presented along with a discussion of the general trends in water level changes.

**2.1 Garrane, Co. Kerry (Site No. 2)**

A total of seven Walrags were installed at Garrane, six in conifer plantation of varying height and quality and one in an area of old wet cutover blanket bog. The felling of trees and blocking of drains took place during the summer of 2003.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | V 71942 81303 | Dense shaded coniferous woodland, dominated by tall Sitka spruce. Ground vegetation dominated by mosses, epecially *Thuidium tamariscinum*, with *Ilex aquifolium* seedlings also present. | Located c. 30 metres west of deep drain which separates forestry and planted bog. |
| 2 | V 71917 81310 | Rather open coniferous woodland, dominated by tall Sitka spruce. Ground vegetation dominated by *Molinia* with *Sphagnum capillifolium* and *Thuidium tamariscinum* also frequent. | Located c. 30 metres west of deep drain which separates forestry and planted bog. |
| 3 | V 71910 81277 | Very wet cutaway bog dominated by *Molinia caerulea. Myrica gale, Eriophorum angusifolium* and *Sphagnum papillosum* also frequent. Not planted. | |
| 4 | V 71895 81248 | Shallow blanket bog planted with Sitka spruce but trees very poorly grown (2 to 4m tall). *Molinia* dominant. *Myrica gale, Carex panicea, Eriophorum angustifolium* also frequent. | |
| 5 | V 71849 81215 | Blanket bog planted with Sitka spruce, trees 5 to 10m tall. *Molinia* dominant. *Myrica gale, Erica tetralix, Sphagnum capillifolium* and *S. papillosum* also frequent | Results not used due to continual malfunctioning of the Walrag. |
| 6 | V 71799 81068 | Shallow blanket bog planted with Sitka spruce but trees poorly grown (1.5 to 4m tall). *Molinia* dominant. *Sphagnum capillifolium* and *Erica tetralix* also frequent. | |
| 7 | V 71792 81169 | Blanket bog planted with Sitka spruce but trees rather poorly grown (5 to 7m tall). *Molinia* dominant. *Sphagnum capillifolium* and *Erica Myrica gale* also frequent. | |




**Water levels in Garrane Walrags.**
**Blue = Unplanted wet cutover bog, Red = Blanket bog with poor conifers, Green = Blanket bog with tall conifers.**

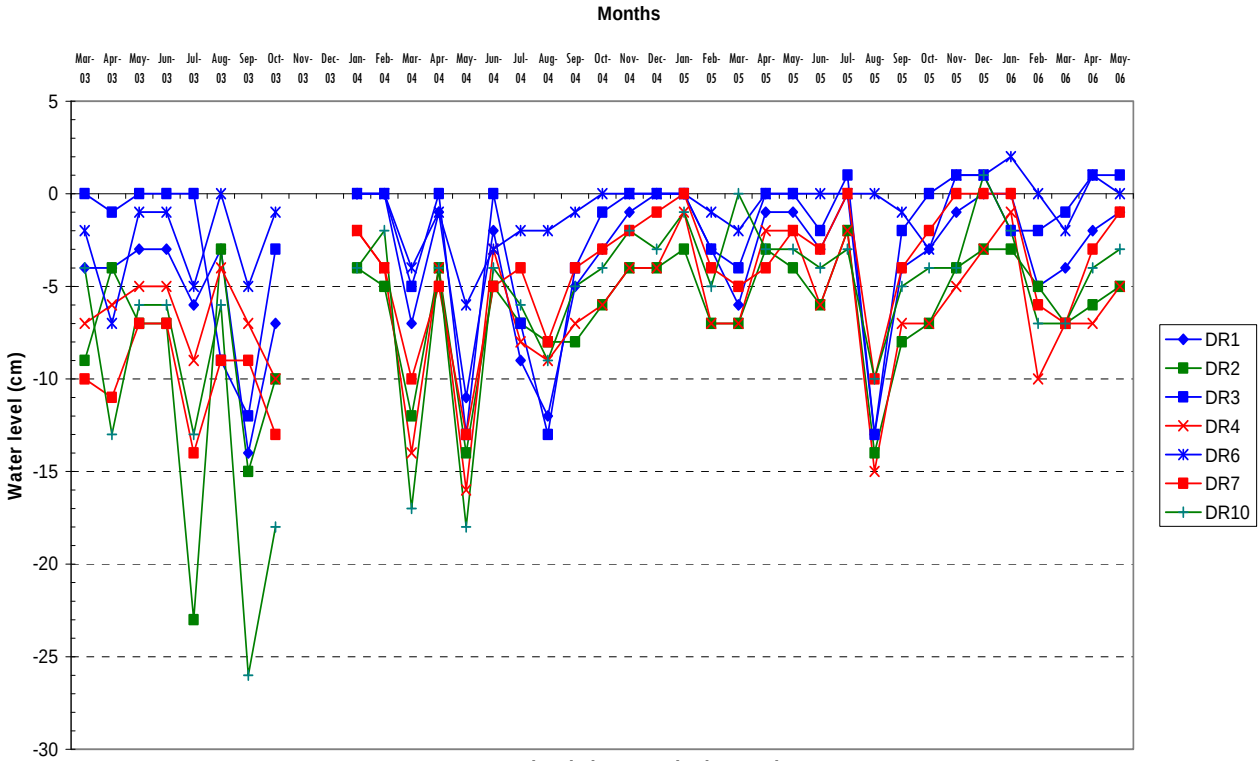
The water levels of the planted blanket bog at Garrane are among the lowest observed in the project and the water level fluctuations are also quite marked. The very “spiky” nature of the water levels is probably a result of the presence of shallow and well-drained blanket bog which dominates the site. Most of the Walrags located in areas supporting a low yielding conifer plantation have water levels which tend to fluctuate between -30cm and ground level however the only Walrag with water levels consistently in the top 10cm of the peat soil is located in the area of wet cutover bog. There is little evidence of water level rise within this site over time and this is reflected by the fact that the site is particularly prone to unwanted invasion by birch.

**2.2 Drumalonhurt, Co. Kerry (Site No. 3)**

At Drumalonhurt ten Walrags were installed, six in conifer plantation of varying height and quality and four in areas of unplanted blanket bog. The felling of the conifers took place during the summer of 2003 while the drains were blocked during summer 2004.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | V 69566 81507 | Intact blanket bog on low hill dominated by *Schoenus nigricans, Racomitrium lanuginosum* and *Erica tetralix*. | Not planted, located on open bog west of plantation. |
| 2 | V 69602 81516 | Blanket bog planted with Sitka spruce. Tree cover dense and between 6 and 8m tall. Ground cover dominated by *Hypnum cupressiforme* with some *Thuidium tamariscinum* and *Molinia*. | |
| 3 | V 69650 81526 | Open blanket bog on unplanted fire break in middle of plantation. Vegetation dominated by *Schoenus nigricans, Racomitrium lanuginosum* and *Calluna vulgaris*. Moss cover <10%. | |
| 4 | V 69666 81527 | Blanket bog planted with Sitka spruce. Tree cover sparse and only between 4 and 7m tall. Ground cover dominated by *Hypnum cupressiforme* and *Sphagnum capillifolium* with *Molinia* and *Erica tetralix* also frequent. | |
| 5 | V 69670 81534 | Blanket bog planted with Sitka spruce. Tree cover sparse and only between 3 and 6m tall. Ground cover dominated by *Sphagnum capillifolium* with *Molinia*, *Sphagnum papillosum* and *Erica tetralix* also frequent. | Results not used due to continual malfunctioning of the Walrag. |
| 6 | V 69704 81184 | Wet and intact blanket bog dominated by *Schoenus nigricans, Erica tetralix* and *Eriophorum angustifolium.* | Not planted, located on open bog west of plantation. |
| 7 | V 69749 81184 | Blanket bog drained and planted with spruce but trees very stunted (1 to 3m tall). Ground vegetation dominated by *Molinia caerulea* with *Sphagnum capillifolium* and *Pleurozium schreberi* also very common. | |

| | | | |
|---|---|---|---|
| 8 | V 69786 81238 | Blanket bog on unplanted fire break in middle of plantation. Area very wet and flushed. Vegetation dominated by *Sphagnum capillifolium, Molinia caerulea* and *Juncus effusus*. | Results not used due to continual malfunctioning of the Walrag. |
| 9 | V 69806 81241 | Blanket bog planted with Sitka spruce. Tree cover rather sparse and between 5 and 7m tall. Ground cover dominated by *Sphagnum capillifolium*, *Hypnum cupressiforme* and *Molinia*. Flushing by surface water evident | Results not used due to continual malfunctioning of the Walrag. |
| 10 | V 69832 81347 | Blanket bog planted with Sitka spruce. Tree cover quite dense and between 7 to 8m tall. Ground cover dominated by mosses such as *Sphagnum capillifolium*, *Hypnum cupressiforme* and *Rhytidiadelphus loreus*. Flushing by surface water evident. | |




**Water levels in Drumalonhurt walrags.**
**Blue = unplanted bog, Red = bog with low/stunted conifers, Green = bog with tall conifers**

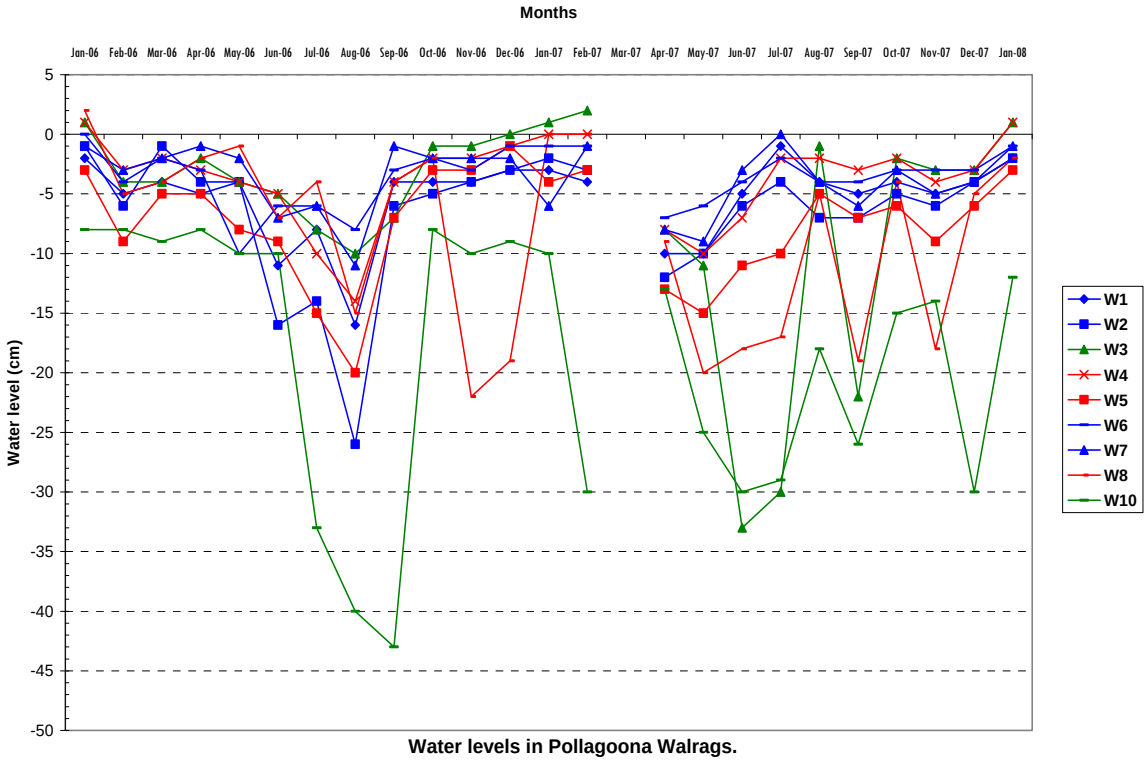
Water levels at Drumalonhurt are generally much higher than that observed at Garrane, which is located only 3 km to the east. The water levels in Walrags at Drumalonhurt generally appear to indicate that peat soil conditions at the site are getting progressively wetter. Although this could possibly be a result of more frequent and consistent rainfall from September 2004 onwards there does appear to be a definite damping in the water table fluctuations from that month onwards.

**2.3 Pollagoona, Co. Clare (Site No. 4)**

At this site a total of ten Walrags were installed in both open blanket bog areas and blanket bog planted with Sitka spruce. The trees planted in these areas did not generally grow well as a result of poor drainage of the very wet peat soil. The felling of trees and blocking of drains during the first phase of restoration operations at this site took place between August 2003 and August 2004. Walrag readings only commenced in January 2006, well after restoration activities had been completed.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | R 64127 96127 | Shallow blanket bog dominated by *Molinia caerulea*, located c. 60 metres from plantation edge. *Erica tetralix, Cladonia portentosa* and *Potentilla erecta* also frequent. | Peat only just over 1 metre deep in this area. |
| 2 | R 64091 96151 | Shallow blanket bog dominated by *Molinia caerulea*, located c. 15 metres from plantation edge. *Erica tetralix, Sphagnum capillifolium* and *Calluna vulgaris* also frequent. | Peat only just over 1 metre deep in this area. |
| 3 | R 64076 96172 | Sitka spruce plantation on shallow blanket bog. Trees 8 to 10 metres tall. Ground layer dominated by mosses such as *Sphagnum capillifolium, Thytidiadelphus loreus* and *Dicranum scoparium*. | Peat only round 1 metre deep in this area. |
| 4 | R 64092 96209 | Very poor Sitka spruce plantation on shallow blanket bog. Trees 4 to 6 metres tall and sparse. Ground layer dominated by *Molinia caerulea*. *Sphagnum papillosum, Erica tetralix* and *Vaccinium oxycoccus* also very common. | |
| 5 | R 64103 96231 | Very poor Sitka spruce plantation on shallow blanket bog. Trees 3 to 7 metres tall and sparse. Ground layer dominated by *Molinia caerulea*. *Sphagnum capillifolium, Eriophorum vaginatum* and *Hypnum cupressiforme.* | |
| 6 | R 64184 96087 | Intact and very wet bog dominated by *Narthecium ossifragum*. Other common | |

| | | | |
|---|---|---|---|
| | | species include *Sphagnum papillosum, Eriophorum angustifolium* and *Trichophorum cespitosum*. | |
| 7 | R 64211 96004 | *Molinia*-dominated bog located c. 10 metres from edge of plantation. *Myrica gale, Erica tetralix* and *Eriophorum angustifolium* also common. | |
| 8 | R 64215 95976 | Very poor Sitka spruce plantation on blanket bog. Trees 1.5 to 6 metres tall and sparse. Ground layer dominated by *Molinia caerulea* with *Myrica gale, Calluna vulgaris* and *Eriophorum vaginatum* also common. | |
| 9 | R 64228 95945 | Very poor Sitka spruce plantation on blanket bog. Trees < 2 metres tall and sparse. Ground layer dominated by *Molinia caerulea*. *Myrica gale* and *Sphagnum capillifolium* also very common. | Area drained for forestry but drains quite full with water. Results discarded due to malfunctioning of Walrag. |
| 10 | R 64129 96258 | Tall and dense Sitka spruce (7 to 12 m tall) on dried-out peat. Ground layer dominated by *Hypnum cupressiforme* with *Molinia caerulea, Plagiotheicum undulatum* and *Dicranum scoparium* also frequent. | |




**Water levels in Pollagoona Walrags.**

**Green = Bog with tall conifers. Red = Bog with low/sparse conifers, Blue = Open bog, unplanted.**

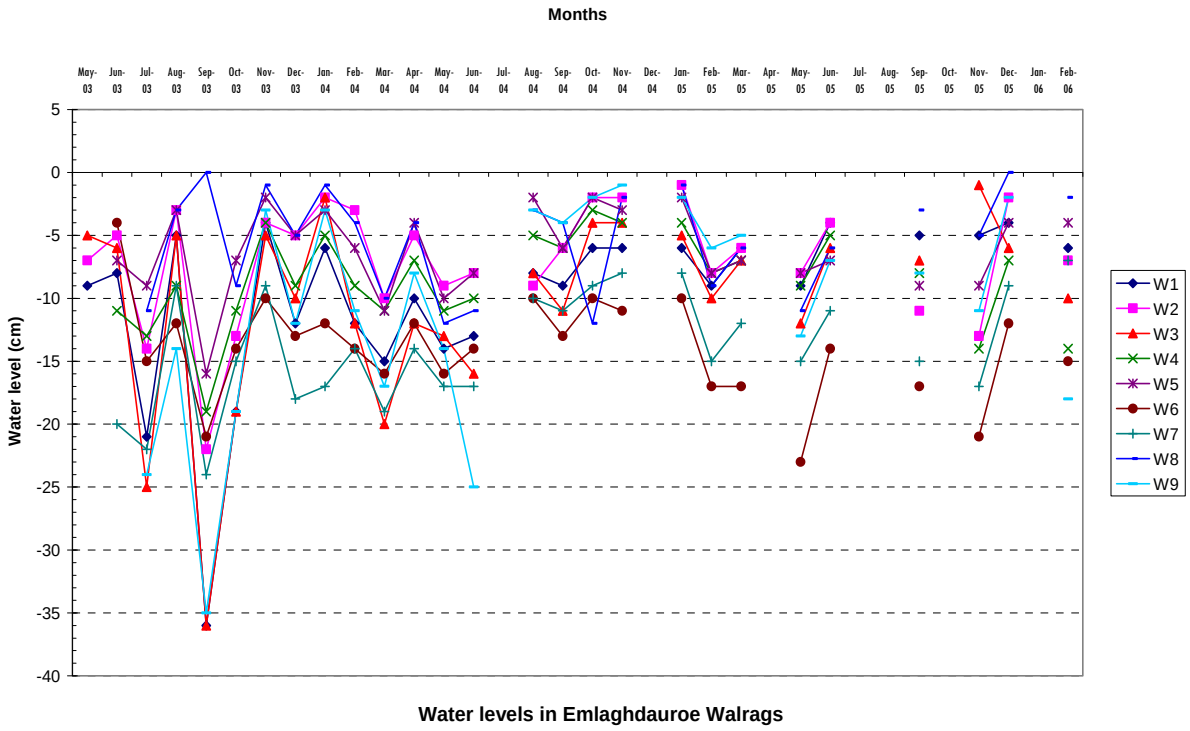
The generally high water levels in Walrags at Pollagoona, in both intact and afforested areas, reflect the very wet nature of the site. Of particular note is the observation that the areas of bog which now support a crop of stunted Sitka spruce are very wet, with the water level lying in the top 10cm of peat for the majority of the year. The areas of bog which have a cover of tall Sitka spruce show a considerable fluctuation in water level which can dip as low as -40cm (see W10).

**2.4 Emlaghdauroe, Co. Galway (Site No. 5)**

At Emlaghdauroe a total of nine Walrags were installed, eight in tall conifer plantation and one in unplanted blanket bog along an electricity line which runs through the western end of the site. The felling of trees and blocking of drains took place between June 2003 and August of 2004.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | L 74892 49956 | Tall lodgepole pine plantation, 10 to 12m tall. Ground flora dominated by pine litter with no vascular plant cover. Moss cover <5%. | Trees felled during the summer of 2004. |
| 2 | L 74892 49956 | Unplanted blanket bog in electricity line corridor surrounded by conifers. Vegetation dominated by *Molinia caerulea* and *Sphagnum capillifolium.* | |
| 3 | L 7496 4995 | Tall lodgepole pine plantation, 10 to 12m tall. Ground flora dominated by pine litter with no vascular plant cover. Moss cover c.30% with *Thuidium tamariscinum* and *Polytrichum commune* the main species. | Trees felled during the summer of 2004. |
| 4 | L 75123 49981 | Lodgepole pine plantation, 7 to 10m tall. Ground flora dominated by pine litter with vascular plant and moss cover <10%. *Molinia caerulea* and *Sphagnum subnitens* frequent. | Trees felled during the summer of 2003. |
| 5 | L 75191 49981 | Lodgepole pine plantation, 8 to 10m tall. Ground flora dominated by pine litter with moss cover <10%. *Hypnum cupressifrome* and *Polytrichum commune* frequent | Trees felled during the summer of 2003. |
| 6 | L 75285 49984 | Lodgepole pine plantation, 8 to 10m tall. Ground flora dominated by pine litter with moss cover <10%. *Hypnum cupressifrome, Molinia caerulea* and *Polytrichum commune* frequent. | Trees felled during the summer of 2003. |
| 7 | L 74962 49756 | Lodgepole pine plantation, 7 to 10m tall. Ground flora dominated by pine litter with moss cover <5%. *Hypnum cupressifrome* and *Sphagnum capillifolium* frequent. | Trees felled during the summer of 2003. |
| 8 | L 7507 4974 | Sitka spruce plantation, >12m tall. Ground flora dominated by the moss *Hypnum cupressifrome.* | Conifer crop tall and well-grown. Trees felled during the summer of 2003. |

| | | | |
|---|---|---|---|
| | | *Rhytidiadelphus loreus* also frequent. | |
| 9 | L 75138 49680 | Lodgepole pine plantation, 7 to 10m tall. Ground flora dominated by pine litter with moss cover c. 15%. *Hypnum cupressiforme* and *Molinia caerulea* frequent. | Trees felled during the summer of 2003. |




**Water levels in Emlaghdauroe Walrags**

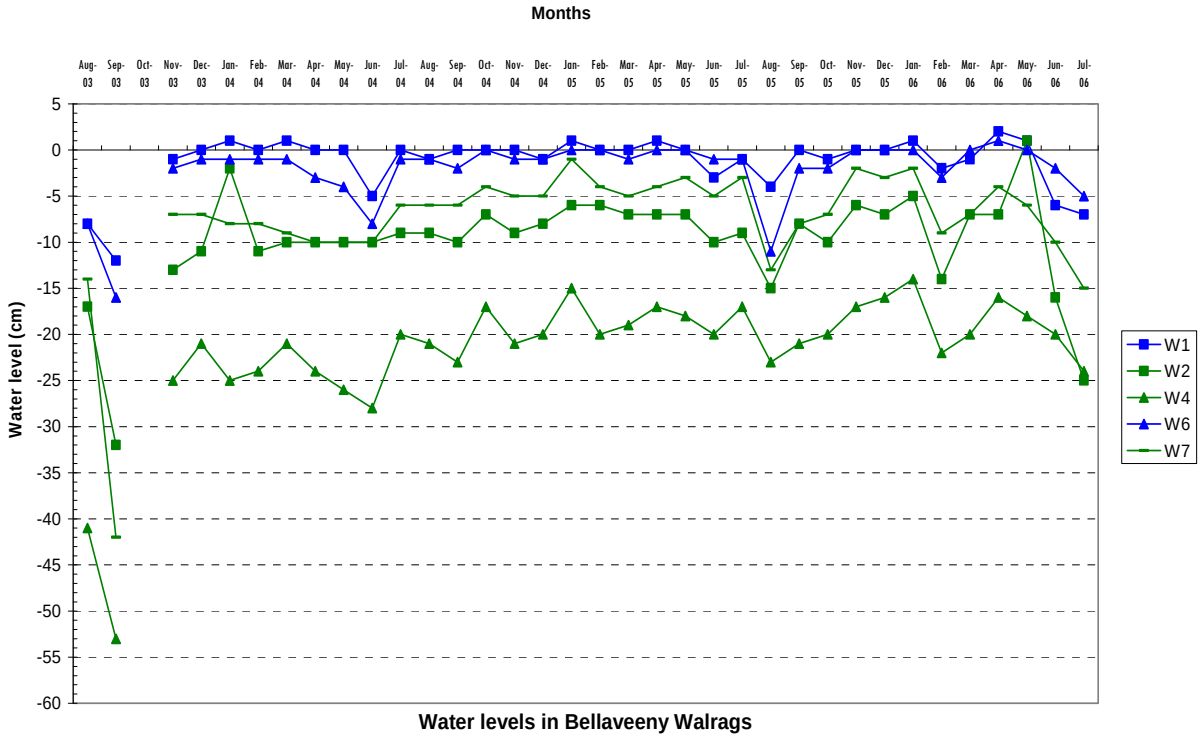
At Emlaghdauroe most of the conifer crop was felled during the summer of 2003. This commercial crop was dominated by lodgepole pine which was planted in the mid-1970's. The peat cover at this site is generally less than 2 metres in depth, especially on the higher slopes to the east. All but one of the Walrags were sited in areas which were previously afforested.

The main point of note with regard to the water levels in Walrags is the fact that the levels appear to be relatively high for peat soil which has been afforested with a heavy crop of conifers for c. 30 years. Typically the water levels rarely fall more than 15cm below the peat surface apart from very dry periods such as September 2003. The reasons for the relatively high watertable at Emlaghdauroe are not clear however the fact that relatively high water levels in afforested peat were also observed at Bellaveeny suggests that the shallow nature of the peat at both sites may be a factor. With regard to water-level rise in the peat there is little evidence of improvement visible in the two years since tree harvesting however the fact that water level data is missing from some months in 2004 and 2005 limits the vale of the data.

**2.5 Bellaveeny, Co. Mayo (Site No. 6)**

This site consisted of an area of relatively tall coniferous plantation on blanket bog. The peat at this site is generally quite shallow with depth of between 1 and 2 metres typical. A total of seven Walrags were inserted in a mixture of open and afforested areas. The felling of trees and blocking of drains at this site took place between August 2003 and August 2004.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | F 86888 03383 | Open blanket bog in fire break between two areas of forestry. Vegetation dominated by *Schoenus nigricans*, *Molinia caerulea* and *Erica tetralix*. | |
| 2 | F 86965 03373 | Dense lodgepole pine plantation, trees 8 to 10 metres tall. *Molinia* and *Hylocomium splendens* dominant in the ground layer. | |
| 3 | F 86953 03655 | Dense lodgepole pine plantation, trees 10 to 12m tall. *Hypnum cupressiforme* dominant in the ground layer. | Readings from this Walrag were discarded due to a suspected fault. |
| 4 | F 86885 03888 | Dense lodgepole pine plantation, trees 10 to 12m tall. *Hypnum cupressiforme* dominant in the ground layer. | |
| 5 | F 86924 03995 | Dense lodgepole pine plantation, trees 10 to 12m tall. *Hypnum cupressiforme* dominant in the ground layer. | Readings from this Walrag were discarded due to a suspected fault. |
| 6 | F 86849 04092 | Open blanket bog in fire break between two areas of forestry. Vegetation dominated by *Molinia caerulea* and *Sphagnum cuspidatum* | |
| 7 | F 86900 04096 | Dense lodgepole pine plantation, trees 6 to 10 metres tall. *Molinia* and *Hylocomium splendens* dominant in the ground layer. | |




**Water levels in Bellaveeny Walrags**

**Blue = Open blanket bog, not planted. Green = Blanket bog with heavy cover of lodgepole pine.**

The general water levels at Bellaveeny are similar to other sites with September 2003, June 2004, August 2005 and July 2006 being the driest months recorded. In the case of the Walrags located in intact blanket bog the water levels lie within the top 10cm of the peat for at least 95% of the year and for the majority of this time the water levels are within 5 cm of the peat surface. In two of the afforested blanket bog Walrags the water levels are also relatively high, lying between –10 and –5cm of the peat surface for the majority of the time however in the case of W4 the water level generally varies between –30 and –15cm below the peat surface. In the case of W4 there appears to be a gradual rise in the water levels from July 04 onwards which may be due to the affects of tree felling and drain blocking although this trend of improvement appeared to halt somewhat in the late Spring/early summer of 2006.

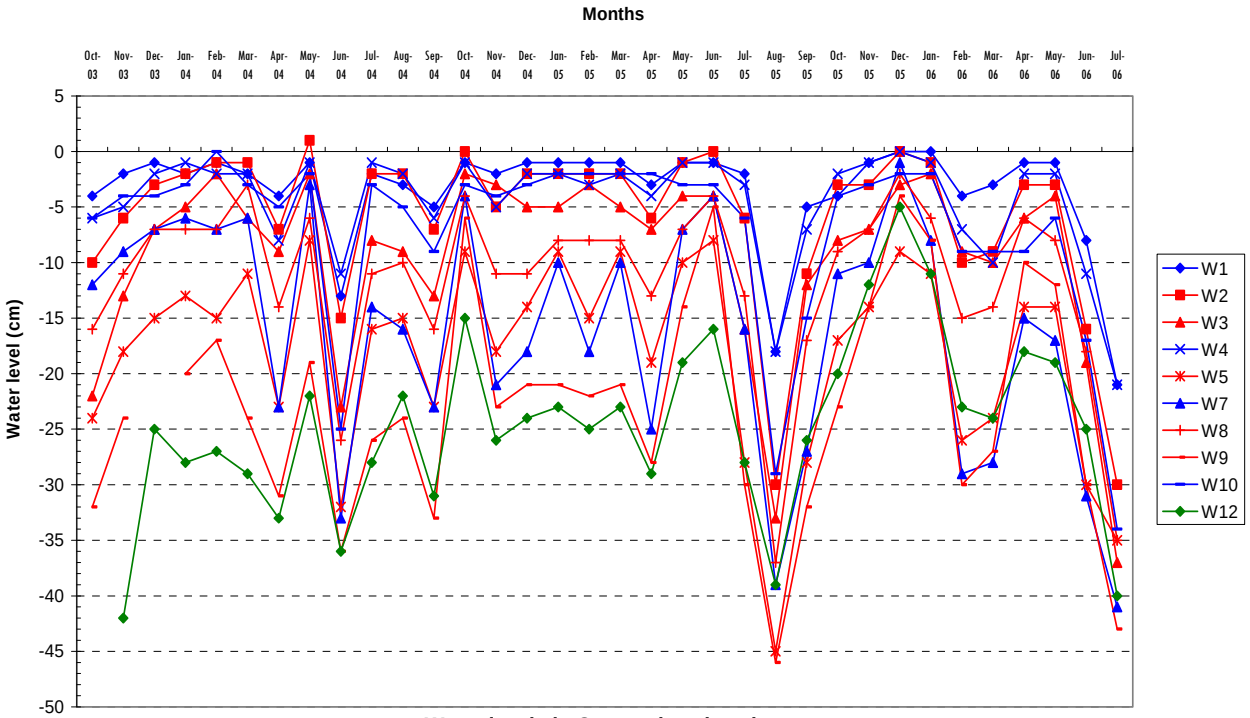
**2.6 Owenanirragh, Co. Mayo (Site No. 9)**

This site consisted of young coniferous plantation on blanket bog. Owenanirragh is different to most of the other sites in this project because it was tunnel ploughed, in order to promote peat drainage. Tunnel ploughing results in the presence of open surface drains only every 40 metres or so and these were blocked with plastic dams after the trees were felled and wind-rowed. Subsequent observations have revealed however that in some sections of these blocked drains the water level remains low and it is thought that tunnel ploughing, in which the bottom of the drain is either at or close to subsoil, is at least partly responsible for these low water levels.

A total of 12 Walrags were inserted in a mixture of open and afforested areas. The felling of trees and blocking of drains at this site took place between August 2003 and July 2004.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | F 94156 37746 | Open blanket bog dominated by *Schoenus nigricans* and *Molinia caerulea.* | Located approx. 30 metres south of young forestry. |
| 2 | F 94166 37788 | Young coniferous plantation on blanket bog, trees 1.5 to 4 metres tall. *Molinia* and *Hypnum cupressiforme* dominant in the ground layer. | No open drains in immediate vicinity. |
| 3 | F 94172 37818 | Young coniferous plantation on blanket bog, trees 1.5 to 3 metres tall. *Molinia* and *Hypnum cupressiforme* dominant in the ground layer. | No drains in immediate vicinity. |
| 4 | F 94038 37652 | Open blanket bog dominated by *Schoenus nigricans*, *Molinia caerulea* and *Narthecium ossifragum.* | Intact blanket bog west of afforested area with open pools surrounding. |
| 5 | F 94013 37641 | Young coniferous plantation on blanket bog, trees 4 to 6 metres tall. *Molinia* and *Hypnum cupressiforme* dominant in the ground layer. | |
| 6 | F 93999 37630 | Young coniferous plantation on blanket bog, trees 3 to 6 metres tall. *Molinia* and *Hypnum cupressiforme* dominant in the ground layer. | Readings from this Walrag were discarded due to a suspected fault. |
| 7 | F 93715 37492 | Open blanket bog dominated by *Molinia caerulea* and *Tricophorum cespitosum.* | |
| 8 | F 93752 37500 | Young coniferous plantation on blanket bog, trees 3 to 6 metres tall. *Molinia* dominant in the ground layer. | Walrag located at edge of planted area and open bog. |
| | | | |

| | | | |
|---|---|---|---|
| 9 | F 93773 37507 | Young coniferous plantation on blanket bog, trees 5 to 7 metres tall. *Molinia* dominant in the ground layer. | |
| 10 | F 93462 37928 | Open blanket bog dominated by *Narthecium ossifragum* and *Schoenus nigricans.* | |
| 11 | F 93451 37984 | Young, dense coniferous plantation on blanket bog, trees 6 to 7 metres tall. *Molinia* sparse in the ground layer. | Bog very dry due to drainage and tree growth. Readings from this Walrag were discarded due to a suspected fault. |
| 12 | F 93450 38017 | Young, dense coniferous plantation on blanket bog, trees 6 to 7 metres tall. *Molinia* sparse in the ground layer. | Bog very dry due to drainage and tree growth. |




**Water levels in Owenanirragh walrags.**

**Blue = Open, unplanted bog, Red = Bog with low/sparse conifers, Green = Bog with tall conifers.**

The water levels at Owenanirragh show patterns which are broadly similar to the other sites. According to the water levels in the Walrags the driest months were June 2004, August 2005 and July 2006 while the winter months were generally the wettest. In the case of intact blanket bog the water levels remain in the top 5 cm of soil for greater than 90% of the year with the notable exception of W7 which is located in a hummocky area of intact bog. At this location the water levels can dip below –10 cm for considerable portions of the year and even went below –30cm in June 2004 and August 2005. The data from this Walrag indicates that even in intact blanket bog there may be periods of naturally low water levels and this may be expected in hummocky bog areas.

In the Walrags located in areas of afforested blanket bog the water levels generally occur in the top

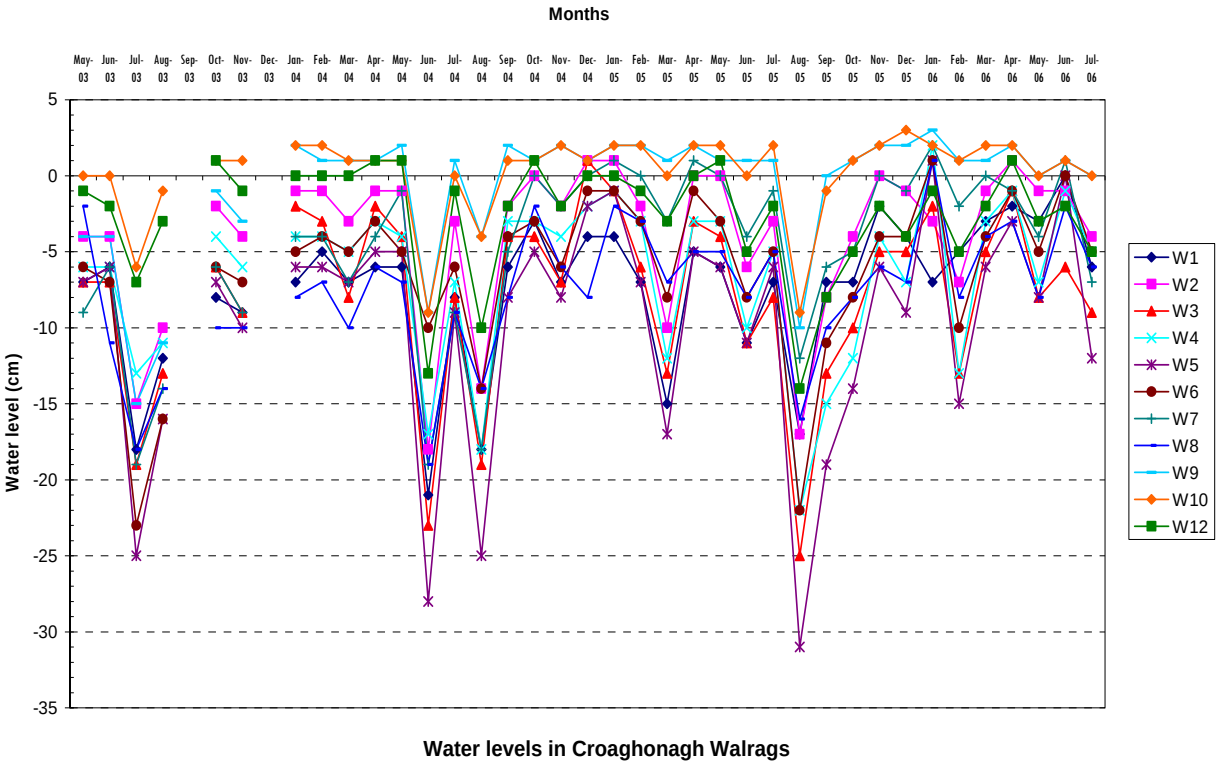
25cm of the peat for the majority of the year, only going below 25cm during short dry spells during the summer. From the graph it is noteworthy that W12, which was dominated by a relatively tall conifer crop, has one of the lowest water levels. In general there do not appear to be any significant improvements in water levels following tree felling and drain blocking. This can be explained, in part, by the lack of a large network of surface drains at this site.

**2.7 Croaghonagh, Co. Donegal (Site No. 13)**

Croaghonagh is the only site in the project where forestry drains were dug but conifers were not subsequently planted. A total of twelve Walrags were installed in unplanted blanket bog areas between forestry drains. The blocking of drains with plastic dams was carried out during the summer of 2003 (In the case of Walrags 6 to 12) and during the summer of 2004 (in the case of Walrags 1 to 5).

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | H 05471 88651 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. | |
| 2 | H 05490 88648 | Blanket bog between drains. *Molinia caerulea* and *Calluna vulgaris* co-dominant. | |
| 3 | H 05516 88648 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. | Steeply sloping area of bog. |
| 4 | H 05543 88638 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. *Cladonia portentosa* and *Sphagnum capillifolium* also frequent. | |
| 5 | H 05572 88632 | Blanket bog between drains. *Molinia caerulea* dominant with *Cladonia portentosa* and *Calluna vulagris* also frequent. | |
| 6 | H 05662 88711 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. *Erica tetralix and Calluna vulgaris* also frequent. | |
| 7 | H 05646 88721 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. *Erica tetralix and Calluna vulgaris* also frequent. | |
| 8 | H 05624 88737 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium lanuginosum* sub-dominant. *Erica tetralix* and *Cladonia portentosa* also frequent. | |
| 9 | H 05605 88759 | Blanket bog between drains. *Molinia caerulea* dominant with *Racomitrium* | |

| | | | |
|---|---|---|---|
| | | *lanuginosum* sub-dominant. *Calluna vulgaris* and *Cladonia portentosa* also frequent. | |
| 10 | H 05685 88857 | Intact blanket bog. 20m north-east of drained area, dominated by *Trichophorum cespitosum*. Area surrounded by shallow bog pools. | |
| 11 | H 05672 88815 | Blanket bog between drains. *Eriophorum angustifolium* dominant with *Erica tetralix and Eriophorum vaginatum* also frequent. | Readings from this Walrag were discarded due to a suspected fault. |
| 12 | H 05685 88775 | Blanket bog between drains. *Molinia caerulea* dominant with *Eriophorum angustifolium* and *Eriophorum vaginatum* also frequent. | |




**Water levels in Croaghonagh Walrags**

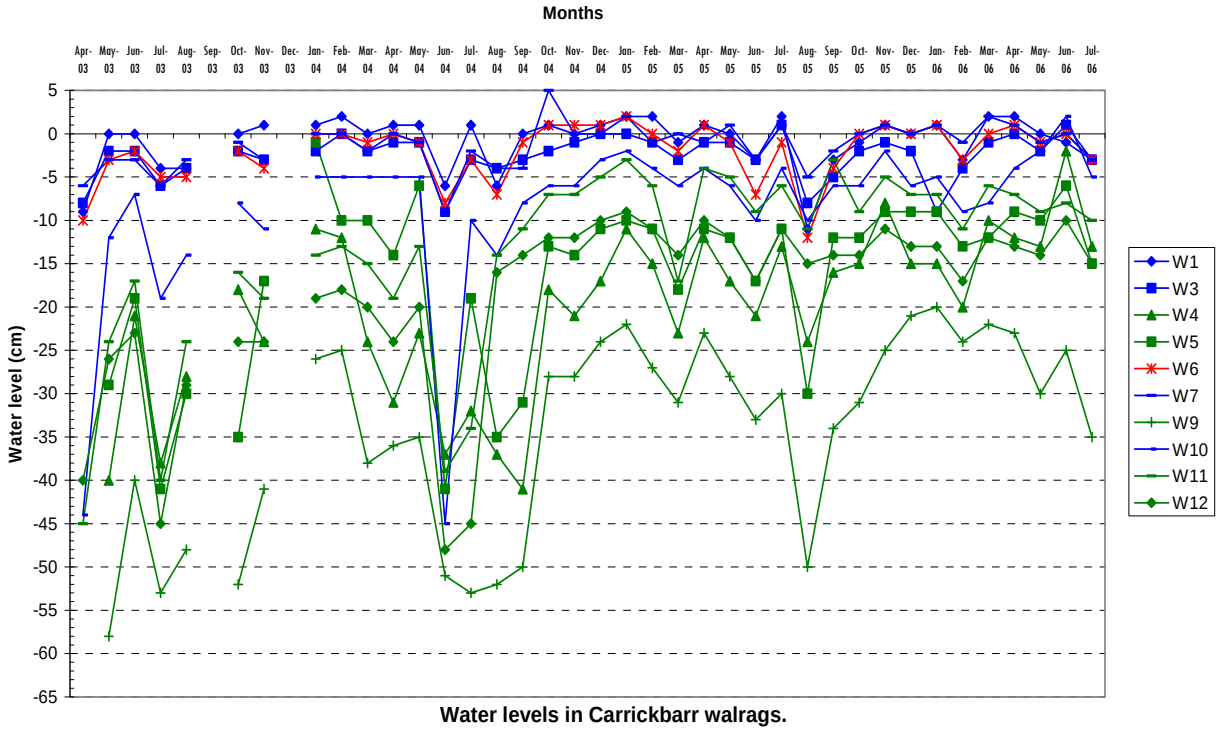
Due to the fact that all of the most of the Walrags at Croaghonagh were located in similar environments the water level graphs are broadly similar. In this drained peatland soil most of the water stays in the top 10 cm of peat for the majority of the year, apart from dry periods which generally occur in late Summer. In the case of Walrags 9, 10 and 12 the water levels rarely dip below 5 cm and this is probably due to the fact that these walrags are located only c. 10 metres from intact, undrained bog. Only one of the Walrags installed at Croaghonagh was located in intact blanket bog (W10) and this has the highest water levels seen at the site. There is generally little indication that water levels are consistently higher after drain blocking however as there is relatively little difference between intact and drained bog it will be difficult to detect small improvements in hydrology even if they occur.

**2.8 Carrickbarr, Co. Donegal (Site No. 14)**

At Carrickbarr a total of twelve Walrags were installed both in unplanted blanket bog areas and in areas planted with a crop of tall conifers (Mostly lodgepole pine). The ring-barking of trees and blocking of drains at this site took place between August 2004 and October 2004.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | H 01455 74743 | Open blanket bog containing Sphagnum hummocks and pools. Vegetation dominated by *Eriophorum angustifolium* and *Tricophorum cespitosum*. | |
| 2 | H 01460 74714 | Open blanket bog containing numerous shallow pools. Vegetation dominated by *Eriophorum vaginatum* and *Racomitrium lanuginosum*. | Readings from this Walrag were discarded due to a suspected fault. |
| 3 | H 01458 74685 | Open blanket bog containing numerous linear pools. Vegetation dominated by *Eriophorum angustifolium* and *Tricophorum cespitosum*. | Located c. 60 metres north of afforested area. |
| 4 | H 01460 74630 | Dense lodgepole pine plantation, trees 10 to 12m tall. Ground cover of mosses/ vascular plants <5%. Hypnum is the main species present. | |
| 5 | H 01438 74625 | Dense lodgepole pine plantation, trees 10 to 12m tall. Ground cover of mosses/ vascular plants <5%. Hypnum is the main species present. | |
| 6 | H 0152174741 | An area of stunted and sparse lodgepole pine plantation, trees 1 to 2.5m tall. Ground cover is dominated by a bog flora with *Molinia caerulea* and *Racomitrium* the main species present. | |
| 7 | H 01526 74695 | Open blanket bog containing numerous shallow pools and large Sphagnum hummocks. Vegetation dominated by *Eriophorum vaginatum.* | |
| | | | |

| | | | |
|---|---|---|---|
| 8 | H 01536 74649 | Open blanket bog with intact vegetation dominated by *Eriophorum vaginatum* and *Eriophorum angustifolium*. | Readings from this Walrag were discarded due to a suspected fault. |
| 9 | H 01547 74607 | Dense lodgepole pine plantation, trees 8 to 12m tall. Ground cover of mosses/ vascular plants <5%. *Hylocomium splendens* is the main species present. | |
| 10 | H 01572 74601 | An area of low and quite open Sitka spruce plantation, trees 5 to 8m tall. Ground cover is dominated by modified a bog flora with *Sphagnum capillifolium* the main species present. | |
| 11 | H 01643 74645 | Dense lodgepole pine plantation, trees 8 to 12m tall. Ground cover of mosses/ vascular plants <5%. *Hypnum cupressiforme* is the main species present. | |
| 12 | H 01643 74616 | Dense lodgepole pine plantation, trees 8 to 12m tall. Ground cover of mosses/ vascular plants <5%. *Molinia caerulea* and *Hypnum cupressiforme* are the main species present. | |



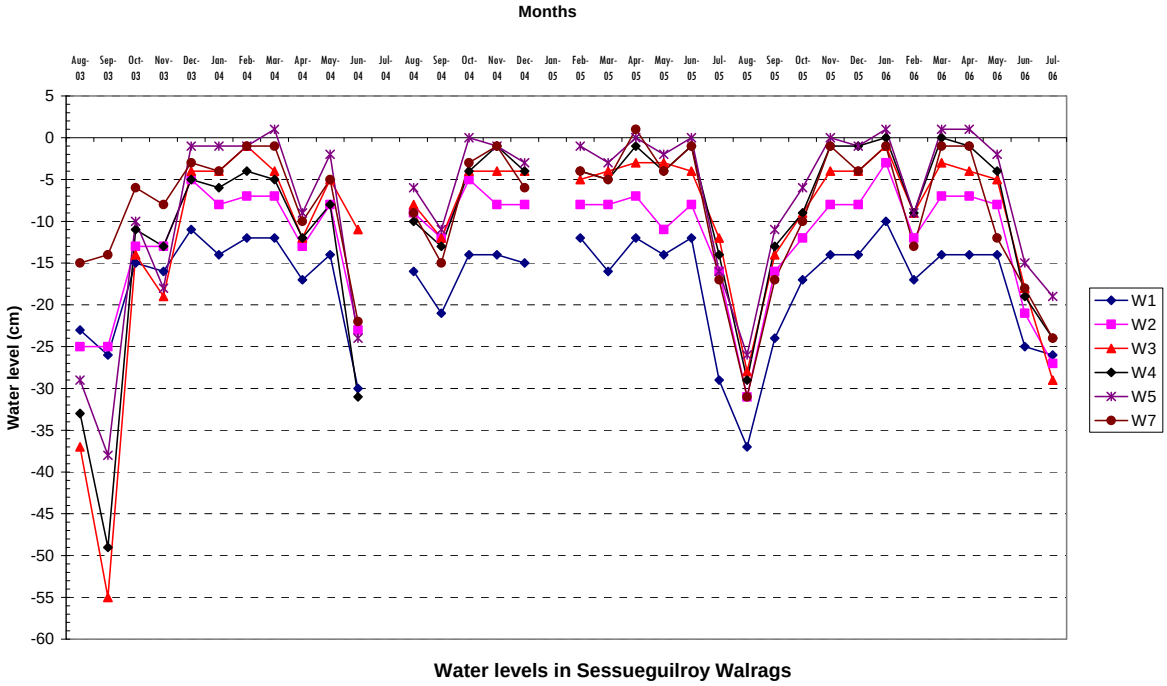

**Water levels in Carrickbarr walrags.**
**Blue = Unplanted blanket bog, Red = Bog with low/sparse conifers, Green = Bog with with tall conifers.**

In the north-western section of Carrickbarr the conifer crop was felled, but killed standing. This was carried out in late summer/early autumn of 2004. In addition, drains along the margins of the conifer plantation were blocked using plastic dams during the summer of 2004. The water levels at Carrickbarr show patterns which are broadly similar to the other sites, with June 2004 and August 2005 being the driest months. In the case of intact blanket bog Walrags the water levels lie within the top 10cm for at least 95% of the year and for the vast majority of the time the water levels are within 5cm of the peat surface. The remainder of the Walrags are located in afforested blanket bog where the cover of conifers is heavy. These Walrags show a surprising degree of variation with the water levels in some Walrags lying between –10cm and –5cm from the peat surface for significant portions of time. W9 shows the lowest water levels of all the Walrags with water levels generally between -55cm and –20cm of the peat surface and little indication of improvement. At this site however there are indications that there is a gradual but consistent increase in the water levels with time. The water levels in W4, W5, W11 and W12 are consistently high and much more stable after October 2004 than before October 2004.

### 2.9 Sessueguilroy, Co. Sligo (Site No. 15)

At this site a total of seven Walrags were installed in blanket bog areas planted with a crop of tall conifers (Mix of Sitka spruce and lodgepole pine). The felling of trees and blocking of drains at this site took place between July 2003 and October 2003. In general, the blanket bog at Sessueguilroy is relatively shallow, being typically between 1 and 2 metres in depth.

| Walrag Number | GPS location (Irish National Grid) | Vegetation | Comments |
|---|---|---|---|
| 1 | G 43106 18181 | Dense conifer plantation, trees 8 to 10 metres tall. *Hypnum cupressiforme* dominant in the ground layer. | Shallow peat area on slope therefore relatively dry. |
| 2 | No reading available | Dense conifer plantation, trees 8 to 10 metres tall. *Hypnum cupressiforme* dominant in the ground layer. | |
| 3 | No reading available | Dense conifer plantation, trees 6 to 8 metres tall. *Hypnum cupressiforme* dominant in the ground layer. | |
| 4 | No reading available | Dense conifer plantation, trees 6 to 8 metres tall. *Hypnum cupressiforme* and *Rhytidiadelphus loreus* dominant in the ground layer. | |
| 5 | No reading available | Dense conifer plantation, trees 8 to 10 metres tall. *Sphagnum capillifolium* and *Rhytidiadelphus loreus* dominant in the ground layer. | |
| 6 | G 43165 18384 | Open blanket bog dominated by *Molinia caerulea* and *Sphagnum capillifolium*. | Readings from this Walrag were discarded due to a suspected fault. |
| 7 | No reading available | Dense conifer plantation, trees 6 to 8 metres tall. *Hypnum cupressiforme* dominant in the ground layer. | |




**Water levels in Sessueguilroy Walrags**

The water levels in the Walrags at Sessueguilroy reflect the relatively shallow and heavily drained nature of the peat soil at the site. In spite of this however the water level in most of the Walrags lies within the top 10cm of the peat during the wetter periods of the year but typically declines to between -20cm and -25cm during very dry spells. The low water levels evident before September 2003 could have been due to the heavy tree cover and drainage however they could also have been due to a lack of rain at this time. In general there is little evidence for ongoing improvement of the water levels at this site however this is not surprising in view of the previous presence of a heavy conifer crop and the relatively shallow nature of the peat.

**3. Conclusions**

In general there is relatively little evidence for an increase in water levels in Walrags over the duration of the restoration project. This could indicate that drain blocking has a negligible effect on water levels within blanket bog sites however a number of other possible reasons for the lack of increase generally are possible. It is possible that the blocking of drains only produces a quantifiable elevation in water levels very close to the drain. Such local increases in water level would therefore not be reflected in the Walrags readings which were generally located more than a couple of metres from blocked drains. It is also considered likely that significant increases in water level would be difficult to achieve and sustain at well-drained sites with a relatively shallow peat depth, e.g. Bellaveeny and Emlaghdauroe. There is also a distinct possibility that it may take many decades for a high water level regime to return to areas of blanket bog which have been drained in the past. Although the water level monitoring undertaken has failed to reveal widespread evidence of hydrological recovery it has provided an important baseline against which any possible future hydrological monitoring could be gauged.

Although intensive and continuous water level recording is not advised for all sites at present it would be revealing to compare the water levels in restored blanket bog areas and in adjoining intact blanket bog areas in the future. This could be repeated at 5 year intervals in order to chart the improvement, or otherwise, in the hydrological regime at blanket bog restoration sites.