MONITORING AND EVALUATION PLAN FOR MDBA DEMONSTRATION REACHES

(version 2: revised April 2010)

Demonstration Reach name

Namoi Demonstration Reach (NDR).

Proponent and capacity to implement the M&E plan

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Background to the demonstration reach

NSW DPI are currently managing a NAP strategic reserve funded project on behalf of the Namoi CMA entitled the 'Namoi Aquatic Habitat Initiative'. Part of this initiative is the establishment of a Demonstration Reach in the Namoi River between Molly Weir and Boggabri (see map) to highlight to the community best practice for the management of aquatic habitats.
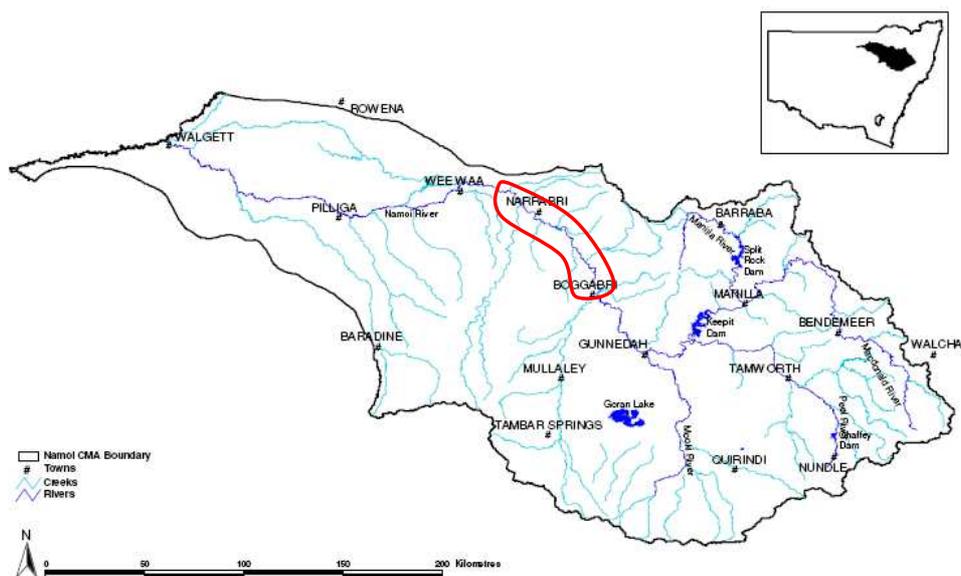
Location of NDR shown in red. Between Mollee Weir (about 20Km downstream of Narrabri) and Boggabri.

The recently released first report for the Sustainable Rivers Audit (Davies *et al.* 2008) shows the lowland reaches of the Namoi Valley ecosystem to be in poor health. Although the fish assemblage is dominated by native species, biomass is dominated by aliens such as carp and *Gambusia*. Many expected and some disturbance-sensitive macroinvertebrate families were found to be absent. The flow regime has undergone substantial changes in volume and seasonality.

Many factors have contributed to the deterioration of fish habitat and native fish populations including:

- barriers to fish passage;

- significant changes to water flow;

- thermal pollution[1];

- wetland degradation;

- instream habitat degradation;

- degradation of riparian vegetation;

- entrainment of native fish in irrigation offtakes; and

- the introduction of alien species;

A number of species listed as threatened under the *Fisheries Management Act 1994* (FM Act) are known to or have historically occurred in the rivers within the Namoi CMA area, but were absent in recent SRA surveys (Davies *et al.* 2008):

These species are:
- silver perch (*Bidyanus bidyanus)*;
- a water snail (*Notopala sublineata)*. – lower Namoi;
- Western population of purple spotted gudgeon (*Mogurnda adspersa)*; and
- Western population of the olive perchlet (*Ambassis agassizii),*

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[1] Although Keepit Dam can produce cold water pollution (CWP) in the Namoi Catchment, a recent scoping study [Boys, C.A., Miles, N., and Rayner, T. 2009a. Scoping options for assessing the impact of cold water pollution mitigation on the fish assemblage downstream of Keepit Dam, Namoi River. Final report prepared for the Native Fish Strategy, Murray-Darling Basin Authority, Canberra.] and various studies contained within suggest that reaches between Gunnedah and Keepit Dam can be classed as having high potential for CWP, whereas reaches between Gunnedah and Boggabri can be classed as low potential for CWP. It is very unlikely that the demonstration reach downstream of Boggabri is affected by any temperature depression, even in years where conditions suit maximum CWP release from the dam.

Goals and Interventions:

The overarching goal or vision of the demonstration reach is to address the key conservation issues within the site in a coordinated way in order to promote a measurable improvement in native fish. This M&E plans elaborates on what a "measurable improvement" is and how it will be quantified. More specifically, the goals of the reach are:

Goal	Intervention*
Restore fish passage	Concept designs being developed for lock fishways at Molly and Gunidgera weirs and vertical slot at Weeta weir. Staged construction in 2011-13 [C];
Improve wetland connectivity and condition	Fencing off wetlands to exclude stock [IH]; Off-channel water points to discourage stock from entering wetlands [IH]; Improve connectivity to wetlands by remediation of road crossings [IH].
Increase the availability of in-channel habitat for fish	Re-snagging of selected sites and planting of aquatic vegetation in selected sites [IH].
Improve the density of riparian vegetation in some areas	Fencing of riparian zone in some sections to exclude stock [IH]; Off-channel water points to discourage stock from entering riparian zone [IH].
Reduce the entrainment of native fish in irrigation pumps	Scoping and pilot study of mitigating infrastructure on pumps [IH].
Reduce the proportion of carp within the reach	Integrated carp management plan incorporating carp musters [IH] and carp cages on weirs [FR].

* Funding security: IH: In hand
                                    C: Committed
                                    FR: Currently unfunded and dependent future fund raising
                                    AS: Funding application submitted

Given that monitoring resources are finite and must be strategically split between the Bourke to Brewarrina Demonstration Reach and the Namoi Demonstration Reach, it will not be possible to monitor all interventions. In addition to overall **condition-based monitoring** in the reach, **intervention-based monitoring** will be carried out on the following:

1. Reintroduction of large woody debris to create physical habitat and induce positive hydraulic changes;
2. Improvement of fish passage through fishway construction at Molly, Gunidgera and Weeta weirs.
3. Scoping study into refining fish screening at water diversions

Links between interventions, goals, hypotheses, monitoring scales and chosen indicators

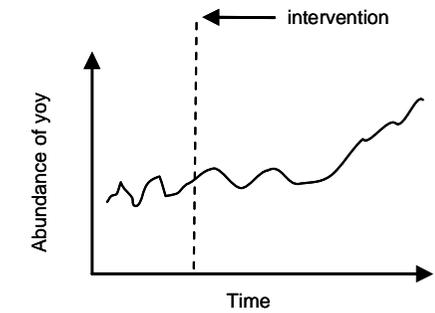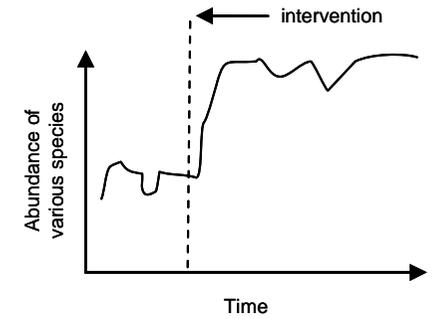| Interventions	Goals	Hypothesised response	Scale of response / measurement Temporal[2] (E.g. 0-4 years or ≥ 5 years)	Spatial (E.g. demo reach or sub-reach)	Indicators to be measured
All interventions	Trajectory of improvement in native fish numbers in the whole demonstration reach.	H_1: Increase in the abundance of native fish at the demonstration reach scale when compared to control reaches on other rivers	>5	Demo reach	Assemblage attributes associated with native fish response such as proportion of natives to aliens, abundance of golden perch, silver perch and Murray cod.
Re-snagging	Increase the availability of in-channel habitat for fish	H_2: Re-snagging increases hydraulic diversity;	0-4	Sub reach	Flow related indices (velocity, direction, turbulence) used to create a 3D hydraulic model through time and linked to river flow.
		H_3: Changes in hydraulic conditions create favourable habitat for native species such as golden perch and Murray cod.	0-4	Sub reach	Habitat suitability indices for selected native species by linking fish distribution to hydraulic model.
Fish passage	Improved connectivity of habitats and dispersal of migratory fish species;	H_4: Reduction in accumulations of migratory species downstream of fishway.	0-4	Sub reach	Mean abundance and size class analysis of migratory species e.g. golden perch, silver perch, Murray cod and carp.

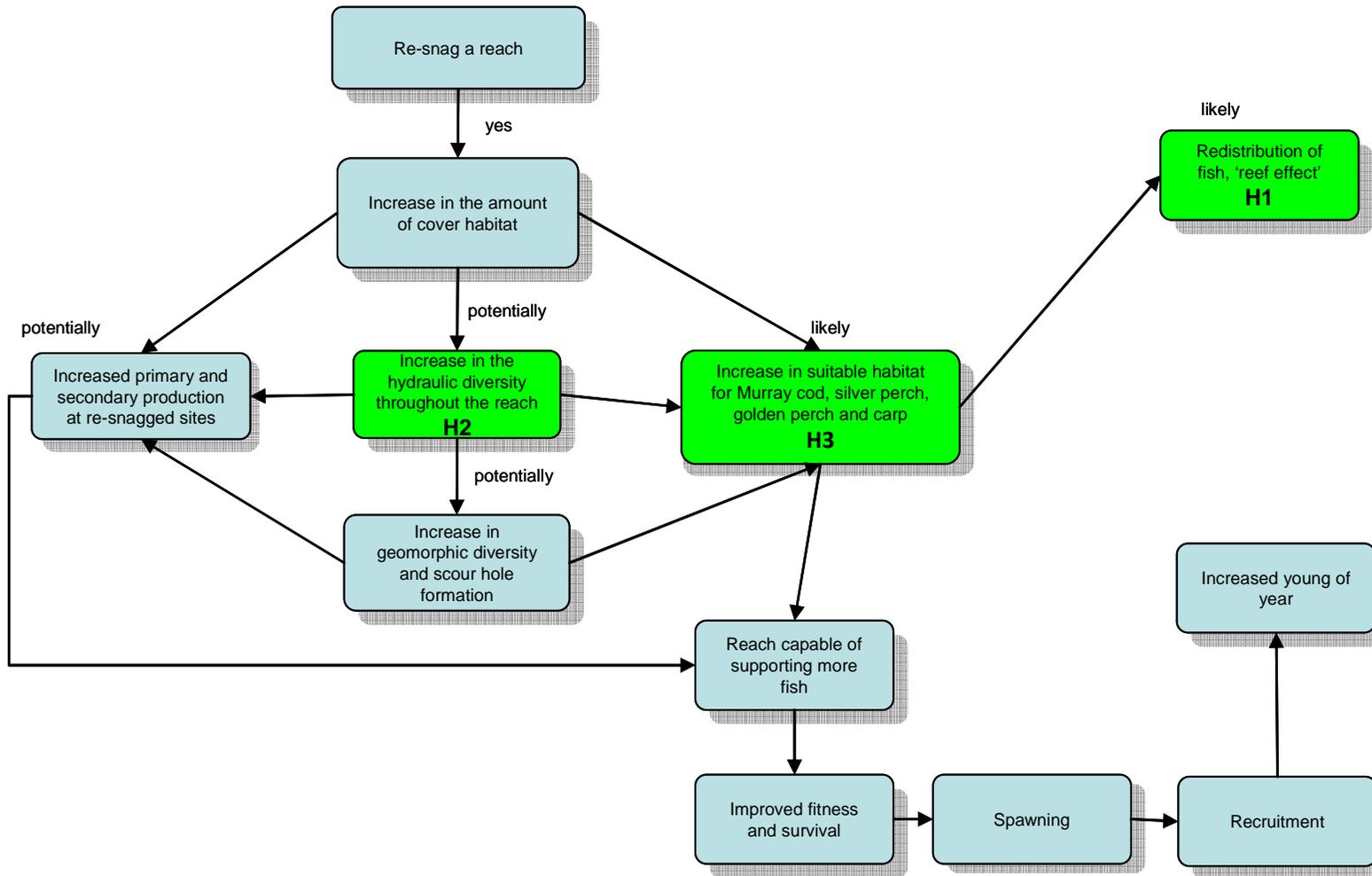| Fish screens on pumps	Demonstrate the effectiveness of screens in reducing the entrainment of native fish and scope feasibility of larger-scale roll-out. Guide the roll-out of this technology to other reaches	H_5: Fish screens reduce the level of fish entrainment in treated pumps relative to unscreened pumps.	0-4	Sub reach	Will be monitored as separate MDBA/NSW DPI project

Conceptual models

The following conceptual models cover the three main interventions being undertaken and their associated hypotheses. Only the components shown in green are being monitored:

- Re-snagging
- Fishways
- Fish screens

Re-snagging

Re-snag a reach

→ yes

Increase in the amount of cover habitat

→ potentially

Increase in the hydraulic diversity throughout the reach **H2**

→ potentially

Increase in geomorphic diversity and scour hole formation

Increased primary and secondary production at re-snagged sites

potentially

likely — Increase in suitable habitat for Murray cod, silver perch, golden perch and carp **H3**

likely — Redistribution of fish, 'reef effect' **H1**

Reach capable of supporting more fish

Improved fitness and survival → Spawning → Recruitment

Increased young of year

Abundance of various species — intervention — Time

Abundance of yoy — intervention — Time

Fishways

Native fish assemblage

Increased predation

Increased disease

Increased competition

No access to demo reach

Accumulations of migratory species downstream of weir H_4

Build fishway on weir

No change in the abundance of a range of fish species and size classes that can pass barrier

Increase in the abundance of migratory fish species of various size classes that can pass barrier

H_4

H_4

No change in accumulations of migratory species downstream of weir

Reduction in accumulations of migratory species downstream of weir

Recommend operational change (e.g. different cycle time) and design trial to test refinements

Increase in migratory species upstream in demo reach

Increase in carp upstream in demo reach

Build carp separation cage on fish lock

Produce carp cage management plan

Bio-bin cost effective solution to carp disposal

H_1

\- +
\- + + +
+ \-
+ \-

Offtake trial

Screen irrigation pump

likely

Reduction in number of fish entrained in pump
H5

Response variable

Mesh size 3

Mesh size 2

Mesh size 1

Size distribution curve. Area under curve equals abundance

Abundance

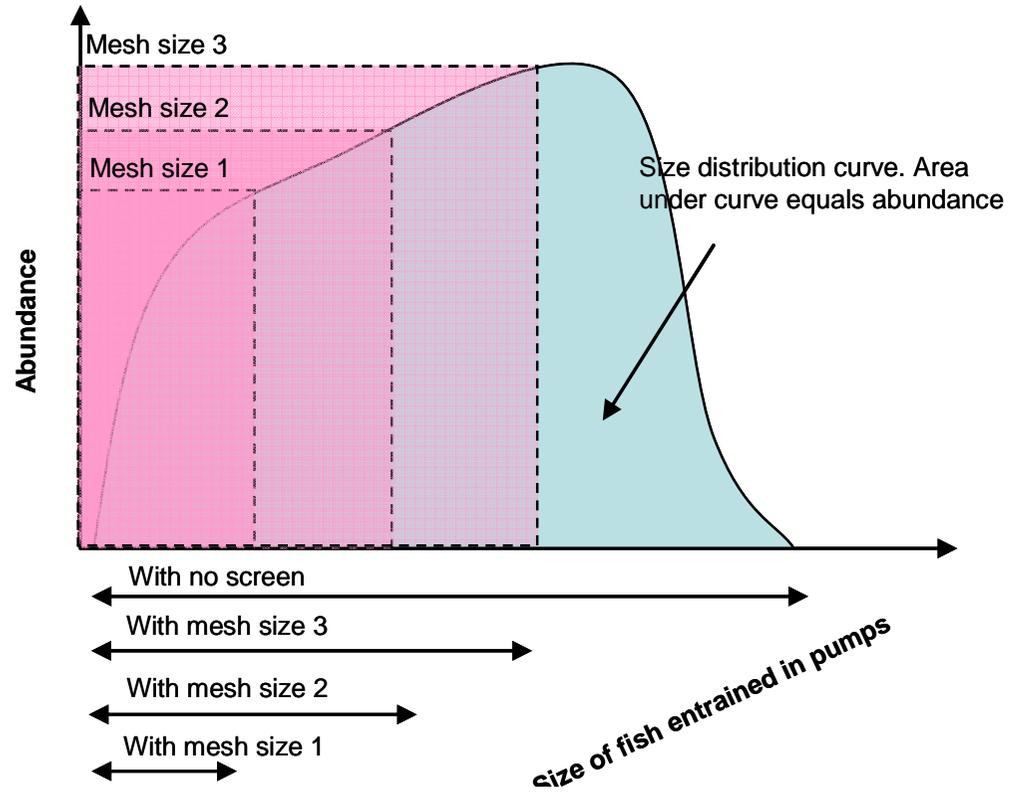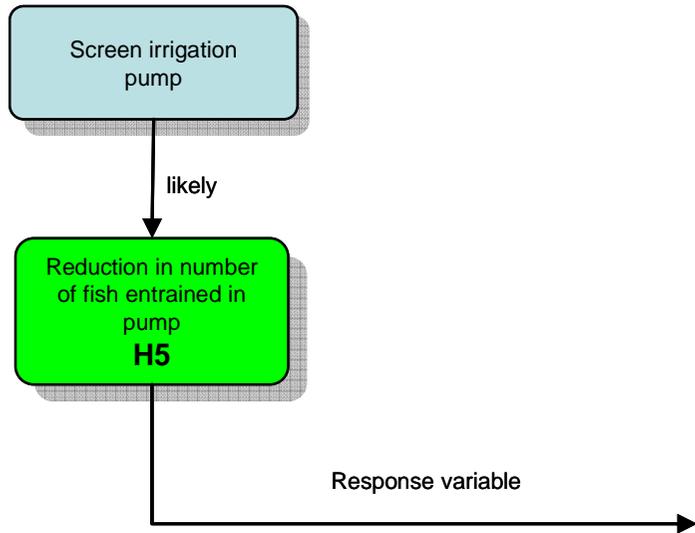With no screen

With mesh size 3

With mesh size 2

With mesh size 1

Size of fish entrained in pumps

Task 1. Demo reach scale condition monitoring of fish assemblage (Hypothesis 1):
Annual fish surveys (November to January) both within the DR and at external
control reaches in the Gwydir using boat mounted electrofishing and bait trapping as
per SRA protocols. Since 2006, 6 sites have been monitored within the vicinity of the
DR as part of SRA and IMEF, two of these are within the current DR. These existing 2
sites have been supplemented with 4 more within the DR, taking the total treatment
sites up to 6. Because there is a lack of 'before' sampling for the reach as a whole, DR
scale trends in the fish assemblage will be measured using a site trajectory approach
which enables treatment sites to be compared to untreated controls with limited
need for 'before' data (Boys *et al.* 2009b). The level of effort for all electrofishing
surveys are based on similar analysis of power conducted in the B2B DR.

**Task 2. Monitoring of hydraulic change and habitat enhancement through re-
snagging (Hypothesis 2 & 3):**   This work will be conducted as a collaborative effort
between Industry & Investment NSW and the Department of Geography at UNE,
through a post graduate position. Dr Craig Boys and Prof Martin Thoms will both
supervise this component. The student will begin as of June 2010. At this time the
exact methods will be developed by the research team. The following, however,
gives a short description of the approach to be employed. UNE will collect baseline
hydraulic data at selected reaches at a range of flows using ADCP to develop a 3D
hydraulic mosaic model. The relationships between this model will be made through
electrofishing at the resolution of microhabitat scale to develop an eco-hydraulic
model and develop habitat suitability indices. This approach has been employed
successfully by Prof Thoms' lab previously on the Murray River in collaboration with
ARI.

Task 3. Monitoring fish passage at selected Weirs (Hypothesis 4): The accumulation
of fish below 3 weirs (Molly, Gunidgera and Weeta) will be determined by boat
electrofishing below each structure (12 shots), three times a year throughout the
peak irrigation flows and migration period (Sept, Nov and Jan). This will commence in
2010 and will also be done in 2011. If State Water funding can be secured, sampling
will continue in 2012. The design will be a BACI one. With one or two weirs being
monitored prior to commissioning of the fishway and one or two being used as
controls. Some uncertainty remains over which of the weirs (Molly, Gunidgera or
Weeta) will be considered treatment and which will be controls, since the
construction schedule still needs to be finalised by State Water (the tender process
for a construction company is close to finalisation). Once a staged construction
process is known, it will then be evident which weirs will serves as which
components in the design. Three fishways will be monitored The Deelder fishlock is
due to be constructed in 2010/2011.

Task 4. Offtake trial (Hypothesis 5): The offtakes monitoring (to be undertaken as
part of another research project) will utilise a latin square design and movable

pumping station. This design has been developed in close consultation with an independent biometrician (Wayne Robinson) and approved through the relevant projects steering committee. The trial utilises direct trapping of fish entrained by pumps and a combination of Acoustic Doppler and DIDSON to look at impingement and velocity thresholds surrounding pumps. Methods developed and endorsed by separate steering committee. The results will be used to roll out this technology in this and other demonstration reaches throughout the Basin. The trial in the Namoi Demonstration reach will be conducted throughout September 2009.

References

Boys, C.A., Miles, N., and Rayner, T. 2009a. Scoping options for assessing the impact of cold water pollution mitigation on the fish assemblage downstream of Keepit Dam, Namoi River. Final report prepared for the Native Fish Strategy, Murray-Darling Basin Authority, Canberra.

Boys, C.A., Robinson, W., Butcher, A., Zampatti, B., and Lyon, J. 2009b. Framework for developing and implementing ecological monitoring and evaluation of aquatic rehabilitation in demonstration reaches. Final report prepared for the Native Fish Strategy, Murray-Darling Basin Authority, Canberra.

Davies, P.E., Harris, J.H., Hillman, T.J., and Walker, K.F. 2008. SRA Report 1: A Report on the Ecological Health of Rivers in the Murray–Darling Basin, 2004–2007 Prepared by the Independent Sustainable Rivers Audit Group for the Murray–Darling Basin Ministerial Council, Canberra.