Shire of Bridgetown-Greenbushes

Guidelines for the Construction of Dams

Adopted 29 July 2010

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ACKNOWLEDGEMENTS

This document was adapted from the Eastern Metropolitan Regional Council (EMRC) and the Shire of Mundaring's Environmental Guidelines for the Construction of Dams, 2000. It has been reviewed by the Shire of Bridgetown-Greenbushes Planning and Environment Services, the Shire of Bridgetown-Greenbushes Sustainability Advisory Committee, the Shire of Manjimup Planning Services and the Department of Water (DoW).

1. PURPOSE

The purpose of these guidelines is to provide procedures to minimise the impacts of dam construction on watercourses and the broader environment.

2. BACKGROUND

One of the key features of the Shire of Bridgetown-Greenbushes is the Blackwood River and its associated tributaries, watercourses and seasonal upland wetlands. The Blackwood River is a degraded watercourse polluted by many factors of which clearing for agricultural development is a significant cause. Associated with this has been the development of dams for water storage which has a direct affect on the total runoff reaching the river system. This is exacerbated by a drying climate.

Dam construction, excavation or remediation raise concerns regarding environmental, hydrological and landscape impacts, particularly with on-stream dams. Guidelines to properly assess the significance of potential impacts are thus necessary.

Under the *Rights in Water and Irrigation Act 1914 of WA (*administered by DoW), parts of WA are proclaimed for water resource management through licensing, and the remainder is unproclaimed. The Blackwood catchment is unproclaimed, with the exception of a few small public water supply catchments.

In proclaimed catchments riparian rights generally allow for water to be taken for ordinary stock and domestic purposes, including a household garden without the need for a licence. In proclaimed areas, where the land was alienated from the Crown prior to 1914, there is an additional riparian right to take water to irrigate a non-commercial garden of up to two hectares in area. Riparian rights only apply where the landowner has access to the water resource by having it within their property or where the property is contiguous to it. Riparian rights do not exist where the landowner's property is separated from the water resource by way of a reserve or other land classification.

In unproclaimed areas, subject to the access specifications above, a person has a right to take water for ordinary stock and domestic purposes, fire fighting and for any other purpose provided that the flow of water in a water course, or amount of water in a wetland, is not sensibly diminished.

DoW recognises that licensing as a management tool may have benefits. DoW is seeking to establish mechanisms for managing water diversions in a way that:

- minimises the impact on the natural drainage system;
- supports the values of local government; and
- provides landowners with a self-supply water resource.

The Council of Australian Governments (COAG) has agreed to commit the nation to water reform to address a range of issues associated with sustainable water resource use and allocation. The Western Australian Government, through DoW, is proposing to amend the *Rights in Water and Irrigation Act 1914* to accommodate the changes needed to conform to COAG water resource objectives.

Of relevance to these guidelines are proposals related to off-stream farm dams and on-stream dams. Although there are minimal proposed changes to the management of off-stream farm dams, the water reform process may require the formulation of local water rules to manage the configuration and operation of on-stream dams in a manner that protects other people and the environment. In areas of intensive water use, licensing of dams may be required. The outcomes of the water reform process relevant to dams will need to be incorporated into these guidelines as information becomes available.

There is currently no requirement for a development application for dam construction or dam remediation proposals in the Shire of Bridgetown-Greenbushes, except within some stream protection areas. The construction of marron dams for a commercial enterprise needs local government planning approval.

The Shire of Bridgetown-Greenbushes Natural Environment Strategy, seeks to minimise environmental damage. Concerning Water Resources, Council should:

"(i) Protect, manage, conserve and enhance: wetlands; waterways; and other water resources which sustain catchments or have identified environmental values.

(ii) Take account of the availability of water resources to ensure maintenance of water quantity and quality for existing and future environmental and human uses.

(iii) Encourage best management practices through water sensitive designs that better manage stormwater quantity and quality; that reduce the impacts of stormwater flows; and control or remove pollutants and nutrients so as to improve water quality, retain habitats, conserve water and provide for recreational

opportunities and conservation functions through multiple use drainage systems.

(iv) Ensure the provision of buffer zones around wetlands and waterways to maintain or improve the ecological and physical function of water bodies. Such buffer zones will aim to maintain the natural drainage function, protect wildlife habitats and landscape values, lessen erosion and facilitate filtration of sediment and wastes associated with surface run-off.

(v) Consider flood risk and avoid intensifying the potential for flooding as a result of inappropriately located land uses and development."

The main objective of these guidelines is to ensure that dam development is done in a sustainable manner recognising the importance of retaining and protecting the natural features associated with watercourses. On-stream gully dams are generally considered inappropriate.

Dams constructed within (on-stream), or adjacent to (off-stream) a watercourse are the most common type of dam constructions, which highlight the need for careful planning, assessment and management. Clearly there is a need to balance the benefit gained by an individual having a dam with the preservation of a natural drainage system. Issues including the intended use of the dam, justification for its location and size, and the need to communicate with the surrounding landowners require consideration. Salinity, a drying climate and competition (plantations, other dams) for a finite resource will all affect the proposed dam construction.

These guidelines address five key areas requiring consideration in the assessment of proposed dam construction being:

- dam location;
- dam size and stability;
- maintenance of natural water flow;
- the cumulative impacts associated with a series of dams along a watercourse; and
- vegetation clearing.

Each of these key areas is briefly addressed below. Table 1 provides for a simple method of assessing each proposed dam construction by summarising the dam characteristics and their potential impacts.

Each impact is weighted allowing for the summation of a score. The total score allocated against the proposed dam will assist in ascertaining the level of assessment needed.

3. KEY AREAS

3.1. Dam Location

The location of the dam is one of the most important considerations. On-stream dams can impede the natural flow of water, cause disturbance to riparian vegetation and fauna habitat and potentially deprive downstream users of water. These dams may collectively impede natural base flows and capture unseasonal rain events due to increased storage within the watercourse.

They also have a tendency to collect sediments as they effectively block the natural transportation of silt downstream. On-stream dams have a potentially high impact, given the combined effect on the environment and on downstream users, and thus are considered inappropriate.

Off-stream dams may not impede the natural water flow and are designed to take water from the watercourse during peak flows. Off-stream dams do not generally collect sediments from the watercourse or impede the transportation of silt downstream. In addition, they are unlikely to interrupt the flow of the stream during summer rain events and thus have only a slight impact on the environment and downstream users. Construction of dams within 50 metres of a watercourse may be acceptable from an environmental perspective, providing they are structurally sound and address issues such as vegetation protection, erosion controls, maintenance of local hydrology and revegetation requirements.

Catchment dams are located higher in the landscape, well outside the defined watercourse (i.e. 50 metres or greater from the watercourse), obtain water mainly from the surface catchment and are therefore unlikely to impact on local hydrology. Such dams are generally more efficient, collect less silt and may provide for gravity delivery instead of pumped delivery of water to where it is used This is the preferred location for water supply dams.

No dam should impact upon a boundary or adjoining property. There should be a minimum of 10 metres from the toe of the dam wall and a boundary. Water should not be permitted to pond across a boundary.

3.2. Dam Size and Stability

The structural safety, water holding capacity and evaporative control (shape) are real factors that need to be considered when designing dam earthworks. There is limited information regarding acceptable standards for "sizing" dams based on proposed use or land area. As a guide, DoW suggest that water requirements for a 2-4 hectare property based on riparian rights may be achieved with storage capacities in the order of 2,000-2,500 Kilolitres (KL). This assumes that the water would be used for domestic use, irrigation and stock and that the landowner has a 92,000 Litre rainwater tank. DoW considers dams up to 8,000kL are only suitable for riparian rights purposes.

The foundations for the dam must be structurally sound, built on clay rather than be situated on gravel, sand or seepage areas. Clay content, water holding capacity, wall design and spillway design (including erosion factors) are all to be considered as part of the proposed dam construction. In most cases, it is recommended that expert advice on these subjects be obtained from a structural engineer, agricultural (soil and water) engineer or a hydrogeologist.

Spillway width and freeboard (height of dam wall above the spillway floor) should reflect the size of the dam and be designed to cope with the 1 in 100 year storm event to ensure dam wall integrity. With on-stream gully dams there should be a minimum freeboard of 1.5 metres including wall settlement (DAFWA Bulletin 4576, Dam Design).

Water should be returned to the drainage line and exit the property in the same location it did prior to dam construction.

3.3. Maintenance of Natural Stream Flow

The maintenance of a natural stream flow, particularly under base flow conditions, has implications for downstream users and the environment.

An on-stream dam without dedicated provision to maintain natural water flow has the potential to adversely impact on downstream uses and the environment. For the benefit of stream ecology it is recommended that as well as an appropriate spillway, all on-stream dams have an in-wall pipe and valve so that any flows into the dam in summer can be released, even if the dam capacity is below the spillway level. This could be also achieved by a bypass channel that takes this flow around the dam. All on-stream dams must demonstrate that natural base flows are maintained within the

watercourse. In essence, during base flow conditions (i.e. non-rain periods) the amount of water flowing from each property should be equal to the flows entering the property. During rain periods when flows are greater than base flows, it is generally acceptable to harvest excess water whilst maintaining stream flows. These measures protect the rights of downstream users, protect water quality and minimise impacts on downstream ecosystems.

Water supply principles advocated by DoW include:

(i) off stream dams are preferable;
(ii) storage capacities of 2,000-2,500KL (which will require surface runoff, water from a fresh soak, or the diversion of water from a watercourse);
(iii) except under high flow conditions, landowners only be permitted to pump or divert water from a stream to dam storage for 2 hours per day;
(iv) no water to be diverted from a watercourse between the drier months of November and April; and
(v) if an on-stream dam is the only option, the maximum storage capacity is 5,000KL with a bypass channel to divert all stream flow occurring to the watercourse between November and April.

These principles advocate the construction of dams off-stream which capture inflow during runoff events following rain and do not affect natural base flows. This approach also minimises the potential for the silting up of dams, a problem common to on-stream dams.

3.4. The Cumulative Impacts of a Series of Dams

Careful consideration should be given to the cumulative impacts of dams along a watercourse. A series of dams can seriously limit the amount of water flow available for downstream users, particularly natural base flows and early winter flows. In these cases, the increased storage volumes in dams along the watercourse favour upstream users with downstream users subjected to restricted flows and possible increased sedimentation of dams due to disturbance and subsequent erosion.

The cumulative impacts of a series of dams therefore require consideration when assessing proposed dam construction. Where dams are already located downstream and upstream the need to consider the cumulative impacts may require more detail in how base flows will be maintained and erosion minimised during dam construction.

3.5. Vegetation Clearing

Riparian vegetation plays an important role in maintaining water quality and calming flood water, and special care needs to be taken to protect remnants and rehabilitate degraded riparian vegetation. The clearing of remnant trees, shrubs and sedges for dam construction should not be considered as it is likely to have high local impact on the environment and the potential for water quality problems downstream (nutrient export, siltation, increased salinity, erosion).

Vegetation retention and minimising downstream impacts on water quality are important aspects of dam construction. The Shire of Bridgetown-Greenbushes Natural Environment Strategy and Local Planning Policy - Managing the Natural Environment identifies the need for a 50 metre buffer zone of riparian vegetation, that reflects the original vegetation type of the area, to protect the functionality of the watercourse (maintain habitat and protect biodiversity and maintain water quality and quantity).

If there is no alternative but to clear this may require approvals under the Clearing of Native Vegetation Regulations 2004 from the Department of Environment and Conservation (DEC).

4. DAM ASSESSMENT

Table 1 below integrates the key areas of concern in relation to dams and provides a scoring method to assist in determining the significance of impacts associated with individual proposed dam construction. The methodology should only be used as a guide and will need to be supported with site specific information.

Table 1: Proposed Dam Construction Assessment Based on Potential Impact Significance

DAM CHARACTERISTICS	IMPACTS			
	HIGH (3 points each)	**MODERATE (2 points each)**	**LOW (1point each)**	**NEGLIGIBLE (0 points)**
Dam Location	Across a watercourse or within a public water supply catchment	Adjacent to watercourse, but outside the seasonal flow path	Greater than 50m from the watercourse	Greater than 100m from the watercourse
Dam Size	Storage capacity exceeding •5,000KL (on-stream) •2,500KL (off-stream) or •5,000KL (catchment dam)	Storage capacity no greater than • 5,000KL (on-stream) • 2,500KL (off-stream) • 5,000KL (catchment dam)	Dams with storage capacity below those previously stated	Not applicable
Maintenance of Stream Flow	On-stream dam with limited structures to maintain stream flow	On-stream dam with comprehensive measures to maintain stream flow	Off-stream dam that only receives flow during a storm event	Catchment dam which does not receive any water from watercourse
Cumulative Impact (500m upstream and downstream)	Greater than 4 dams within a 1Km stretch	2-4 dams within a 1Km stretch	1 dam within a 1Km stretch	No dams within a 1Km stretch
Vegetation Clearing	Requires extensive clearing of remnant trees, shrubs and sedges	Requires some clearing of remnant vegetation	Requires minimal vegetation clearing	Does not require any vegetation clearing

In order to incorporate the dam construction assessment methodology into decision making, a level of assessment and referral procedure has

been developed which corresponds to the potential impact significance of the proposal (see Table 2).

Table 2: Impact Significance

Assessment Score	Impact Significance	Referral for Approval
Greater than 10 points	High	Seek DoW or DAFWA advise
Between 5-10 points	Moderate	NA
Less than 5 points	Low	NA

Dam construction proposals with potentially high impact (>10 points) or within a gazetted public water supply catchment, may require referral to DoW for approval. Note: this scoring methodology only provides guidance on the potential impact of dams

Table 3: Level of Information to Consider for Proposed Dam Construction and Excavation

Impact Significance	Level of Supporting Information
High	• Comprehensive hydrogeological and or geotechnical information (including impact assessment and management provisions) • Certified engineering considerations (safe wall and spillway, adequate freeboard, evaporation control) • Revegetation/landscape considerations • Location plan • Site and or construction details (include dam cross-sections)
Moderate	• Brief hydrogeological and or geotechnical considerations • Certified engineering considerations (as above) • Combined location and site plan
Low	• Combined location and site considerations including site specific land capabilities • Engineering considerations (as above)

The level of information to consider in Table 3 is a guide and will need to be considered against the dam characteristics primarily responsible for the impact significance score. There is also a checklist provided in Appendix 1, which identifies a range of issues requiring consideration when proposing the construction of a dam.

5. CONCLUSION

These environmental guidelines have highlighted the five key areas requiring consideration and an assessment process of proposed dam construction, excavation or remediation. The use of the assessment (Table 1) in conjunction with the impact significance (Table 2) provide direction on the level of assessment needed for proposed dam construction based on their impact significance (Table 3).

The combinations of these measures aim to provide an adequate level of environmental protection with respect to proposed dam construction, excavation or remediation. It may be appropriate to develop a detailed statutory policy as further information becomes available from the water reform process being undertaken by DoW.

6. REFERENCES

Department of Agriculture and Food Western Australia (DAFWA), has a range of useful publications (including Farmnotes) that describe in detail a range of topics relating to farm dams. Many of these publications are freely available on line at www.agric.wa.gov.au.

1. Dam design for pastoral stock water supply; DAFWA Bulletin 4576 (2003).

2. Tree windbreaks in the Wheatbelt; DAFWA Bulletin 4723 (2007)

3. Potential capture of surface run-off for reliable water supplies in the 500-825mm rainfall zone of South Western Australia; DAFWA Resource Management Technical Report 314 (2007)

4. Farm Dams Planning, Construction and Maintenance; B. Lewis (2002), CSIRO Publishing.

7. APPENDIX 1

Checklist for Planning a Dam

When planning to construct a dam care should be taken to ensure that all of the following issues are assessed:

- Examine alternative methods in which water demand could be met taking into consideration:
  - reliability
  - cost
  - maintenance
- Assess the size of the dam and the demand for water
- Assess the soil types surrounding the dam site to ensure stability (engineering integrity)
- Determine the level of creek flow and assess whether your dam may alter creek flow
- What is the current water quality of the watercourse?
- Will your dam affect water quality or will your dam impact on the creek system by:
  - altering the local ecosystem
  - impacting on local vegetation
- Will your dam affect other users of the watercourse through:
  - alteration of flow
  - alteration of supply
  - possible effects due to dam burst
- What is the size of the catchment and is your dam suitable for the amount of water generated?
- Have you planned for storm events and evaporation?
- What measures do you propose to minimise sedimentation?
- What measure do you propose to control mosquitoes?
- Will your dam construction affect salinity levels?
- What are the safety issues involved in constructing and maintaining a dam?
- What are the local government requirements for building a dam in your area?
- Is it in a stream protection area?
- Is there a local catchment group in the area?
- Is there a management plan covering the watercourse or catchment in your area?