

ON-SITE STORMWATER DETENTION IN THE UPPER PARRAMATTA CATCHMENT — LESSONS FOR ALL COUNCILS

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SUMMARY

The Upper Parramatta River Catchment Trust (UPRCT) has been at the forefront of the development and implementation of on-site stormwater detention (OSD) policy in NSW. Following the lead provided by the Trust, many NSW councils have now implemented OSD policies, and a number have been modelled on those of the Trust.

The Trust has also been monitoring the effectiveness of its policies and a number of implementation problems have arisen which have raised serious concerns. Recent auditing of constructed systems and also of the Council approval process has identified potential pitfalls which all Councils that have OSD policies should be aware of.

There is a critical need for funding, resourcing and education to ensure appropriate implementation and maintenance of OSD systems for perpetuity.

Councils which already have OSD policies need to carefully review their policies and the installed systems in the light of the lessons learnt by the Trust. Suggestions for check lists, WAE plans, certification and fees are all contained in the body of the paper.

Further, where Councils do not yet have OSD and are considering it, they should tread cautiously given the potential pitfalls. A selective application of OSD is likely to be preferable to a blanket approach. However either alternative will be costly in terms of Council resources and there are no 'quick fixes'.

In conclusion, unless OSD is adequately resourced, it should not be implemented. Where it has been implemented, Councils will experience continued problems which can be mitigated through additional expenditure on inspections and on-going maintenance.

1. BACKGROUND AND HISTORY

Parramatta was settled in 1788 and periodic flooding has occurred since — the largest recorded flood being in 1889 when floodwaters reached the top of the arch of the Lennox Bridge in the Parramatta CBD. Intensive development continued in the post World War II period with little regard for the potential impact of development on flooding, and vice versa.

Extensive flooding occurred in 1986 and 1988, and the Upper Parramatta River Catchment Trust (UPRCT) was established in 1989 to co-ordinate and accelerate the provision of flood mitigation, water quality and catchment management works and measures. The Trust's catchment is the Parramatta River, upstream of its tidal limit which is just below the Parramatta CBD, and has an area of

approximately 110km². It comprises parts of its four constituent Councils, ie Blacktown, Parramatta, Baulkham Hills and Holroyd.

In addition to a range of flood mitigation works which the Trust has constructed over its ten year life, the Trust has facilitated the introduction of development controls within its constituent Councils to ensure that existing flooding problems are not made worse by future development. The Trust's principal activity in this regard has been the development and application of a catchment wide on-site stormwater detention (OSD) policy.

It is the effectiveness of this policy which was developed in 1990 and 1991 and has been the subject of on-going review since that time, which is the subject of this paper.

The Trust has been at the forefront of OSD development and research within NSW and also nationally. Given the proliferation of OSD policies throughout urban Councils within NSW, many Councils can learn valuable lessons from the Trust and its experiences.

2. THE EXISTING UPRCT SYSTEM — ITS STRENGTHS

Bewsher (1995) reports that OSD has been regarded within NSW as a panacea for many of our stormwater ills. This has arisen for two main reasons – funding and legal liability. Most councils have insufficient funds to upgrade existing stormwater infrastructure and OSD is seen as a means of allowing development to proceed in areas where stormwater infrastructure is sub-standard, without increasing a council's legal liability from downstream property owners.

There are also other benefits from OSD including its ability to be implemented concurrently with the development, associated water quality improvements and its low cost (when compared with infrastructure upgrade costs).

In regard to the specific OSD system implemented by the UPRCT, there are three key strengths, as outlined below.

2.1 Catchment-Wide Application

The benefits of integrated catchment management are promulgated by many, but there are few working examples within NSW. Usually the difficulties of co-ordinating activities across local government areas (LGA's) and the "turf" of government departments and authorities, makes practical implementation difficult and rare. Burton (1995) claims the adoption of the Trust's OSD policy was a 'first' for NSW in respect to catchment-wide development control policies spanning multiple LGA's.

It is commendable that the UPRCT has achieved a uniform policy across its four councils, despite some of these Councils having different OSD policies outside the Trust's area.

Further the OSD policy is applied uniformly to all properties in the catchment, where major development or redevelopment is proposed. There are some exceptions, most notably where hydrologic studies show that OSD may have little benefit or possibly some disbenefit (eg. In the lower part of the catchment). In these situations, the policy is flexible enough to allow the OSD provisions to be waived. Further in such cases, the Trust is moving to a system to require these latter developers to be required to install water quality improvement measures of a similar cost, in an attempt to preserve 'equity' between upstream and downstream properties. This latter initiative, whilst relatively new demonstrates the Trust's willingness to amend its policy where necessary, to provide a system which is hydrologically sound whilst being seen as equitable by the community.

2.2 Provision of OSD Parameters

Since its establishment, the Trust's staff have been progressively engaged on the development of hydrologic and hydraulic computer models of its catchment. These models have allowed extensive catchment-wide studies to be undertaken including those used to derive the principal OSD system design

parameters for application to all sites within the catchment, ie:
< a permissible site discharge (PSD) of 80l/s/ha; and
< a site storage requirement (SSR) of 470m³/ha.

With these parameters, the modelling indicates that for all storms up to the 100 year average recurrence interval, and for all durations, existing flood problems will not be worsened by development or redevelopment. Whilst this will not reduce the present level of flood damages in the catchment, it will prevent them from getting worse. (Existing flooding problems are addressed separately by the Trust on a priority basis).

The provision of the parameters by the Trust simplifies the sizing of the OSD system by developers and their consultants, many of whom have insufficient expertise to perform the necessary hydrologic calculations. This ensures consistency and is quicker than other procedures which require the designers to make their own calculations of the PSD and SSR.

One criticism of the Trust's approach is that it is overly conservative for some properties, or that it may not recognise the unique characteristics of a site and its proposed development. In such cases the Trust has modified its original policy and will now allow the developer to submit their own hydrologic calculations (provided these are rigorous) and to use these in preference to the Trust's standard PSD and SSR parameters. However it is understood this has only occurred on a handful of occasions.

2.3 Technical Guidance

Whilst OSD may seem to be a simple concept, its practical implementation is far from simple. As discussed later in the paper, the difficulties for Council officers, designers, builders and owners, in implementing and maintaining workable OSD systems is a major issue which in the main, Councils across NSW have not yet come to terms with.

Given these concerns, the Trust has carried out research and initiated numerous investigations into the practicalities of constructing OSD systems. In the absence of published material on this subject, the Trust has produced an OSD handbook (UPRCT, 1994) which has had two editions, with a third due mid year. The handbook comprises over 100 pages of technical information for designers and includes standard construction details and worked examples.

The document is widely regarded as the best available in the industry and has been adopted in entirety or in part, by many other councils.

3. THE EXISTING UPRCT SYSTEM — ITS WEAKNESSES

As part of the authors' review of the performance of existing OSD systems, a number of weaknesses have emerged. These weaknesses relate to deficiencies in policy, design, construction, and/or maintenance.

3.1 Policy Implementation Deficiencies

The Trust made a number of improvements to its policy when preparing the second edition of its handbook in 1994. For example the second edition clarified that OSD was only required for the portion of large properties that directly related to the Development or Building Application. It also allowed areas not affected by the site development (eg areas that remained as pervious areas) to be excluded from the area to be controlled by the OSD facilities (provided that their runoff could be diverted around the OSD system).

In addition, in the light of on-going problems with small site OSD systems the Trust has been reviewing its 'lower limit' for sites required to provide OSD and also the current flexibility that allows new subdivisions to apportion their OSD requirement to the individual allotments. With regard to the latter item, the upcoming third edition of the Trust's handbook will stipulate that OSD is to be constructed at subdivision stage and this may encourage community basins rather than individual basins.

3.2 Design Deficiencies

Design deficiencies can arise through either of two circumstances:

- < deficiencies in the code. If the code does not spell out the importance of key aspects of the design there are likely to be gaps in the submissions. It therefore follows that Council's reviewing officers will not notice the problems since the designer may well have submitted a design which is in accordance with the code,
- < deficiencies in the submission. In these cases the code is specific in its requirements but the submitted design does not conform to the code. In such cases unless both the designer and the Council reviewing officer have in-depth knowledge of Council's code there is always the possibility that a deficient design will be approved.

This latter circumstance has historically been an issue in the Trust's area.

Either of the above situations are obviously unsatisfactory since once the design has been approved the potential for successfully negotiating the undertaking of works or measures to correct the deficiencies is very difficult for any Council officer. And even if the Council officer is particularly skilful in persuading the developer to undertake corrective works, his or her success rate is usually inversely proportional to the additional costs involved. To address these concerns, the third edition of the Trust's handbook will incorporate detailed check lists similar to those discussed in Section 4.2.2 of the paper.

Councils therefore need to have confidence that both their code is sufficient in its level of detail and that designers and Council staff fully understand the code. But how many Councils have considered these issues (especially the latter)? How adequate is the training of Council staff? In a move to address this issue, the Trust will be running OSD seminars at each of its four Councils for all staff associated with development approval.

3.3 Construction Deficiencies

The early emergence of problems due to unsatisfactory construction of OSD systems quickly led to the introduction of certification requirements. The Trust placed the onus on a suitably skilled professional person to certify that the works had been completed in accordance with the design drawings.

However the certification process is not working well and is therefore not solving the problem of poor or unsatisfactory construction. Based on the authors' experience in undertaking audits of OSD systems it is obvious that at least some OSD designers do not take the certification process seriously because the evidence, which is often very stark, is that many certified works are deficient.

Also in speaking to staff of various Councils the comment frequently expressed is that the signed certification forms often do not mean much. They frequently find that when a final Council inspection is made — after receipt of work-as-executed (WAE) plans and a completed certification form — there are deficiencies with the works. Not only are there Council-identified deficiencies that need rectification before the officer will sign off on the project but given the dubious worth of the initial certification the Council officers see no point in asking for re-certification.

A major problem also exists with the quality (or lack of it) of the WAE survey. All too often the WAE survey consists of checking the invert levels of stormwater pits, confirming pipe diameters and simply quoting the achieved storage volume with little or no information about potentially critical overall drainage patterns or precise details about the storage itself, etc.

Also, difficulties will arise if the Council officer charged with signing-off on the project does not have sufficient skill to identify all the problems with the completed works.

The third edition of the Trust's handbook will be tackling these issues by requiring the completion of a detailed WAE checklist of the type advocated in Section 4.3.2 of the paper.

3.4 Maintenance Deficiencies

Just like any other engineered structure, an OSD system requires maintenance. But the reality is that seemingly very few systems receive any maintenance.

Of course it has become relatively common place for the onus to be placed on the owner to maintain the system — usually by way of a positive covenant. But how many owners or new property purchasers understand what the covenant means? Or even if the legal ramifications are known or explained to them, how many can read the engineering plans — or even understand that often their whole property is integral to the OSD system rather than it just involving say a couple of stormwater pits and pipes and an underground tank?

How many Councils have realised there are problems with some (or many?) of the OSD systems in operation in their LGAs? Are the problems only realised by accident, for example by way of property owners complaining?

A number of Councils have begun inspections of completed systems to try and identify maintenance or other problems. Some of those Councils, having undertaken inspections and identified problems, have written to owners asking them to rectify deficiencies, which exist due to inadequacies in the completed works (or directing them in cases where owners have made illegal modifications). We are not aware of any such Councils having anything but limited success with their requests.

4. MAKING THE OSD SYSTEM BETTER FOR ALL

4.1 OSD Policies

4.1.1 Is OSD Needed?

Almost all Councils have adopted across-the-board OSD policies. While almost all codes exclude requirements for lower limits of development — such as small building extensions — very few have considered whether OSD is appropriate or necessary for all other sites in the LGA. For example, is OSD required for sites which do not drain to Council's overloaded stormwater system and therefore are not contributing to creating a bigger problem for others? Or similarly is it appropriate for runoff from downstream sites to be retarded, wouldn't it be better to allow that site's peak runoff to be discharged before the overall catchment flood peak arrives?

Is there actually a problem existing throughout the LGA? Is it possible through a combination of review of historical data and research to determine if OSD requirements can be waived for some or parts of some catchments. Gosford City Council (Tysoe et al, 1997) has undertaken such a review, and Hornsby Shire Council is known to be currently making such an assessment.

For the Trust, most of the worst flooding occurs at the bottom of the catchment and therefore it has been determined that OSD is needed virtually universally across the whole catchment.

4.1.2 Does the OSD Policy Have a Whole Site Requirement?

Does the policy insist or imply that the whole of the property is expected to be commanded by the OSD design? Is this necessary or appropriate? In the authors' experience, one of the most problematic areas in OSD design relates to inadequate design or complete oversight of drainage systems that are required to divert external catchment runoff around the OSD-commanded catchment. Even if the collection and conveyance system is appropriate, problems can still arise at the downstream boundary due to the concentration of the former sheet flow regime.

Such problems would be minimised if the policy limited the area to be commanded to a fixed percentage of the property (which would typically be related to the maximum development footprint) such that there is more opportunity for the external flows to be easily passed through the property. Nonetheless even minor landscaping works undertaken by an unsuspecting owner can inadvertently upset the provisions for site drainage.

4.1.3 Treatment of Subdivisions

Does the policy permit subdivided lots to have individual OSD systems rather than a single basin servicing the whole subdivision? The latter arrangement should be adhered to since the overwhelming experience has been that a proliferation of small scale OSD systems is undesirable.

4.1.4 Does the Policy Spell out the Technical Details?

This question is not intended to encourage Councils to be so prescriptive in their approach to OSD that there is no flexibility for an innovative designer. Rather it is trying to highlight the importance of good design features - features which should be spelt out in the policy. For example, the provision of overland flowpaths to both service the OSD system and to account for external runoff, details of discharge control pits and return valve installations, use of grates rather than solid lids, minimum acceptable dimensions for access, freeboard to habitable and non-habitable floor levels, etc.

While there has been a significant amount of practical OSD-related research undertaken, some Councils have failed to update their codes to reflect that research. For example, the Trust has commissioned studies related to details such as orifice plates and outlet protecting screens and makes this research freely available to other authorities.

It would seem to make sense for there to be a common local government specification/standard for the technical aspects of OSD. In the interim, it is suggested that the Trust's handbook details could be adopted as the standard.

4.2 Design Submissions

4.2.1 Certification of Designers

Some would argue that one way of improving the quality of the design submissions would be to improve the quality of the designers. The Trust has generated a fair bit of debate over the past six months or so by proposing that designers operating in the Trust's area should have both Institution of Engineers NPER Civil registration (or its equivalent for non-engineering bodies) and ISO 9000 quality assurance accreditation. In response to criticisms, especially regarding the latter, it is understood that the Trust is proceeding with implementation of the first requirement while treading more cautiously with the latter item.

But does the fact that a civil engineer has NPER (Civil) registration mean that the standard will improve? It is the authors' belief that it will not because NPER (Civil) is a general civil engineering classification and therefore does not guarantee design competence in the field of urban stormwater systems. Rather if this approach is to have significant benefits, bodies such as the Institution should be strongly lobbied by representative Council bodies, etc. to consider introducing a specialty registration area which would include OSD. (Enquiries made with the Institution have confirmed that this is an option since they have recognised the need for such specialties and are developing a specialty registration for fire safety engineering.)

But even with such a specialist pre-qualification can a Council be guaranteed that every submitted design will be satisfactory?

Another option that has periodically been floated is for Councils to have their own list of approved designers. However a major drawback of such a system would be the amount of effort that is involved in producing the initial list and periodically updating it along with other likely legal and political difficulties (eg. conflict Trade Practices Act).

4.2.2 Use of a Detailed Check List

Some Councils have a tick-a-box style check list system whereby the designer needs to confirm that the submission is in accordance with the Council code. Typically the system involves say five or six general questions.

Such lists are in principle a good idea but should be taken a step further, in particular:

- < the check list should be very comprehensive (to reflect all the areas of the code);
- < it should include two boxes, one for the designer and one for the Council reviewing officer to acknowledge; and
- < be separated into concept design, detailed design and WAE/Certification lists.

While such lists might seem like an overkill or just another piece of paper warfare, it is the authors' experience with OSD audits that there are common faults in both the submissions and in the Council checking. Not only would the check lists minimise the potential to accept a deficient design but also both designers and Council staff would rapidly become better acquainted with the policy and also retain their knowledge about the policy.

However, it is important that such checklists should not be used as a means for resource-strapped Councils to allow unskilled junior staff to carry out OSD checking.

4.2.3 Charges for Submissions and/or Re-Submissions

Some Councils charge for checking of OSD submissions while others also charge for checking of re-submitted designs. In contrast other Councils seem reluctant to impose similar charges. Given the critical nature of the works and the substantial effort that is required to adequately complete the various reviews, Councils should adopt a cost recovery system when it comes to processing OSD submissions.

Charges applied to re-submissions would also hopefully serve the additional function of gradually filtering out the poor designers.

4.3 The Finished Works

4.3.1 Bonds

A number of Councils have a specific bond to cover the OSD system and often the size of the bond varies with the nature and size of the development. Such an approach is the most effective way of ensuring that the OSD system has been satisfactorily completed. However of course such an arrangement relies on the competency of the Council officer who is signing off on the OSD system and recommending that the bond should be released.

4.3.2 Use of a Check List

Once again the use of a thorough checklist would not only improve the submission of WAE details and certification by the designer but also be a valuable aid to the Council officer whose responsibility it is to review the completed works.

4.4 On-Going Performance

Regular inspections are essential. In this regard it is acknowledged that the typical positive covenant does give Councils powers to inspect, direct that works be undertaken or failing that to enter a property to undertake any repair or maintenance works and subsequently recover the costs associated with the works. The practical application of such powers is another matter however.

Hopefully Councils will not become bogged down in taking legal action against a potentially large number of ratepayers at some considerable (or even unacceptable) political cost.

An option could be that maintenance is carried out by certified contractors and that an on-going maintenance contract, to give effect to this, was a condition of consent..

4.5 Education about OSD

There is a critical need for improved education of all persons involved in OSD systems.

4.5.1 Council Staff

Councils usually rely on the skill and experience of only a very small number of staff to look after OSD-related matters. It is important that those staff have the necessary skills and therefore there should be regular training sessions. Given the costs in setting up such training it would be desirable for external courses to be available to cover both initial training and refresher courses with in-house supplementary training to cover the particular features and requirements of a Council's code.

4.5.2 Designers

There would seem to be substantial benefits in compiling a report (complete with diagrams, colour photographs, etc) that documents different types of OSD installations. The style and layout could be similar to DLWC (1995) and would be most appropriate as an education tool. In particular it would be a very useful tool for selling the many advantages of above ground systems to developers and their architects.

Together with feedback about deficiencies in a submitted drainage concept plan, improved education would assist to reduce the number of difficult OSD sites.

4.5.3 The Property Owners

As mentioned earlier it is likely that very few members of the public have any real understanding of the nature of the OSD works within their property.

Perhaps a well made video (complete with graphics showing what happens as a storm passes over the property) would be the most appropriate education tool combined with (or followed by) a personal visit to explain the unique features of the property's OSD system. Desirably such a visit should take place on a regular basis.

Obviously it would make sense for the video to be produced for all Councils to use.

Simple handouts (also with good graphics) would also be appropriate for general education and for initially advising new owners of their responsibilities.

For a number of Councils there is the added complication of potentially numerous owners having non-English speaking backgrounds and therefore determining the most appropriate way to communicate with those owners. Producing the video in a number of languages would help address this issue without significantly adding to the overall production cost.

5. LESSONS FOR ALL COUNCILS

5.1 What is OSD's Future?

OSD is the option of last resort but there are many situations where it is the only option. Unfortunately many existing OSD systems are not functioning properly, particularly in major storms, and if insufficient resources continue to be allocated towards OSD, OSD is likely to become further discredited.

Accordingly, OSD has an uncertain future. Its future is at risk from attacks on three fronts:

- (a) A legal challenge — a court which is made aware of the poor performance of OSD systems to date, may well consider that OSD will not guarantee adequate protection to the downstream environment.
- (b) A large flood — how quickly public opinion changes with a flood. What if the Wollongong flood

of August 1998 had happened in Parramatta? In the furore following such an event, the media (and the government) may look for a scapegoat. Will the public realise that OSD was never intended to solve their existing flood problems? Will the adoption of OSD be considered as good practice when most systems are not functioning as designed? Will councils who used OSD to divert attention away from rectifying their stormwater infrastructure problems, be exempt from the public spot light? Let us all beware.

- (c) Community backlash — will the development community continue to accept the imposition of OSD? Will existing residential communities that are actively opposing new development in their catchments, latch onto the pitfalls of OSD and publicise these in an attempt to have development stopped?

5.2 Advice For Those Councils Without OSD

- (a) Become aware of OSD's deficiencies as well as its benefits. Don't embrace OSD until you have thoroughly investigated all options in a catchment and are convinced that it's in the long term interests of the community. In some situations OSD may be the only option left, but you should treat it that way, ie. as the last resort. Avoid 'blanket' OSD policies.
- (b) If OSD is adopted in a catchment, then adequate funds for monitoring, maintenance and education must be provided. If your Council is unwilling to commit these funds then don't proceed down the OSD path. Those who have overseen the introduction of OSD policies attest to the fact that:
"No OSD is better than ineffectual OSD"
- (c) Consider the partial use of OSD as proposed by Tysoe et al (1997) for Gosford City Council. Promote larger community basins, infiltration, or developer-financed enlargements to Council drainage systems, as alternatives to OSD. Then only use OSD selectively, where there are demonstrated flood risks downstream, or where there are valuable creek habitats that need to be protected from peak discharges.

5.3 Advice For Those Councils With OSD

- (a) Establish a data base of all installed systems OSD systems.
- (b) Inspect your OSD systems annually and follow-up to ensure deficiencies are rectified promptly. Record these activities in the data base.
- (c) Use check lists and bonds, and charge for assessment and re-assessment of OSD submissions. Insist on detailed WAE plans and ensure that these plans and the original design plans are accessible via the data base.
- (d) Educate your staff and your Councillors about the function of OSD and its potential pitfalls if systems are not designed and maintained properly. Emphasise the need for on-going funding to ensure that your OSD systems continue to operate effectively for perpetuity.
- (e) Educate your OSD property owners. This needs to be on-going and address new owners when properties are sold.
- (f) Consider a time-frame for partial removal of on-going requirements for OSD in some catchments if funds for upgrading of stormwater infrastructure becomes available, eg. construction of community basins.

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