WSA Reports Comments and Highlights:

WSA has released a few of the reports they commissioned in 2022 (https://www.wsask.ca/partners-agricultural-water-management-research-demonstration-projects/).

They include:

1. WSA responses to questions from the last engagement meeting

2. Economic Threshold Analysis from SRC

3. Drainage Policy Outcomes from the SCDA (this include separate reports: Hydrology Report from Associated Engineering, Habitat Report from Bob Clark, Ground Water Report by Garth van der Kamp, and Reviewer Comments)

4. Refining Economic Costs from PAMI

The other reports WSA commissioned have not been released.(ex: SWF report). (https://www.wsask.ca/partners-agricultural-water-management-research-demonstration-projects/).

In going through these reports here are some thoughts:

a. There is no discussion or estimate of the benefits or costs associated with wetland retention and restoration.

b. There is no indication or discussion as to who will compensate / pay society or those affected / impacted for the negative impacts and costs identified in these reports (for example who will pay for anticipated damage to infrastructure, declines in water quality, loss of recreational opportunity, etc.).

c. The economic analysis does not include all the potential costs and is mostly focused on the economic gains to the farmers.

d. While promoted as a Mitigation Policy there is no mitigation proposed. Placing limits on wetland loss is not mitigation. Mitigation involves compensating for the damages done when development occurs.

The following points are taken word for word from these reports:

1. The results presented in this report also do not include the potential impacts of future climate change. This is an important limitation of this work and a topic that should be considered as part of Saskatchewan's wetland mitigation policy development.

2. Eutrophication caused by the enrichment of surface waters by phosphorus and nitrogen is a significant issue in Saskatchewan, as it is elsewhere in the prairie region, throughout Canada and indeed, throughout the world. It has been identified as well, as a significant issue in most Saskatchewan Watershed Plans, prepared by local watershed advisory and technical committees.

3. It appears that the objectives set by the Prairie Provinces Water Board for sediment in the Assiniboine River at Kamsack would begin to be exceeded regularly at a wetland drainage level of 10 to 20 %, Total Phosphorus at a drainage level of 30 to 40 %, and Total Nitrogen at a drainage level around 10 %. It can reasonably be argued that the threshold for water quality impairment arising from wetland drainage has already been reached or exceeded.

4. From the Habitat Report: A review of the relationships between wetland retention scenarios and major environmental policies and agreements indicated that removing wetlands to expand area of agricultural crop production is directly contra to a number of general and specific goals stated in:

- Saskatchewan's Growth Plan, as well as Saskatchewan's Game Management, Climate Change, and Protected Areas Plans;
- North American Waterfowl Management Plan and North American Bird Conservation Initiative;
- Canada's Species at Risk Act; and the
- International Convention on Biological Diversity.

5. Losses of wetlands and other natural habitats to expand agricultural crop production represent some of the greatest environmental threats to biological diversity – for game and nongame species alike - in Saskatchewan and world-wide. Wetlands cannot be replaced by upland habitat due to the distinct functions of aquatic systems; whether wetland drainage impacts could possibly be partly mitigated by restoration of upland habitat is largely unknown. Extensive losses of smaller wetlands such as seasonally-flooded Class III wetlands would be nearly catastrophic for Saskatchewan's wildlife; these Class III wetlands – as well as complexes of wetlands composed of varying size and permanence classes - must be conserved to safe-guard the large number of species that rely on these highly productive, unique systems.

6. Schedule E of the MAA is a transboundary water quality agreement that was most recently updated with Attachment "A" in 2021. This agreement sets site-specific objectives for water quality in transboundary rivers, which may also be impacted by artificial drainage projects in Saskatchewan.

7. 50% wetland area retention in the Assiniboine, Qu'Appelle, and Souris river basins was predicted to increase runoff volumes by about 100% to 110% for events with 1:2 year return periods, about 35% to 40% for events with 1:10 year return periods, and about 10% or 11% for events with 1:100 year return

periods. Instantaneous peak flows were predicted to increase by about 65% to 75%, with slightly lower increases as flood volume increases. These increases in runoff volume and peak flow were considered to present erosion and flood risks and potentially damage existing infrastructure. A wetland mitigation policy target of 50% retention of historical wetland area could present serious challenges for the province without additional requirements to reduce runoff volumes and peak flows.

8. The overestimation of “current” wetland area retention in this study compared to others is likely due to an assumption that “farmed” wetlands and 50% of the area of “partially-drained” wetlands were included in the calculation of “current” wetland area. Study Team’s estimate of the current area of wetlands and which was used in this report, may have been overestimated.

9. The Province of Saskatchewan has established water quality objectives for its surface waters (Surface Water | Water Security Agency (wsask.ca)) (Saskatchewan Water Security Agency 2015).Saskatchewan’s water quality objectives consist of guidance and interpretive statements, narrative guidance for many applications including controlling effluents (for example, effluents must be “free from nutrients in concentrations that create nuisance growths of aquatic weeds or algae or that results in an unacceptable degree of eutrophication of the receiving water”) plus specific numeric objectives derived or adopted directly from the Canadian Council of Ministers of the Environment Guidelines (e.g., Canadian Council of Ministers of the Environment | Le Conseil canadien des ministres de l'environnement (ccme.ca). Objectives are set for the protection of agricultural uses (irrigation, livestock watering), aquatic life, water-based recreation and aesthetics, and protection of potable water supplies. As outlined in later sections of this report, the water quality variables most likely to be affected by wetland drainage or restoration are phosphorus, nitrogen, various salts such as chloride, sodium, potassium, sulphate, magnesium, and others, as well as sediments. While specific objectives are not provided in Saskatchewan’s water quality objectives for the nutrients phosphorus and nitrogen, guidance is provided for the prevention of nuisance algae including blue-green algae, with additional guidance provided in a separate document (SaskatchewanWater Security Agency 2016). Appendix Pg 6

10. As outlined in later sections of this report, the water quality variables most likely to be affected by wetland drainage or restoration are phosphorus, nitrogen, various salts such as chloride, sodium, potassium, sulphate, magnesium, and others, as well as sediments. While specific objectives are not provided in Saskatchewan’s water quality objectives for the nutrients phosphorus and nitrogen, guidance is provided for the prevention of nuisance algae including blue-green algae, with additional guidance provided in a separate document (Saskatchewan Water Security Agency 2016).

11. A key challenge identified in Saskatchewan’s fishery management plan is to incorporate fisheries management planning and habitat considerations into land-use decisions including drainage. It is also noted throughout that balancing the need to maintain and protect fisheries habitat with the need for economic development and growth presents another significant challenge.

12. Legally-binding water quality standards have been established by North Dakota and Montana. Manitoba has proposed phosphorus and nitrogen concentration targets for Lake Winnipeg and has proposed that its approach be enshrined in a regulation under its Water Protection Act (Manitoba 2020a, Burton and Armstrong 2020) with the draft regulation located at Manitoba Regulatory Consultation Portal (gov.mb.ca).

13. Site-specific water quality objectives for a number of materials including TN, Total Dissolved P, and TP have been developed by the PPWB using a background approach whereby the water quality objective is set at the 90th percentile of historic data, resulting in an expected normal excursion frequency of 10 %. Dr. John-Mark Davies, Saskatchewan's representative on the PPWB's Committee on Water Quality, advised that while all members have an interest in the issue of wetland drainage and water quality, the Committee does not have specific initiatives underway at the present time to examine further the many questions surrounding the issue (pers. comm.). However, Dr. Davies did advise that a joint PPWB Committee on Hydrology / Committee on Water Quality is investigating changes that have been occurring in the Carrot River beginning about 2005. As an example, excursions of the PPWB's water quality objective for phosphorus is now occurring at a frequency greater than 10 %.

14. Of importance to efforts to reduce the movement of phosphorus and nitrogen to Lake Winnipeg, through a rigorous 9-year process, the International Joint Commission recommended to governments the adoption of objectives at the international border between Minnesota / North Dakota and Manitoba for phosphorus and nitrogen for both concentration and loading (International Joint Commission 2020 and located at IJCIRRB_Report_on_Nutrient_Management_Strategy_Red_River_Watershed_May_2020.pdf). (P 0.15 mg/L and N 1.15 mg/L)

15. While water is the solvent moving materials off the landscape, much less water moves off the land during a dry weather cycle, but following wetland drainage, even though the volume of water moving off the landscape may be less, it will be draining cropland which will lose nutrients and sediment at a greater rate relative to the original wetlands (Badiou et al. 2018a).

16. As mentioned earlier in this report, an exercise of this nature would ideally involve the development of a calibrated and validated model for each watershed in the agricultural region of Saskatchewan. Modelling would then provide more specific information on the impacts to water quality that additional drainage or restoration may have on ambient water quality. However, this was not possible for this wetland drainage and retention scenario project given its short timeline.

17. Overall and although relatively small compared to total nutrient loading from all sources to Lake Winnipeg, additional contributions from upstream wetland drainage along with increases in water yield,

would make it more difficult to meet the targets and would require additional reductions from other watershed sources. Pg 118

18. Saskatchewan, similar to many jurisdictions including those within the Canadian prairie region, has put in place costly measures to reduce the contribution especially of nitrogen and phosphorus to aquatic systems and to place strict control measures on new sources. Nutrient contributions from additional wetland drainage without offsetting mitigation may threaten the success of these existing expenditures and initiatives.

19. In terms of how the wetland drainage and retention scenarios would affect the degree to which water quality objectives would be exceeded, it appears that the objectives set by the Prairie Provinces Water Board for sediment in the Assiniboine River at Kamsack would begin to be exceeded regularly at a wetland drainage level of 10 to 20 %, TP at a drainage level of 30 to 40 %, and TN, at a drainage level around 10 % or near the current level of drainage.

20. While modelling was not done in this exercise to convert annual loads to in-lake concentrations, the additional nutrient loads potentially arising from further wetland drainage are significant and would likely be expressed in greater algal blooms in Buffalo Pound Lake including more harmful blooms of cyanophytes or blue-greens.

21. Pasqua, Echo, Mission, and Katepwa Lakes are located on the Qu'Appelle River system and generally are classified as hyper-eutrophic. In addition to receiving materials from the upstream basin, they also receive nutrients from the City of Regina. The City of Regina has implemented costly but effective Biological Nutrient Removal technologies to reduce both P and N from its wastewater. Each 10 % decrement of wetland drainage is predicted to add 5.7 %, 6.7 %, and 4.3 %, respectively, to the annual sediment, TP, and TN loading currently received by this chain of lakes. This would be counter to the remedial measures already put in place to reduce nutrient loads to Pasqua, Echo, Mission, and Katepwa lakes.

22. Consequently, from a science-based water quality perspective, it is difficult to identify any threshold whereby the contribution of additional sediment, phosphorus, and nitrogen to downstream water systems would be acceptable without equivalent offsets from Beneficial Management Practices. The most effective or efficient Beneficial Management Practice has been identified as wetland restoration. Pg 137

23. Reviewer Comment: An apparent underestimation of historic drainage – at least to this reviewer, but was also highlighted in the hydrology study – is perhaps the most significant shortfall in the entire set of analyses. If the WLI significantly underestimates historic drainage, it affects this entire exercise.

24. Reviewer Comment: Conclusion seems to be contradicted by the work of Pomeroy's group on Smith Creek, where they have concluded that the combination climate change and wetland drainage has created hydrological regime change in Smith Creek with a dramatic increase in streamflow volume and runoff generation efficiency and the development of unprecedented rainfall induced and summer flooding in the last 20 years.

25. Reviewer Comment: Additionally, it is worth noting that thresholds for wetland drainage was an underlying theme in the various sections, but it remains difficult, if not impossible to identify these thresholds in the absence of a defined target (see more detailed comments on water quality section). In this context it is unclear how thresholds beyond which drainage should not occur can be identified without first knowing what targets for (change to) wildlife, water export and flooding, groundwater recharge, or elemental and sediment transport are.

26. Reviewer Comment: Completing focused marginal analysis, even as a preliminary case study, would be quite informative to management decisions and policy development. This analysis would better inform cost-effective policy approaches that provide levels of environmental quality…. (and) Developing tradeoff curves representing levels of ecosystem functions, ecosystem services, and potentially economic costs, would enable a more informed application of the research results.

Response: In my opinion, these are excellent suggestions (another reviewer also raises this point); marginal/trade-off analyses would be very useful. While such analyses are beyond the scope of the current work, this suggestion could be addressed by WSA when the economic analysis has been completed.

27. Reviewer Comment: An apparent underestimation of historic drainage – at least to this reviewer, but was also highlighted in the hydrology study – is perhaps the most significant shortfall in the entire set of analyses. If the WLI significantly underestimates historic drainage, it affects this entire exercise.

28. Highlights of the aggregate impact of wetland drainage in the southern Agricultural Zone (combined black and brown soil types), based upon 37.4 million acres of cropland with an average of 10% wetland coverage, include: 520,000 acres drained under current conditions, increasing to 3.24 million acres of wetland drained under floor conditions. Under average conditions there is a possible increase of annual farm receipts (PV) of $955.4 million per year (scenario of 50% wetlands retained). Under HHH conditions, total benefit increases to $1.4 billion per year. The increased farm receipt income from wetland drainage ranges from 2 – 8 % of Saskatchewan's annual agriculture crop receipts of $13.4 billion.

29. Under the current conditions society loses approximately $133 million in wetland ES benefits annually, and when discounted by 3% over 30 years, this increases to $2.6 billion. Should drainage

increase to the floor scenario, annual social loss will increase to $832.5 million in one year and up $16.3 billion over 30 years.

30. A general conclusion is that permitting moderate levels of wetland drainage will benefit agricultural producers across the province. However, the private benefits of drainage diminish at higher levels and come with significant loss of ES values, which are important to the broader Saskatchewan society.

31. Models where input costs are high, and profits and yields are low result in low profitability and even financial loss in higher-level scenarios of drainage.

32. There are limitations to this economic study that limit the precision of the results. First, a formal farm simulation and risk model was not created due to time constraints. Second, a broad array of BMPs were not analyzed due to data limitations. Third, not all the public benefits information was based on representative Saskatchewan case studies. Benefit transfer and other accepted forms of comparison were included where necessary.

33. A limitation is that this is an observational study rather than one involving experimental manipulation and means the results should be validated with further experiments.

34. The main message from this study is that drainage response can be highly variable: in some instances, there were significant responses by drainage but in others, there were not huge responses. Understanding the significant variables for specific datasets will more greatly aid in determining whether agricultural drainage is both economically and agronomically practical in specific situations.

35. Secondary data suggest that the easiest (cheapest) to drain wetlands have already been drained (current drainage levels from WSA indicate 87% remaining/13% drained). And that higher levels of drainage become increasingly more expensive; the range in this analysis is from $500 to $5,000 per wetland acre.

36. Wetland conservation is an issue that can position different sectors of society against each other: agricultural producers can receive economic benefit from wetland drainage (highly dependent upon different variables), yet such drainage comes at a high financial cost to society in terms of lost ES benefits.

37. All of the reports highlighted significant levels of uncertainty with respect to the results. This makes the interpretation and the application of the results difficult. This is clearly not unexpected in any analysis addressing more complex environmental issues. The Intergovernmental Panel on Climate Change (IPCC) has developed a terminology framework to address confidence and certainty with respect to climate science. I would suggest a similar approach applied to the findings of these reports could make the results more accessible and useable by relevant stakeholders. I have attached a basic summary of the terminology used by the IPCC to represent levels of confidence and likelihood of an outcome to illustrate this point: Author Comment: This suggestion is appreciated. However, consistency across reports cannot be guaranteed at this stage of editing. If the reports are consolidated and edited as one unit, it may be possible to edit for consistency later.

Confidence Terminology	Degree of confidence in being correct
Very high confidence	At least 9 out of 10 chance
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance

Likelihood Terminology	Likelihood of the occurrence/ outcome
Virtually certain	> 99% probability
Extremely likely	> 95% probability
Very likely	> 90% probability
Likely	> 66% probability
More likely than not	> 50% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Extremely unlikely	< 5% probability
Exceptionally unlikely	< 1% probability